PERIYAR UNIVERSITY

PERIYAR PALKALAI NAGAR

SALEM – 636011

DEGREE OF MASTER OF SCIENCE

CHOICE BASED CREDIT SYSTEM

SYLLABUS FOR

M.SC. PHYSICS

(SEMESTER PATTERN)

(For Candidates admitted in the Colleges affiliated to Periyar University from 2021-2022 onwards)

M.Sc PHYSICS REGULATIONS

1. OBJECTIVES OF THE COURSE

The recent developments in Physical Sciences have been included in the enriched M.Sc., (Physics) Syllabus to meet out the present day needs of Academic and Research Institutions and Industries.

2. DURATION OF THE PROGRAMME

The course of study shall be on Semester System. The two year post graduate programme in M.Sc., Physics consists of four semesters.

3. ELIGIBILITY

A candidate who has passed the B.Sc., Degree Examination with Physics as the main subject or B.Sc., Applied Physics or B.Sc., Physics (Vocational) of this University or an examination of some other universities accepted by the Syndicate as equivalent there to is eligible for admission to the Programme.

4. COURSE OF STUDY

The course of study for the Degree of Master of Science in Physics shall be under (CBCS-Choice Based Credit System) semester system with internal assessment according to the syllabus prescribed from time to time. This Course consists of Core Subjects and Elective Subjects.

5. DISTRIBUTION OF CREDIT POINTS

The minimum credit requirement for a two-year Master's Programme shall be 90 Credits. The break-up of credits for the Programme is as follows:

Core Courses	:	68 credits
Elective Courses	:	16 credits
Extra Disciplinary Course	:	06 credits

COURSE OF STUDY AND SCHEME OF EXAMINATION

S.No.	Course	Paper Code	Subject Title	Hours/Week	Credits	Exam Hours	University Examination		
							Internal (25%)	External (75%)	Total
SEMESTER I									
1	Core-I	21PPH01	Classical Mechanics, Thermodynamics and Statistical Mechanics	5	4	3	25	75	100
2	Core-II	21PPH02	Mathematical Physics	5	4	3	25	75	100
3	Core-III	21PPH03	Electronics	5	4	3	25	75	100
4	Core Practical-I	21PPHP01	General Physics – Experiments*	6	4	4	25	75	100
5	Elective-I		Elective–I (From Group A)	5	4	3	25	75	100
6	EDC - I		Extra Disciplinary Course - 1	4	3	3	25	75	100
SEMESTER II									
1	Core-IV	21PPH04	Theory of Semiconductor Devices	5	4	3	25	75	100
2	Core-V	21PPH05	Quantum Mechanics - I	6	4	3	25	75	100
3	Core-VI	21PPH06	Computational Physics &C++ Programming	6	4	3	25	75	100
4	Core Practical-II	21PPHP02	Electronics (Analog & Digital) *Experiments	6	4	4	25	75	100
5	Elective-II		Elective–II (From Group A)	5	4	3	25	75	100
6	Common Subject	21PHR01	Human Rights	2	-	3	25	75	100
7	Internship	21PPHIN	Compulsory Internship Programme (15 Days) Related to Curriculum-Report to be submitted	-	-	-	-	-	-

**** Examinations will be at the end of Second Semester***

S.No.	Course	Paper Code	Subject Title	Hours/Week	Credits	Exam Hours	University Examination		
							Internal (25%)	External (75%)	Total
SEMESTER III									
1	Core-VII	21PPH07	Electromagnetic Theory & Plasma Physics	5	4	3	25	75	100
2	Core-VIII	21PPH08	Quantum Mechanics-II	5	4	3	25	75	100
3	Core-IX	21PPH09	Molecular Physics & Spectroscopy	5	4	3	25	75	100
4	Core Practical-III	21PPHP03	Microprocessor Experiments **	6	4	4	25	75	100
5	Elective-III		Elective–III (From Group B)	5	4	3	25	75	100
6	EDC-2		Extra Disciplinary Course-2	4	3	3	25	75	100
SEMESTER IV									
1	Core-X	21PPH10	Nuclear & Elementary Particle Physics	5	4	3	25	75	100
2	Core-XI	21PPH11	Condensed Matter Physics	5	4	3	25	75	100
3	Core Practical-IV	21PPHP04	Micro Controller & C++ Programming Experiments **	6	4	4	25	75	100
4	Elective-IV		Elective–IV (From Group B)	5	4	3	25	75	100
5	Core-XII	21PPHPR1	Project & Viva-Voce	9	8	-	-	-	200
			TOTAL	**120**	**90**				**2400**

***** Examinations will be at the end of Fourth Semester***

6. EXAMINATION

For the purpose of uniformity, particularly for inter-departmental transfer of credits, there will be a uniform procedure of examinations to be adopted by all teachers offering courses. The practical examinations for M.Sc., Physics course shall be conducted at the end of every year.

Distribution of marks:

(a)The following are the distribution of external and internal marks for Theory papers.

i).	External Exam.	:	75 Marks
	Passing Minimum	:	38 Marks
ii).	Internal Exam	:	25 Marks
	Passing Minimum	:	12 Marks

(b) The following are the distribution of Internal marks for Theory papers.

1.	Test (One best test out of 3 tests)	:	05 Marks
2.	End Semester Model Exam	:	10 Marks
3.	Assignments & Attendance	:	05 Marks
4.	Seminar	:	05 Marks
	TOTAL	**:**	**25 Marks**

(c)The following are the distribution of Internal marks for Practical papers.

1.	Minimum 15 experiments	:	10 Marks
2.	Model Exam	:	10 Marks
3.	Attendance	:	05 Marks
	TOTAL	**:**	**25 Marks**

Submission of Record Notebooks for Practical Examinations:

Candidates taking the Practical Examinations should submit bonafide Record Note Books prescribed for the Practical Examinations with due certification by Staff in-charge & HOD is a must for External Practical Examination (for both Regular and Arrear Candidates). Otherwise, the candidates will not be permitted to take the Practical Examinations.

Allocation of Marks for University Practical Examinations:

Record	10 Marks
Formula and Formula Description	10 Marks
Circuit Diagrams / Diagrams	07 Marks
Observation-Tabulation and Readings	20 Marks
Calculations	15 Marks
Presentation	02 Marks
Result	05 Marks
Viva-Voce	06 Marks
TOTAL	**75 Marks**

Project & Viva-voce Exam:

Students are required to submit a Project report at the end of Semester - IV and also required to make presentation of the project work during Viva- voce Examination. The Project work shall be based on research-oriented topics both in the fields of theoretical and experimental physics under the guidance of a faculty member of the Department as a Project Supervisor. In the course of the project, the student will refer books, Journals or collect literature/data by the way of visiting research institutes/ industries. He/she may even do experimental /theoretical work in his/her college. After completion of the project work by the end of semester IV, each student should submit **THREE** copies of the project report with a minimum of 50 pages not exceeding 70 pages to the Department on or before the date notified for the same.

Format for Preparation of Project Report

The sequence in which the project should be arranged and bound should be as follows

1. Cover Page and title Page
2. Certificate
3. Declaration
4. Acknowledgement (not exceeding one page)
5. Contents (12 Font size, Times New Roman with 1.5 or double line spacing)
6. List of Figures/ Exhibits/Charts
7. List of tables
8. Symbols and notations
9. Chapters
10. Result & Discussion
11. Conclusion

12. References

13. Xerox Copies of Publications/Certificates of Seminar, Conference Participation

The bifurcation of marks for project will be as follows:

1. Evaluation of the Project Report : 150 Marks
2. Viva- voce Examination : 50 Marks

Distribution of marks for Project Report & Viva-Voce (200 Marks)

(a). For Organization and presentation of Project - 100 marks

(b). For the Novelty/Social relevance - 30 marks

(c). Presentation of work/Participation in
State/National level Seminar/Publication - 20 marks

(d). Viva-Voce (Preparation, Presentation of
work and Response to questions) - 50 marks

7. QUESTION PAPER PATTERN

The following question paper pattern shall be followed for the candidates admitted from the academic year 2021–2022 onwards.

Time: 3 Hours Maximum: 75 Marks

Part – A (15 x 1 = 15 Marks)
Answer **ALL** the Questions
Three Questions from each unit
15 multiple choice questions with four options

Part - B (2 x 5 = 10 Marks)
Answer Any **TWO** Questions out of FIVE
One Question from each unit.
All Questions carry equal Marks.

Part - C (5 x 10 = 50 Marks)
Answer **ALL** the Questions
One Question from each unit with Either or Type
All Questions carry equal Marks.

8. PASSING MINIMUM

In order to pass a paper 50% minimum is compulsory both in the internal and external. A candidate who has secured a minimum 50 marks (internal - 12 and external - 38) in

all the courses prescribed in the programme and earned a minimum of 90 credits will be considered to have passed the Master's Programme.

9. COMMENCEMENT OF THIS REGULATION

This regulation and syllabus shall take effect from the academic year 2021 - 2022, for students who are admitted to the first year of the course during the academic year 2021 - 2022 and thereafter.

10. GRADING

Once the marks of the cumulative internal assessment and end semester examinations are available, they will be added. The mark thus obtained will then be graded as per details given below:

Marks and Grades:

The following table gives the marks grade points, letter grades and classification to indicate the performance of the candidate.

Conversion of Marks to Grade Points and Letter Grade:

Range of Marks	Grade Points	Letter Grade	Description
90-100	9.0-10.0	O	OUTSTANDING
80-89	8.0-8.9	D+	EXCELLENT
75-79	7.5- 7.9	D	DISTINCTION
70-74	7.0-7.4	A+	VERY GOOD
60-69	6.0-6.9	A	GOOD
50-59	5.0-5.9	B	AVERAGE
00-49	0.0	RA	RE-APPEAR
ABSENT	0.0	AAA	ABSENT

Ci = Credits earned for course i in any semester
Gi = Grade Point obtained for course i in any semester
n = refers to the semester in which such course was credited

For a Semester:

GRADE POINT AVERAGE [GPA] = $\sum i\ Ci\ Gi / \sum i\ Ci$

$$GPA = \frac{\text{Sum of the multiplication of grade points by the credits of the courses}}{\text{Sum of the credits of the courses in a semester}}$$

For the entire Programme:

CUMULATIVE GRADE POINT AVERAGE [CGPA] = $\sum n \sum i$ Cni Gni / $\sum n \sum i$ Cni

$$CGPA = \frac{\text{Sum of the multiplication of grade points by the credits of the entire programme}}{\text{Sum of the credits of the courses of the entire programme}}$$

11. CLASSIFICATION OF SUCCESSFUL CANDIDATES

A candidate who passes all the examinations and securing following CGPA and Grades shall be declared as follows:

CGPA	GRADE	CLASSIFICATION OF FINAL RESULT
9.5 - 10.0	O+	First Class with Exemplary*
9.0 and above but below 9.5	O	
8.5 and above but below 9.0	D++	First Class with Distinction*
8.0 and above but below 8.5	D+	
7.5 and above but below 8.0	D	
7.0 and above but below 7.5	A++	First Class
6.5 and above but below 7.0	A+	
6.0 and above but below 6.5	A	
5.5 and above but below 6.0	B+	Second Class
5.0 and above but below 5.5	B	
0.0 and above but below 5.0	U	Re-appear

*The Candidates who have passed in the first appearance and within the prescribed semester of the PG programme (Core, Elective and Extra Disciplinary Courses alone) are eligible.

12. RANKING

A candidate who qualifies for the M.Sc., Physics, passing all the Examinations in the first attempt, within the minimum period prescribed for the course from the date of admission to the course and secures first or second class shall be eligible for ranking and such ranking will be confined to 10% of the total number of candidates qualified in that particular subject to a maximum of 10 ranks. The improved marks shall not be taken into consideration for ranking.

13. CONFERMENT OF THE DEGREE

No candidate shall be eligible for conferment of the Degree unless he / she has undergone the prescribed course of study for a period of not less than four Semesters in an institution approved by/affiliated to the Periyar University and has passed the Examinations as have been prescribed therefore.

14. ELECTIVE COURSES

Elective courses will be chosen by the respective colleges from the list of Group Elective Papers. Paper Codes are given in the bracket.

Elective Papers: List of Group

Group – A (Elective First Year - Select any **TWO** of the following**)**

1. Microprocessor & Microcontroller (21PPHE01)
2. Nano Physics (21PPHE02)
3. Fundamentals of Instrumentation (21PPHE03)
4. Laser Physics & Non-Linear Optics (21PPHE04)

Group – B (Elective Second Year - Select any **TWO** of the following**)**

5. Physics of Non-conventional Energy Resources (21PPHE05)
6. Electronic Communications (21PPHE06)
7. Modern Optics and Imaging (21PPHE07)
8. Crystal Growth & Thin Film Physics (21PPHE08)

15. EXTRA DISCIPLINARY COURSES

The students from other postgraduate programs, in affiliated colleges, will get a choice to select any one of the Extra Disciplinary Courses. The students can take up the extra disciplinary course at the beginning of First & Third semester.

List of Extra Disciplinary Courses (EDC)

1. Energy Physics
2. Nano Science
3. Medical Physics
4. Electronic Appliances

16. TRANSITORY PROVISION

Candidates who have undergone the Course of Study prior to the Academic Year 2021 - 2022 will be permitted to take the Examinations under those Regulations for a period of four years i.e., up to and inclusive of the Examination of April 2025 thereafter they will be permitted to take the Examination only under the Regulations in force at that time.

M.Sc. PHYSICS

SEMESTER - I

CORE I – 21PPH01 - CLASSICAL MECHANICS, THERMODYNAMICS & STATISTICAL MECHANICS

UNIT-I: LAGRANGIAN FORMULATION & HAMILTON'S EQUATION

Mechanics of a particle - Conservation Laws - Types of Constraints - Generalized Co-ordinates - Principle of Virtual work – D'Alemberts principle - Conservative and non-conservative systems - Lagrange's equation of motion - Applications to LinearHarmonic Oscillator - Simple Pendulum - Compound Pendulum - Atwood's Machine- Cyclic coordinates - Hamilton's principle - Lagrange's equation from Hamilton's principle - Variational Principle - Hamilton's Canonical equation of motion - Applications to Harmonic Oscillator, Simple Pendulum, Compound pendulum - Principleof Least action.

UNIT-II: CANONICAL TRANSFORMATION & THEORY OF SMALL OSCILLATIONS

Canonical transformations - Generating functions and different forms - Poisson's brackets and its properties - Infinitesimal contact transformation - Lagrange Brackets – Hamilton - Jacobi Theory - Harmonic oscillator problem - Jacobi identity - Action-angle variables - Application to Kepler problem in action angle variables - Eigen value equation - symmetry, invariance and Noether's theorem.

Theory of Small Oscillations: Equilibrium - Normal coordinates - Normal modes - Normal frequencies of vibration - Vibrations of a Linear Triatomic molecule.

UNIT-III: KINEMATICS OF RIGID BODY & THEORY OF RELATIVITY

Rigid Bodies: Independent coordinates of rigid body - Orthogonal transformation - Angular velocity of a rigid body - Angular momentum of a Rigid body - Euler's angle and Euler's theorem - Coriolis force - Angular momentum and kinetic energy of motion - Moments and products of inertia - Euler's equations of motion - Torque free motion of a rigid body - motion of a Symmetrical top.

Special Theory of Relativity: Galilean Transformations - Lorentz Transformations –

Length contraction - Time dilation – Variation of mass with velocity - Mass-energy equivalence - Relation between momentum and energy - Four vectors - Four Velocity - Space, time and energy - momentum vectors - Relativistic classification of particles – Relativistic Lagrangian and Hamiltonian for a particle.

UNIT - IV: THERMODYNAMICS & FUNDAMENTALS OF STATISTICS

Thermodynamic Systems - Thermodynamic processes - Laws of Thermodynamics - Equations of state – Carnot Cycle - Carnot's Theorem - Entropy - Thermodynamic potentials - Chemical potential - Maxwell's Thermodynamical relations - Phase transitions - Gibbs Phase rule – Clausius - Clapeyron equation.

Fundamentals of Statistics: Phase space - Microstates and Macrostates - micro canonical, canonical and grand-canonical ensembles - comparison of various ensembles - Liouville's Theorem - Stirling's formula - Entropy and probability - Gibbs' paradox - Sackur Tetrode equation - Partition function - Grand Partition function - Density of states - Equipartition and Viral theorems.

UNIT - V: CLASSICAL & QUANTUM STATISTICS

Classical Statistics: Maxwell-Boltzmann Statistics - M-B distribution law and its applications.

Bose-Einstein Statistics – B-E Energy distribution law - Bose Einstein gas - Degeneracy and Bose Einstein condensation - Black body radiation and Planck's distribution law.

Fermi Dirac Statistics – F-D Energy distribution law - Fermi Dirac gas at zero and low temperature - Fermi energy and Fermi momentum - Thermionic emission - Comparison of three types of statistics - One dimensional Ising model and its solution.

Specific Heat of Solids: Dulong-Petit law - Einstein and Debye Theory.

BOOKS FOR STUDY AND REFERENCE:

1. Classical Mechanics, S.L.Gupta, V.Kumar, H.V.Sharma, Pragati Prakashan, Meerut (2015).
2. Classical Mechanics, J.C.Upadhyaya, Himalaya Publishing House, Mumbai (2019).
3. Classical Mechanics, G.Aruldhas, Prentice-Hall of India Private Ltld., New Delhi(2008).
4. Classical Mechanics, H.Goldstein, C.Poole and J.Safko, Pearson Education Asia, New Delhi (2002).

5. Classical Mechanics, B.D.Gupta and Satya Prakash, Kedar Nath Ram Nath, Meerut (2020)
6. Elementary Statistical Mechanics, S.L.Gupta and V.Kumar, Pragati Prakashan, Meerut (2019).
7. Statistical Mechanics, Satya Prakash, Kedar Nath Ram Nath, New Delhi (2019).
8. Statistical Thermodynamics, M.C.Gupta, New Age International (P) Ltd., New Delhi (2017).
9. Heat Thermodynamics and Statistical Physics, Brijlal, N.Subramanyam and P.S.Hemne, S.Chand & Company Ltd., New Delhi (2010).
10. Thermal Physics, Agarwal and Satya Prakash, Pragathi Prakashan, Meerut (2014).
11. Modern Physics, R. Murugesan and Kiruthiga Sivaprasath, S. Chand and Company Limited, New Delhi (2019).

SEMESTER - I

CORE II - MATHEMATICAL PHYSICS (21PPH02)

UNIT-I: VECTOR ANALYSIS AND BETA, GAMMA FUNCTIONS

Vector Analysis: Concept of gradient, divergence and curl - Gauss divergence theorem, Greens theorem, Stokes theorem - Expression for gradient, divergence, curl and Laplacian in Cartesian, Orthogonal curvilinear coordinates and Spherical co-ordinates - Linearly dependent and independent sets of vectors - Schmidt's orthogonalization process.

Beta & Gamma Functions: Definitions - Symmetry property of Beta function - different forms of Beta function - Evaluation of Gamma function - Fundamental properties of Gamma functions - Relation between Beta and Gamma functions – Examples.

UNIT-II: COMPLEX VARIABLE AND GROUP THEORY

Complex Variable: Functions of complex variable - Analytic functions-Cauchy-Riemann equations-C-R equations in Polar form-Laplace's equation–Examples - Cauchy's integral theorem - Cauchy's integral formula - Taylor's Series-Laurent's Series-Singular Points-Cauchy's residue theorem - poles - evaluation of residues - evaluation of definite integrals.

Group Theory: Concept of a group - Abelian group-Generators of finite group - Cyclic groups - Group multiplication table - Rearrangement theorem - Sub groups - Lagrange's theorem - Conjugate elements and classes - Homomorphism and Isomorphism of groups - Representations of groups - Reducible and irreducible representations - Schur's Lemma - Orthogonality theorem - Unitary Groups - Group of symmetry of an equilateral triangle - Group of symmetry of square - C_2 V & C_3 V Groups in Molecular Physics.

UNIT-III: DIFFERENTIAL EQUATIONS AND PROBABILITY THEORY

Differential Equations: Linear Ordinary Differential equations - First order and second order equations and their various solutions.

Partial differential equations: Linear second order equations - Solution of Laplace equations - Wave equations and their solutions - Solution of Poisson's equations, Helmholtz equations and Green's functions

Elementary Probability Theory: Basic ideas - Probability distributions: Binomial, Poisson and Gaussian distributions - Examples - Error Analysis - Principle of Least squares.

UNIT IV: MATRIX THEORY & TENSOR ANALYSIS

Matrices: Algebraic operations of matrices, Types of Matrices and their properties-Rank of a Matrix, Symmetry and Inverse of matrix-Hermitian, Skew-Hermitian matrix-Orthogonal,

Unitary matrices - Eigen values and Eigen vectors - Cayley-Hamilton's theorem- Diagonalization of different matrices - Problems.

Tensors: Definition - Scalars, Contravariant, Covariant and Mixed tensors - Rank of a Tensor - Tensors of higher rank - addition and subtraction of Tensors - Summation convention - Symmetry and Anti-symmetry Tensor - Contraction and direct product - Quotient rule - Pseudo tensors, Levi-Civita Symbol - Dual tensors, irreducible tensors - Metric tensors.

UNIT-V: SPECIAL FUNCTIONS & INTEGRAL TRANSFORMS

Special Functions: Differential Equations, Rodrigue's formula, Recurrence relations and Generating functions for Legendre, Hermite, Laguerre and Bessel polynomials - Orthogonality relations of these polynomials - Applications of Special functions in Physics.

Integral Transforms: Fourier transforms - cosine and sine transforms.

Laplace transforms: Definition-Linearity, shifting and change of scale properties.

Inverse Laplace transforms: Definition - properties - problems.

BOOKS FOR STUDY AND REFERENCE:

1. Mathematical Physics, B.D.Gupta,Vikas Publishing House Pvt. Ltd, New Delhi (2020).
2. Mathematical Physics, Satya Prakash, Sultan Chand & Sons, New Delhi (2012)
3. Mathematical Physics, B.S.Rajput, Pragati Prakashan (2008).
4. Mathematical Physics, H.K.Dass and Rama Verma, S.Chand & Company Ltd (2014).
5. Mathematical Physics, P.K.Chattopadhyay, New Age International Limited (1996).
6. Mathematical Physics, S.L.Kakani & C.Hemrajani, CBS Publishers & Distributors (P) Ltd., New Delhi (2018).
7. Mathematical Physics, A.K.Saxena, Narosa Publishing House, New Delhi (2015).
8. Mathematical Physics, Binoy Bhattacharyaa, New Central Book Agency(P)Ltd., Kolkatta (2009).
9. Matrices and Tensors in Physics, A.W.Joshi, New Age International (P) Limited., New Delhi (2017).
10. Fundamentals of Mathematical Physics, A.B.Gupta, Books and Allied (P) Limited, Kolkatta (2011).

SEMESTER - I

CORE III - ELECTRONICS (21PPH03)

UNIT-I: SEMICONDUCTOR DEVICES

Semiconductors - Characteristics and applications of PN Junction diode - Zener Diode - Gunn diode - Tunnel diode - Photo diode - Schottky diode - Impatt diode - Varactor diode.

Transistor CB, CE, CC configurations - Transistor biasing methods - Multistage transistor amplifiers - RC Coupled transistor amplifier.

JFET - Structure and Characteristics – MOSFET - Depletion and Enhancement type MOSFFT.

Construction, V-I characteristics and applications of UJT, SCR - DIAC, TRIAC.

UNIT-II: IC FABRICATION & IC TIMER

Basic monolithic ICs - Epitaxial growth - Masking - Etching impurity diffusion - Fabricating monolithic resistors, diodes, transistors, inductors and capacitors - Circuit layout - Contacts and inter connections.

IC 555 Timer: Description - Monostable, Bistable and Astable multivibrators - Phase Locked Loops - Basic principles - Voltage Controlled Oscillator - Design of Square wave, Saw tooth wave and Triangular wave generators.

UNIT-III: OPERATIONAL AMPLIFIER

Operational Amplifier - Characteristics - Parameters - CMRR - Sample and Hold circuits.

Applications of OPAMP: Inverting and non-inverting amplifier - Adder, Subtractor, average amplifiers, Differentiator and Integrator -Voltage follower - Voltage Comparator – Logarithmic amplifier - Solving simultaneous and differential equations - Hartley, Colpitts, Phase Shift and Wien bridge Oscillators - Schmitt Trigger - Square wave, Sine Wave, Triangular wave generators - A/D and D/A converters - Voltage to Current and Current to Voltage Converters, Astable, Bistable and Monostable multivibrators.

Active Filters: Design of Low, High, Band pass and Band reject first and second order filters.

UNIT-IV: SEMICONDUCTOR MEMORIES & DIGITAL ELECTRONICS

Classification of memories and sequential memory - ROM, PROM and EPROM principle and operation Read & Write memory - Static RAM, dynamic RAM. Programmable Logic Array (PLA) - Operation, Internal Architecture. Charge Coupled Devices (CCD) - Principle, construction, working and Data transfer mechanism.

Digital Electronics: Number Systems - Binary, Octal, Hexadecimal, Gray code, Excess-3 code - Basic Logic gates - Universal gates.

Boolean Algebra: Boolean Laws - De Morgan's theorem – Karnaugh map - Simplification using K-map

UNIT-V: DIGITAL CIRCUITS

Arithmetic and Logic Circuits: Half adder - Hall subtractor - Full adder - Full subtractor - Decoder - Encoder - Multiplexer and Demultiplexer.

Sequential Circuits: Flip flops - RS Flip flop - D flip flop - JK flip flop - Master Slave JK flip flop.

Registers: SISO, SIPO, PISO, PIPO Shift Registers.

Counters: Modulus of a Counter - Synchronous, Asynchronous, Ring and Up/Down Counters - BCD Counter.

BOOKS FOR STUDY AND REFERENCE:

1. Principles of Electronics, V.K.Mehta, S.Chand and Company, New Delhi (2015).
2. A text book of Applied Electronics, R.S.Sedha, S.Chand & Company, New Delhi (2017)
3. Modern Digital Electronics, R.P.Jain, Tata McGraw-Hill Edn., Publishing Company Ltd., New Delhi (2010)
4. Principles of Electronics, Partha Kumar & Ganguly, PHI Learning (P) Ltd., New Delhi (2015)
5. Op-Amp and linear integrated circuits, R.F. Coughlin and F.F, Driscol, Prentice Hall of India, New Delhi (1996).
6. Op-Amps and Linear Integrated Circuits -Ramakant A. Gayakwad, Prentice-Hall of India Limited, New Delhi (2015).
7. Digital Computer Electronics, Malvino & Brown, Tata Mc Graw Hill Publishing Company Ltd., New Delhi.
8. Electronic Devices and Circuits, David A. Bell, Prentice Hall (2007).
9. Digital Principles and Applications, Donald P.Leach, Albert Paul Malvino, Goutam Saha, McGraw Hill Education (India) Pvt.Ltd, Chennai, (2018).
10. Digital Fundamentals, V.Vijayendaran, S.V.Printers & Publishers Pvt. Ltd., Chennai (2017).

SEMESTER - I

CORE IV: PRACTICAL - I

GENERAL PHYSICS EXPERIMENTS (21PHP01)

(Examination only at the end of Second Semester)

Group A: OPTICAL PHYSICS & LASERS (Any 12 Experiments - Compulsory)

1. Young's modulus by Elliptical fringes
2. Young's modulus by Hyperbolic fringes
3. Charge of an Electron by Spectrometer
4 Permittivity of a liquid using R.F. Oscillator
5 Iron / Copper Arc spectrum
6. Measurement of Numerical aperture (NA) of an optical fiber
7. Michelson Interferometer -- Determination of wavelength of monochromatic source
8. Biprism-Wavelength of monochromatic source - Refractive Index of a liquid
9. Polarization of light - Verification of Malus law and Brewster angle of glass
10. Determination of Rydberg's constant - Hydrogen spectrum
11. F.P. Etalon - Spectrometer - determination of thickness
12. Ultrasonic Interferometer - Velocity and Compressibility of a liquid
13. Permittivity of a liquid using R.F Oscillator
14. Laser beam - Interference Experiments
    (a) Using an optically plane glass plate (b) Using Lloyd's single mirror method
15. Laser beam - Diffraction Experiments
    (a) Diffraction at straight edge (b) Diffraction at a straight wire
    (c) Diffraction at a circular aperture
16. Determination of (i) thickness of a wire (ii) diameter of a circular aperture and
    (iii) Wavelength of He-Ne laser / diode laser using diffraction grating
17. Determination of refractive index of the liquids using He-Ne/Laser

Group B: THERMODYNAMICS, MODERN PHYSICS & SOLID STATE PHYSICS

(Any 8 Experiments - Compulsory)

1 G.M. Counter - Characteristics, Inverse square law
2. G.M. Counter - Absorption co-efficient
3. Zeeman Effect - e/m of an electron with a laser source
4. Determination of Stefan's constant
5 Determination of Solar constant
6. Thermal Conductivity - Forbe's Method
7. Study of Hall Effect in a semiconductor and Measurement of Hall Coefficient of the Semiconductor
8. Determination of resistivity of a semiconductor by Four Probe Method
9. Determination of band gap in a semiconductor material
10. Thermistor - Temperature Coefficient and Band Gap Energy Determination
11. BH loop - Energy loss of a magnetic material - Anchor ring using B.G/CRO
12. Determination of magnetic susceptibility of liquid by Guoy's method
13. Determination of susceptibility of a paramagnetic solution by Quincke's method

SEMESTER-II

CORE IV - THEORY OF SEMICONDUCTOR DEVICES (21PPH04)

UNIT I: SEMICONDUCTOR PHYSICS

Energy Bands: Semiconductor Materials, Basic Crystal Structure, Mobility and diffusivity - Valence Bands, Energy Bands, Intrinsic Carrier Concentration, Donors and Acceptors, Non-degenerate Semiconductor, Doped Semiconductors - basic diffusion process, diffusion equation, diffusion profiles, Carrier Transport Phenomena: Carrier Drift: mobility, resistivity, Hall Effect. Carrier Diffusion**:** Diffusion process, Einstein Relation, current density equation; Generation and Recombination Processes: direct and indirect recombination, surface recombination, Auger recombination; Continuity Equation, The Haynes - Shockley Experiments; Thermionic Emission Process, Tunnelling Process.

UNIT II: SEMICONDUCTOR DEVICES

Basic Fabrication Steps: Oxidation, Lithography, Thermal Equilibrium Condition: Band Diagram, Equilibrium Fermi Level; Depletion Region: Abrupt junction, Linearly Graded junction; Depletion Capacitance, Current - Voltage Characteristics: generation - recombination and high-injection effects; Charge Storage and Transient behaviour, Junction Breakdown: Tunnelling effect, Avalanche multiplication, Heterojunction.

UNIT III: METAL-SEMICONDUCTOR DEVICES:

MOSFET and Related Devices: MOS Diode - metal & semiconductor work function, the SiO_2-Si MOS diode, CCD; MOSFET fundamental: linear and saturation regions, types of MOSFET, threshold voltage control; MOSFET scaling - CMOS - MOSFET on insulator - MOS Memory structures: DRAM, SRAM, Non-volatile memory-power MOSFET - Metal-Insulator-Semiconductor (MIS) system.

MESFET and Related Devices: Metal-Semiconductor Contacts - the Schottky barrier, semiconductor work function, Ohmic contact; MESFET: Devices structure, principles of operation, high-frequency performance; MODFET fundamentals - Static Induction Transistor (SIT).

UNIT IV: MICROWAVE DIODES, QUANTUM-EFFECT & HOT-ELECTRON DEVICES

Basic Microwave Technology: IEEE microwave frequency bands; Tunnel devices of different types - I-V Characteristics of Tunnel diode - Tunnel diode applications - IMPATT diode - Static & dynamic characteristics, field distributions and generated carrier densities -

electron devices - negative differential resistance, device operation - quantum-effect devices - resonant tunnelling diode, energy of electrons - hot electron devices - HBT, real-space-transfer transistor - MISS diodes.

UNIT V: PHOTONIC DEVICES

Radiative Transitions & Optical Absorption: Radiative transistor, Boltzmann distribution, optical absorption, optical absorption coefficients;

LED: visible LEDs, bandgap semiconductors, Snell's law, organic LED, Infrared LED; **Semiconductor Laser:** Laser operation, energy bandgap, carrier & optical confinement, optical cavity & feedback, basic laser structure, distributed feedback laser, quantum-well laser, energy of charge particle

Photo Detectors: Photoconductor, Photodiode, quantum efficiency, response speed, PIN photodiode, heterojunction photodiode, avalanche photodiode - Photo transistors.

Solar Cell: Solar radiation, p-n junction solar cell, conversion efficiency, silicon & compound - Semiconductor solar cells, optical concentration.

BOOKS FOR STUDY AND REFERENCE:

1. Physics of Semiconductor Devices, S.M.Sze, Kwok K.Ng, John Wiley & Sons, New Delhi (2011)
2. Solid State Electronic Devices, B.G. Streetman, S. Banerjee, Prentice Hall (2009).
3. Semiconductor Physics and Devices: Basic Principles, D.A. Neamen, McGraw-Hill, (2003).
4. Physics of Semiconductor Devices, Dilip K. Roy, Universities Press (India) Private Limited, Hyderabad (2004).

SEMESTER - II

CORE V - QUANTUM MECHANICS - I (21PPH05)

UNIT-I: FOUNDATIONS OF WAVE MECHANICS

Postulates of Quantum Mechanics - adjoint and self-adjoint operators – Linear Operator - Momentum operator - Energy operator - Hamiltonian operator - Hermitian Operator and its properties - degeneracy - observables - Matter waves - Schrodinger Equations of motion - physical interpretation of wave function - normalised and orthogonal wave functions - Expansion theorem - Stationary state solutions - Expectation values - Eigen values and Eigen functions - Momentum eigen functions - Hilbert space - Probability current density – Ehrenfest Theorem - Heisenberg's Uncertainty relation and its applications.

UNIT-II: APPLICATIONS OF SCHRODINGER'S EQUATION-ONE & THREE DIMENSIONAL EIGEN VALUE PROBLEMS

One Dimensional Problem: Particle in a box - Square well potential - Barrier penetration-Quantum mechanical tunnelling - Bound States - Linear Harmonic oscillator - Schrodinger method-Operator method

Three Dimensional Problems: Orbital angular momentum and spherical harmonics - Central forces and reduction of two body problem-Particle in a Spherical well - Rigid Rotator - Hydrogen atom.

UNIT III: ANGULAR MOMENTUM

Orbital angular momentum, Spin angular momentum and Total angular momentum Operators - Commutation relations for angular momentum operators - Eigen value spectrum of J^2, J_z, J_x, and J_y - Ladder Operators - Matrix representation of Angular momentum - Pauli's spin matrices - Addition of angular momenta - Clebsch-Gordan coefficients.

UNIT IV: TIME INDEPENDENT PERTURBATION THEORY

Time independent Perturbation theory in Non-degenerate and Degenerate cases - Application to perturbed Harmonic oscillator - Stark effect in hydrogen atom - Variation method - Application to ground state of He and hydrogen atom - WKB approximation and its application to tunnelling problem - Bohr-Sommerfeld quantization condition.

UNIT V: MATRIX FORMULATION OF QUANTUM THEORY

Hilbert space - Unitary transformation and their properties - Representation of State vector and equation of motion: Schrodinger, Heisenberg and Interaction pictures - correspondence

with classical mechanics - Dirac's Bra & Ket vector notation - Coordinate and Momentum representation - Matrix theory of Harmonic Oscillator.

TIME DEPENDENT PERTURBATION THEORY

Time dependent Perturbation theory - first and second order transitions - Transition to continuum of states - Fermi Golden rule - Constant and Harmonic perturbations - Transition Probabilities - Adiabatic and Sudden approximation - A charged particle in an Electromagnetic field.

BOOKS FOR STUDY & REFERENCE:

1. Quantum Mechanics - G. Aruldhas, PHI Learning Private Limited, New Delhi (2020)
2. Quantum Mechanics - Satya Prakash, Kedar Nath Ram Nath and Co. Publications, New Delhi (2018).
3. Quantum Mechanics, S.L.Gupta, V.Kumar, H.V.Sharma and R.L.Sharma, Jai Prakashnath and Co, Meerut.
4. Quantum Mechanics - Theory and applications - A. K. Ghatak and Lokanathan, Macmillan India Ltd Publication (2015).
5. The Principles of Quantum Mechanics, P.A.M.Dirac, Oxford University Press, London (1973)
6. Principle of Quantum Mechanics - R. Shankar, Plenum US Publication, Tamilnadu(1994)
7. A Text Book of Quantum Mechanics, P. M. Mathews and K. Venkatesan, Tata Mc Graw Hill, New Delhi (1987).
8. Elements of Quantum Mechanics, Atomic and Molecular Spectra, Dr. D.N. Tripathi, R.B. Singh, Kedar Nath Ram Nath, New Delhi (2016).
9. Quantum Mechanics, V.Devanathan, Narosa Publishing House, New Delhi (2011)
10. Quantum Mechanics, Chatwal and Anand, Himalaya Publishing House, Mumbai (1989)

SEMESTER - II

CORE VI - COMPUTATIONAL PHYSICS & C++ PROGRAMMING (21PPH06)

UNIT-I: SOLUTIONS OF LINEAR AND NONLINEAR EQUATIONS

Simultaneous Linear Equations: Gauss elimination method - Jordan's modification - Gauss-Seidel method. Curve fitting - Method of least squares - Normal equations - Straight line fit - Interpolation - Least squares Approximation - Newton Interpolation polynomials - Linear Interpolation - Gregory-Newton Interpolation polynomials.

Roots of Non-linear Equations: Bisection method - Iteration method - Newton-Raphson method - Termination criteria – Pitfalls - Order of convergence.

UNIT-II: NUMERICAL INTEGRATION AND DIFFERENTIATION

Numerical Differentiation - Numerical Integration - Trapezoidal rule - Simpson's 1/3 and 3/8 rules - Random number generation - Park and Miller method - Newton-Cotes formulas - Gaussian quadrature formula - Estimation of errors in evaluating the integrals - Roots of Equation.

UNIT-III: NUMERICAL SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS:

Ordinary Differential equation: Taylor's series method - Euler and Picard methods - Predictor - corrector methods - Chaotic dynamics of a driven pendulum - Boundary-value and eigenvalue problems - The Shooting Method - Linear equations and the Sturm - Liouville problem.

First order equations: Euler and improved Euler methods - Formulas - Second order equation -Euler methods - Solution of Ordinary differential equation by Euler, Runge-Kutta Fourth Order method for solving first order ordinary differential equations.

UNIT- IV: FUNDAMENTALS OF C++ PROGRAMMING

Basic structure of C++ programs - Creating the Source File - compiling and Linking. Tokens, Keywords – Identifiers - Basic Data Types - Symbolic Constants - Type Compatibility - Declarations of Variables - Dynamic Initialization of Variables - Reference Variables - Reading and writing a character - formatted inputs and outputs.

Operators in C++: Arithmetic, relational, logical, assignment, increment, decrement, and conditional, bitwise special operators - Operator Precedence - Type Cast Operator -

Expressions and Implicit Conversions - Operator Overloading - C++ math library functions- C++ standard library header files.

UNIT V: DECISION MAKING, ARRAYS, STRUCTURES, FUNCTIONS & POINTERS

Decision Making Statements: If-else statement - nested if-else, else-if ladder - switch case statement - conditional statement - go to statement - break and continue statement - Nested control statements.

Loops: While loop - do-while loop - For loop - Nested For loop.

Arrays: Defining, initializing arrays - accessing array elements - One/Two dimensional arrays.

Structures: Specifying the structure - accessing structure members.

Functions: Function declaration and definition - Calling the Function.

Pointers: Address and pointers - Address of operator & pointer variables.

BOOKS FOR STUDY AND REFERENCE:

1. Numerical methods in Science and Engineering-M.K.Venkataraman-National Publishing Co., Madras (1996)
2. Introductory Methods of Numerical Analysis, S.S.Sastry-Prentice Hall of India Private Ltd., New Delhi (2007)
3. Numerical Methods, Dr.P.Kandasamy, Dr. K.Thilagavathy, Dr.K.Gunavathi, S.Chand & Company Private Limited, New Delhi (2016)
4. Numerical Methods for Scientific and Engineering Computation, M.KJain, S.R.K.Iyengar and R.K.Jain, New Age International, New Delhi (2007)
5. Numerical methods, E.Balagurusamy, Tata McGraw Hill, New Delhi (1999)
6. Numerical Methods, V.N.Vedamurthy, N.Ch.S.N.Iyengar, Vikas Publishing House Pvt. Ltd., Noida (2011)
7. Programming in C++, E.Balagurusamy, McGraw Hill Education (India) Private Limited, New Delhi (2016)
8. Programming with C++, P.Radha Ganesan, SCITECH Publications (India) Pvt. Ltd, Chennai (2002)
9. Programming with C - Schaum's outline series, Tata McGraw Hill Publishing Company Limited, New Delhi (2004)

SEMESTER - II

ELECTRONICS (ANALOG & DIGITAL)

EXPERIMENTS (21PHP02)

(Examination at the end of Second Semester)

Group A: ELECTRONICS (Minimum 14 Experiments)

1. Construction of Dual IC regulated power supply
2. Study the characteristics of DIAC and TRIAC
3. MOSFET - Characteristics - depletion and enhancement mode
4. FET - Characteristics and FET as amplifier - Frequency response
5. Single stage and multi stage RC coupled transistor amplifier - Frequency response
6. SCR - Characteristics, Wave shaping and switching circuits
7. Study the characteristics of UJT and construction of UJT Relaxation oscillator
8. Characteristics of Tunnel diode and Gunn diode
9. I-V Characteristics of Solar cell and its efficiency
10. Photo diode and Photo transistor characteristics
11. Op-amp - summing, difference, average amplifier, differentiator and integrator
12. Op-amp - Solving simultaneous equations
13. Design of Square wave, Saw tooth wave and Triangular wave generators using OPAMP
14. Design of Square wave, Saw tooth wave and Triangular wave generators using IC 555 Timer
15. Op-amp - Design of Schmitt Trigger and construction of Monostable multivibrator
16. Op-amp - Design of active filters - second order - low pass, high pass, band pass
17. Op-amp – 4 bit D/A converter - Binary weighted method and R-2R ladder method
18. Parameters of Op-Amp, Voltage to current and current to voltage converters using OPAMP
19. Construction of A/D converter using comparator and study its performance
20. Design and study of Monostable and Bistable multivibrators using IC 555

Group B: DIGITAL ELECTRONICS (Minimum 6 Experiments)

1. Universal NAND/NOR Gates
2. Construction of half adder and full adder circuit using NAND gates
3. Construction of half subtractor and full subtractor circuits using NAND gates

4. Flip flops - RS, JK, Master Slave and T flip flops
5. Study of Counters: Ripple, MOD 3, MOD 5 Counters
6. BCD and UP/ DOWN Counters
7. Construction of Shift registers using IC 7476: Serial in-Serial out, Parallel in-Parallel out, Shift left and Shift right Registers.
8. Decoders and Encoders
9. Study of Multiplexer & Demultiplexer using IC for the generation of Boolean functions
10. IC 7490 as Modulus counters and display using IC-7447

SEMESTER - III

CORE VII - ELECTROMAGNETIC THEORY & PLASMA PHYSICS (21PPH07)

UNIT I: ELECTROSTATICS AND POLARISATION

Coulomb's law - Electric field - Continuous charge distribution - Gauss's law and its applications - Electrostatic potential - Laplace and Poisson equations - Boundary value problems - Electrostatic boundary conditions - Energy density of an electrostatic field - Method of images.

Polarisation: Macroscopic electric field - Local electrical field at an atom - Electric displacement and Molecular Polarizability - Electronic, Ionic and Orientational Polarisation- Dielectric constant - Clausius-Mossotti equation - Polarization of Polar molecules - Langevin and Debye relation - Electrostatic energy.

UNIT II: MAGNETOSTATICS

Biot-Savart law: Magnetic field due to steady straight current - Divergence and Curl of B - Ampere's circuital law and its applications - Magnetic Scalar and Vector Potentials and their applications - Magnetostatics boundary conditions - Multipole expansion of vector potential - Magnetization - Magnetic Materials - Magnetostatic energy - Magnetic susceptibility and permeability - Correspondences between Electrostatics and Magnetostatics.

UNIT III: ELECTRO MAGNETISM

Continuity equation - Displacement current - Maxwell's equations and their physical significances - Energy in electromagnetic fields - Poynting's theorem - Electromagnetic potentials - Maxwell's equations in terms of electromagnetic potentials - Gauge transformations - Lorentz Gauge - Coulomb Gauge - Green function for the wave function - Conservation of energy and momentum for a system of charged particles and electromagnetic fields.

UNIT IV: ELECTROMAGNETIC WAVES AND WAVE PROPAGATION

Electromagnetic waves in free space - Propagation of electromagnetic waves in isotropic and anisotropic dielectrics - Reflection and refraction of electromagnetic waves - TM and TE modes - Propagation in Rectangular waveguides - Cavity Resonator - Inhomogeneous wave equation and retarded potentials - Radiation from a localized source - Oscillating electric dipole - Superposition of waves - Polarization - Stokes Parameters.

UNIT V: PLASMA PHYSICS

Introduction, Types of Plasma; Properties of Plasma; V- I characteristics; Advantages of plasma processing. Thermal plasma: Principles of plasma generation; DC plasma torches; AC plasma torches; RF plasma torches, Plasma spraying; Structure of sprayed deposits; Plasma decomposition; Treatment of hazardous wastes - Synthesis of ultrafine/Nano powders. Plasma melting and remelting. Non-thermal plasma: Glow discharge plasma.

Plasma reactors for surface treatment: Corona & DBD atmospheric pressure surface treatment reactors - Magnetic hydrodynamic waves - Alfven waves and magnetosonic waves.

BOOKS FOR STUDY AND REFERENCE:

1. Electromagnetic Theory, K.K.Chopra and G.C.Agarwal, K.Nath & Co., Meerut, (2020).
2. Electromagnetic Theory and Electrodynamics, Sathya Prakash, Kadernath Ramnath& Co., Meerut, (2020).
3. Electromagnetic Field Theory, S.L.Gupta & Sanjeev Gupta, Dhanpat Rai Publications (P) Ltd., New Delhi (2010)
4. Electromagnetic Theory and Applications, A.K.Saxena, Narosa Publishing House, New Delhi (2013)
5. Electromagnetic Waves and Radiating System, K.G. Balmain, Prentice Hall of India, (1995).
6. Electromagnetic Fields, G.S.N.Raju, Pearson, New Delhi (2012)
7. Electromagnetic Field Theory, K.A.Gangadhar & P.M.Ramanathan, Khanna Publishers, New Delhi (2015)
8. Thermal Plasma Processing, P.V.Anantha Padmanabhan and N.Venkataramani, Pergamon Materials Series Vol 2, (1999).
9. Industrial Plasma Engineering -Applications to Non-thermal Plasma processing (Vol. 2), J. Reece Roth, Institute of Physics Publishing, Bristol (2001).

SEMESTER - III

CORE VIII - QUANTUM MECHANICS - II (21PPH08)

UNIT I: IDENTICAL PARTICLES AND SPIN

Identical Particles - Symmetric and anti-symmetric wave functions - Exchange operator - Exchange degeneracy - Spin and Statistics connection: Pauli's Exclusion Principle - Bosons and Fermions - Slater determinant - Spin and Pauli's matrices - Electron Spin Hypothesis: Stern Gerlach experiment - Density operator - Density matrix - Properties - Statistical weight - Symmetric and Anti symmetric wave function of hydrogen molecule.

UNIT II: SCATTERING THEORY

Differential and Total cross-section - Laboratory and Centre of mass coordinate system - Asymptotic behaviour of the Wave function - Scattering amplitude-Partial wave analysis - Optical Theorem-Phase Shifts-Born approximation and its validity-scattering by Coulomb and Screened coulomb potentials - Rutherford scattering formula - Square-well potential - Exponential - Gaussian potential - Low energy scattering: Scattering length and effective range scattering by a perfectly rigid sphere-resonant scattering-non resonant scattering – Ramsauer -Townsend effect - Scattering by square well potential - Breit-Wigner formula.

UNIT III: EMISSION AND ABSORPTION OF RADIATION

Semi-Classical theory of radiation: Einstein's coefficients - atom field interaction - Transition probabilities for stimulated emission & absorption and spontaneous emission of radiation - Electric dipole transition - Selection rules and polarizability-forbidden transitions.

Quantum theory of radiation: Radiation field Hamiltonian-Radiation field as an assembly of oscillators-emission and absorption rates.

UNIT IV: QUANTUM THEORY OF ATOMIC & MOLECULAR STRUCTURE

Approximations in atomic structure - Central field approximation - Thomas Fermi Statistical model - Hartree-Fock Equation - method of self-consistent field - Residual electrostatic and spin orbit interaction - Alkali atoms - Doublet separation - Coupling Schemes - Hund's rule-Born-Oppenheimer approximation.

Molecular orbital Theory: LCAO - Hydrogen molecule- Covalent bond.

UNIT V: RELATIVISTIC QUANTUM MECHANICS

Klein-Gordon Equation for a free particle and its solution - Charge and current densities in four vector - KG equation in electromagnetic field - Dirac relativistic equation for a free particle - Dirac matrices - Charge and current densities - Dirac Equation in Electromagnetic

field - Free particle solutions - Negative energy states - Spin of a Dirac particle - Spin orbit coupling.

Quantization of Wave fields: Classical Lagrangian equation - Classical Hamiltonian equation - Field quantization of the non-relativistic Schrodinger equation - Creation, destruction and number operators - Anticommutation relations - Quantization of Electromagnetic field energy momentum.

BOOKS FOR STUDY AND REFERENCE:

1. Quantum Mechanics - G.Aruldhas, PHI Learning Private Limited, New Delhi (2020)

2. Advanced Quantum Mechanics - Satya Prakash, Kedar Nath Ram Nath and Co. Publications, Meerut (2021).

3. Quantum Mechanics, S.L.Gupta, V.Kumar, H.V.Sharma and R.L.Sharma, Jai Prakashnath and Co, Meerut.

4. Quantum Mechanics - Theory and applications - A.K.Ghatak and Lokanathan, Macmillan India Ltd Publication (2015).

5. Principle of Quantum Mechanics - R.Shankar, Plenum US Publication, Tamilnadu (1994)

6. A Text Book of Quantum Mechanics, P.M.Mathews and K.Venkatesan, Tata Mc Graw Hill, New Delhi (1987).

7. Elements of Quantum Mechanics, Atomic and Molecular Spectra, Dr. D.N. Tripathi, R.B. Singh, Kedar Nath Ram Nath, Meerut (2016).

8.Quantum Mechanics, B.K. Agarwal Hari Prakash, PHI Learning Private limited, New Delhi (2011).

9. Fundamentals of Quantum Mechanics, Statistical Mechanics & Solid State Physics, S.P.Kuila, Books and Allied (P) Ltd., Kolkatta (2012)

SEMESTER - III

CORE IX - MOLECULAR PHYSICS & SPECTROSCOPY

(21PPH09)

UNIT-I: MOLECULAR STRUCTURE AND BONDING

Chemical bonding - The VSEPR model - Valence bond theory - The hydrogen molecule - Homo nuclear diatomic molecules - Polyatomic molecules - Molecular orbital theory - Homo nuclear diatomic molecules - Hetero nuclear diatomic molecules - Bond properties - Polyatomic molecules - Molecular shape in terms of molecular orbitals - Molecular structure, properties and conformations.

UNIT-II: INFRARED SPECTROSCOPY

Vibrational spectroscopy of diatomic and simple polyatomic molecules - Harmonic Oscillator - Anharmonic Oscillator - Rotational vibrators - Normal modes of vibration of Polyatomic molecules - Experimental techniques - Applications of Infrared Spectroscopy - Reflectance Spectroscopy.

UNIT-III: RAMAN SPECTROSCOPY

Classical theory of Raman Scattering - Raman effect and molecular structure - Raman effect and crystal structure - Raman effect in relation to inorganic, organic and physical chemistry - Experimental techniques - Coherent anti-Stokes Raman Spectroscopy - Applications of Infrared and Raman Spectroscopy - Laser Raman Spectroscopy.

UNIT-IV: NMR AND NQR SPECTROSCOPY

Theory of NMR - Bloch equations - Steady state solution of Bloch equations - Theory of chemical shifts - Experimental methods - Single Coil and double coil methods - Pulse Method - High resolution method - Relaxation Time - Applications of NMR to quantitative measurements. Quadruple Hamiltonian of NQR - Nuclear quadruple energy levels for axial and non-axial symmetry - Experimental techniques and applications.

UNIT-V: ESR AND MOSSBAUER SPECTROSCOPY

Quantum mechanical treatment of ESR - Nuclear interaction and hyperfine structure - Relaxation effects - Basic principles of Spectrographs - Applications of ESR method - Mossbauer Effect - Recoilless emission and absorption - Mossbauer spectrum - Experimental methods - Mossbauer Spectrometer - Hyperfine interactions - Isomer shift - Magnetic hyperfine interactions - Electric quadruple interactions - Simple biological applications.

BOOKS FOR STUDY AND REFERENCE:

1. Molecular Spectroscopy, C.N.Banwell, E.M.Mc Cash, Tata McGraw-Hill Publishing Company Ltd., New Delhi (2004).
2. Spectroscopy (Atomic & Molecular) - Gurdeep R.Chatwal and Sham K.Anand, Himalaya Publishing House, Mumbai (2002)
3. Molecular Structure and Spectroscopy, G. Aruldhas, PHI Learning Private Ltd., New Delhi, (2001).
4. Elements of Spectroscopy, Gupta, Kumar and Sharma, Pragathi Prakashan, Meerut (2019)
5. Fundamentals of Molecular Spectroscopy, P.S.Sindhu, New Age International Publishers, New Delhi (2011)
6. Spectroscopy, B.K.Sharma, Krishna Prakashan Media (P) Ltd., Meerut (2017)
7. Spectroscopy, Straughn and Walker, Vol I & II Chapman and Hall (1967).
8. Introductory Raman Spectroscopy, John Ferraro, Academic Press, New York, (2008).
9. Atomic and Molecular Spectra: Laser, Raj Kumar, Kedar Nath Ram Nath, Meerut, New Delhi, (2015).
10. Spectroscopy, Dr. H. Kaur, Pragati Prakasan, Meerut, (2019).

CORE PRACTICAL - III - MICROPROCESSOR PROGRAMMING EXPERIMENTS (21PPHP03)

(Minimum 20 Experiments)

(Examination at the end of Fourth Semester)

Group A: 8085 MICROPROCESSOR PROGRAMMING EXPERIMENTS

(Minimum 15 Experiments-Compulsory)

1. 8 bit Addition and Subtraction
2. 8 bit Multiplication and Division
3. Number conversion: BCD to Binary and Binary to BCD
4. Number conversion: ASCII to HEX and HEX to ASCII
5. Ascending and descending order of numbers
6. Square and square root of a given number
7. Factorial of a given number
8. Largest and smallest number in a set of numbers
9. Search for a given data in an array
10. Interfacing of ADC with 8085 Microprocessor
11. Interfacing of DAC with 8085 Microprocessor (square, saw tooth and triangular waves)
12. Interfacing of 8253 (Timer IC) or 8255 with 8085 Microprocessor
13. Interfacing of 8279 keyboard/ display controller with 8085 Microprocessor
14. Stepper Motor Interface
15. Traffic Light Control Interface
16. Design of digital Clock using 8085 Microprocessor
17. Design of digital Thermometer using 8085 Microprocessor
18. Sum of ‘n’ numbers using 8085 Microprocessor
19. BCD Addition using Microprocessors
20. Program to reverse the given string

Group B: 8086 MICROPROCESSOR PROGRAMMING EXPERIMENTS

(Minimum 5 Experiments-Compulsory)

1. 16 bit Addition and Subtraction
2. 16 bit Multiplication and Division
3. Largest and smallest number in a set of numbers
4. Searching for a number or character in a string
5. Program to reverse the given string
6. Program to count number of vowels in a given string
7. Program to add and subtract two numbers of BCD data
8. Program to determine the sum of elements in an array

SEMESTER - IV

CORE X - NUCLEAR & ELEMENTARY PARTICLE PHYSICS

(21PPH10)

UNIT-I: NUCLEAR STRUCTURE & NUCLEAR MODELS

Properties of Nuclei: mass, charge, Nuclear angular momentum, parity, isospin - Nuclear size and its determination - electric quadrupole moment - Nuclear stability - Binding energy & Mass defect - Theories of Nuclear composition - Nuclear Isomerism - Nuclear Statistics.

Nuclear Models: Liquid drop model – Weizsacker Semi-empirical mass formula - Shell model - Magic numbers - Prediction of Shell Model - Spin-Orbit coupling - Spins of nuclei - Collective model - Optical Model - Nilsson model.

UNIT-II: NUCLEAR FORCES

Characteristics of Nucleus Forces - Exchange forces and Tensor forces - charge independence - Spin dependence of Nucleus Forces - Yukawa's Meson theory of nuclear forces - Ground state of deuteron - Nucleon-nucleon scattering singlet and triplet parameters - Differential Cross-section, Scattering Cross-sections - Effective range theory of n-p scattering at low energies.

Mass Spectrometer-Bainbridge and Jordan mass spectrograph.

UNIT-III: NUCLEAR REACTIONS

Types of Nuclear reactions - Conservation laws - Q value - Scattering and Nuclear reaction cross section - Direct Nuclear Reactions: Knock out reaction, Pick-up reaction, Stripping reaction - Compound nucleus theory - Formation - Disintegration energy levels - Partial wave analysis of Nuclear reaction cross-section - Resonance Scattering and Reaction cross-section – Breit-Wigner dispersion formula - Scattering matrix - Reciprocity theorem - Resonance scattering - Absorption cross section at high energy.

Nuclear fission - Bohr Wheeler theory - Chain reaction - critical size and critical mass - Atom bomb - Nuclear fission reactor - Nuclear fusion processes - source of stellar energy - Solar fusion - Thermo Nuclear reactions - Hydrogen bomb - Transuranic Elements.

UNIT-IV: RADIOACTIVE DECAYS, PARTICLE DETECTORS & ACCELERATORS

Properties of alpha, beta and gamma particles - Alpha decay – Geiger-Nuttal law-Gamow's Theory - Neutrino hypothesis - Beta decay - Fermi theory of Beta decay - K electron capture

- Kurie plot - Fermi & G.T Selection rules - Cerenkov Radiation - Gama decay - Absorption of Gamma rays - Angular momentum and parity selection rules - Internal conversion.

Particle Detectors: Ionization chamber - Proportional counter - G.M counters - Solid state detectors - Scintillation Counter - Bubble Chamber.

Particle Accelerators: Cyclotron - Synchrocyclotron - Synchrotron - Proton Synchrotron - Betatron.

UNIT-V: ELEMENTRY PARTICLE PHYSICS

Classification of Elementary particles – Hadrons - Leptons – Mesons - Hyperons - Types of interaction between elementary particles - Particle quantum numbers - Baryon number - Lepton number - Strangeness number – Hypercharge - Isospin quantum number – Murray Gell-Mann-Nishijima formula - Symmetry and conservation laws - Strangeness and associate production - CPT theorem-Quark model - Color and flavor - Isospin multiplets - SU(2) - SU(3) multiplets - Gell-Mann-Okubo mass formula - Universal Fermi interaction-Grand Unification Theories.

BOOKS FOR STUDY AND REFERENCE:

1. Nuclear Physics, D.C.Tayal, Himalaya Publishing House Pvt., Ltd., Mumbai (2008)
2. Elements of Nuclear Physics, M.L. Pandya and R.P.S Yadav, Kedar Nath Ram Nath Publications, Meerut (2016).
3. Modern Physics, R. Murugesan, Kiruthiga Sivaprasath, S.Chand and Company Limited, New Delhi, (2019).
4. Nuclear Physics, S.N. Ghoshal, S. Chand and Co., New Delhi (1994).
5. Nuclear Physics, R.P.Roy and B.P.Nigam, Age International Ltd, New Delhi (2005).
6. Nuclear & Particle Physics, S.L.Kakani and S.Kakani, Anshan Publications, New Delhi (2009).
7. Concepts of Modern Physics, Shobhit Mahajan, Arthur Beiser and Raj Choudhiry , Tata McGraw-Hill Education Private Limited, New Delhi (2009)
8. Atomic and Nuclear Physics Brijilal, N.Subramaniyam and Jivan Seshan, S.Chand & Company Ltd., New Delhi (2009).
9. Nuclear Physics, Satyaprakash, Pragati Prakashan Educational Publishers, Meerut (2018).
10. Introduction to Nuclear and Particle Physics, V.K.Mittal, R.C Verma S.C.Gupta, PHI Learning Private Limited, New Delhi (2018).

SEMESTER - IV

CORE XI - CONDENSED MATTER PHYSICS (21PPH11)

UNIT I: BONDING AND LATTICE VIBRATIONS

Bonding: Ionic bonding - calculation of lattice energy-calculation of Madelung constant in ionic crystals - Born Haber cycle - Crystals of inert gases - Vander Waals interaction - London interaction - Compressibility and bulk modulus.

Vibration of monatomic lattices - Lattices with two atoms per primitive cell - Quantization of lattice vibrations - Phonon momentum - Inelastic scattering of neutrons by phonons.

UNIT II: CRYSTALLOGRAPHY

Crystallography: Space Lattice – Unit Cell – Point Groups – Space Groups – Bravais Lattices – Three Dimensional Lattice types – SCC, BCC,FCC, HCP types – Lattice Planes – Miller Indices – Atomic Packing - Reciprocal lattices - Vector development of reciprocal lattice - Properties of the reciprocal lattice - Reciprocal lattice to bcc lattice and fcc lattice - Bragg's condition in terms of reciprocal lattice - Brillouin zones - Ewald sphere - atomic scattering factor -Geometrical structure factor.

Crystal Defects: Imperfections in Crystals – Point defects – Line defects – Surface defects – Volume defects – X Ray Diffraction – Bragg’s Law – Bragg’s X Ray Spectrometer – Experimental methods in X-Ray Diffraction – Laue method – Rotating crystal method – Powder Photograph method – Diffraction of Electrons - Diffraction of Neutrons.

UNIT III: FREE ELECTRON THEORY, ENERGY BANDS AND SEMICONDUCTOR CRYSTALS

Band theory of solids - Bloch theorem – Kronig-Penney model - Effective mass – Brillouin Zones - Free electron gas in one dimension - Energy levels and density of states - Free electron gas in three dimensions - Fermi energy - Heat capacity of the electron gas - Thermal conductivity of metals - Wiedemann - Franz law - Hall effect - Intrinsic carrier concentration.

UNIT IV: MAGNETISM AND SUPERCONDUCTIVITY

Diamagnetism and Antiferromagnetism - Langevin classical theory of Diamagnetism - Weiss theory - Quantum theory of Para magnetism - Demagnetization of a paramagnetic salt - Determination of susceptibility of para and diamagnetism using Gouy's method - Ferromagnetism - Spontaneous magnetization in ferromagnetic materials - Quantum theory of ferromagnetism - Curie-Weiss law - Weiss Molecular field - Ferromagnetic domains - The

Domain Model - Domain theory – Antiferromagnetism - Ferrimagnetism - Structure of Ferrite-Ferroelectric crystals.

Superconductivity - Meissner effect - Thermodynamics of Superconducting transition - London equation - Coherence length - BCS theory - Flux Quantization - Type-I and Type-II Superconductors - Josephson tunnelling effect - DC and AC Josephson effect - SQUID - Recent developments in high Temperature Superconductivity - Application of Superconductors.

UNIT V: NANOSOLIDS & TYPES OF MATERIALS

Definition of Nano Science and Nanotechnology - Preparation of Nano materials - Surface to volume ratio - Quantum confinement - Qualitative and Quantitative description - Density of states of nanostructures - Excitons in Nano semiconductors - Carbon in nanotechnology - Buckminsterfullerene - Carbon nanotubes - Nano diamond - BN nano tubes – Nano Electronics - Single electron transistor - Molecular machine - Nano biometrics.

Polymers-Plastics-Ceramics-High temperature materials-Thermoelectric materials - Nuclear engineering materials-Metallic glasses - Metal matrix composites-Biomaterials-Super strong materials.

BOOKS FOR STUDY AND REFERENCE:

1. Solid State Physics, S.L.Gupta and V.Kumar, K.Nath & Co., Meerut (2018).
2. Fundamentals of Solid State Physics, B.S.Saxena, R.C.Gupta and P.N.Saxena, Pragati Prakashan, Meerut (2010).
3. Introduction to Solid State Physics, C.Kittel, Wiley India, New Delhi (2018).
4. Solid State Physics & Electronics, A.B.Gupta, Nurul Islam, Books and Allied (P) Ltd., Kolkatta (2017)
5. Solid State Physics, S.O. Pillai, New Age International Pvt. Ltd., New Delhi (2018).
6. Solid State Physics, H.C.Gupta, Vikas Publishing House Private Ltd., Noida (2001)
7. Solid State Physics, K.Ilangovan, S.Viswanathan Printers & Publishers Pvt. Limited, Chennai (2007)
8. Introduction to Solid State Physics, Arun Kumar, PHI Learning Pvt. Ltd., New Delhi (2015)
9. Solid State Physics, R.L.Singhal, P.A.Alvi, Kedar Nath Ram Nath Co.,Meerut (2020)
10. Solid State Physics, A.J.Dekker, Macmillan Publishers India Ltd., New Delhi (2012)

CORE PRACTICAL - IV - MICROCONTROLLER & C++ PROGRAMMING EXPERIMENTS (21PHP04)

(MINIMUM 20 EXPERIMENTS)

(Examination at the end of Fourth Semester)

Group A: 8051 MICROCONTROLLER PROGRAMMING

(Minimum-10 Experiments compulsory)

1. 16 bit Addition, Subtraction
2. 16 bit Multiplication and Division
3. Largest and smallest number in a set of numbers
4. Binary to BCD conversion and Hex to ASCII conversion
5. Generation of square, triangular, saw tooth waves
6. DC Motor Control Interface
7. HEX key board Interface
8. Switching of an array of LED'S
9. Addition of array of numbers
10. Code conversion programs - Micro Controllers
11. Timer and Counter programming - Microcontrollers
12. Interfacing Traffic signal control using Microcontrollers
13. Interfacing DAC module using Microcontrollers
14. Interfacing Stepper motor control using Microcontrollers
15. Interfacing Seven segment display using Microcontrollers

Group B: C++ PROGRAMMING

(Minimum - 10 Experiments compulsory)

1. Given number is odd or even
2. Greatest number from given numbers
3. Matrix addition and subtraction
4. Matrix multiplication
5. Eigen values of a given matrix
6. Transpose and inverse of a matrix
7. Root of non-linear equation by Newton-Raphson method
8. Solution of simultaneous linear equations

9. Straight line fit by the method of least squares
10. Exponential fit by the method of least squares
11. Newton's (Forward/Backward difference) and Lagrange's Interpolation
12. Numerical integration by Simpson's rules (1/3 & 3/8) and Trapezoidal rule
13. Solution of Differential equation by Fourth order Runge-Kutta Method
14. Calculation of standard deviation of a given range
15. Drawing of rectangle and circles using graphics

M.Sc., PHYSICS

LIST OF ELECTIVE COURSES

ELECTIVE I - MICROPROCESSORS AND MICROCONTROLLERS (21PPHE01)

UNIT - I: MICROPROCESSOR 8085 ARCHITECTURE

Intel 8085 Microprocessor: Introduction - Pin configuration - Architecture and its operations - Machine cycles of 8085 - Opcode fetch machine cycle - Memory read machine cycle - Memory write machine cycle - I/O read cycle - I/O write cycle - Interrupt acknowledge machine cycle. Memory organization in an 8085 based system - Interfacing I/O and Peripheral Devices - Interrupts-Software Interrupts - Hardware Interrupts.

UNIT - II: 8085 ASSEMBLY LANGUAGE PROGRAMMING

Instruction format-Instruction Set: Data transfer instructions - Arithmetic instructions - Logical instructions - Branching instructions and machine control instructions. Addressing modes - Assembly Language programming - programming techniques - Looping, counting and indexing - Counters and time delays - Stack - subroutine - Simple programs - 16-bit additions, subtractions, multiplications and divisions.

UNIT - III: MICROPROCESSOR 8086

Intel 8086 Microprocessor - Introduction - Comparison between 8085 and 8086 Microprocessors - Architecture of 8086 – Pin configuration - Format of 8086 instructions - Classification of 8086 instructions - Memory addressing: 8-bit data from even and odd address bank, 16-bit data from even and odd address bank - Addressing modes - Simple programs - 16-bit additions, subtractions, multiplications and divisions.

UNIT - IV: MICROCONTROLLER 8051 ARCHITECTURE AND PROGRAMMING

Introduction to microcontroller and embedded system - Difference between microprocessor and microcontroller - 8051 microcontrollers: Pin configuration, Architecture and Key features of 8051 - Instruction set: Data transfer instructions - Arithmetic instructions - Logical instructions - Branching instructions - Boolean operations instructions - Program-control instructions - Addressing modes.

UNIT - V: INTERFACING OF MICROPROCESSOR 8085

Basic concepts of programmable device - 8255 Programmable Peripheral Interface (PPI) - interface of ADC and DAC - 8257 Direct Memory Access (DMA) controller - Basic concepts

of serial I/O and data communication-interface of 8251 Universal Synchronous Asynchronous Receiver Transmitter (USART)

BOOKS FOR STUDY AND REFERENCE:

1. Microprocessor Architecture, Programming and Applications with 8085/8080, Ramesh S. Gaonkar, Penram International Publishing (India) Private Ltd., Mumbai (2016).
2. Microprocessors and Interfacing, Douglas V. Hall, Tata McGraw Hill Publishing Company Limited, New Delhi (2006).
3. Fundamentals of Microprocessors & Microcomputers, B.Ram, Dhanpat Rai Publications (P) Ltd., New Delhi (2005)
4. Microprocessors and Microcontrollers, A.P.Godse and D.A.Godse, Technical Publications, Pune (2012).
5. Microprocessor and its Applications, A.Nagoor Kani, RBA Publications, Chennai (1999)
6. Introduction to Microprocessors, Aditya P.Mathur, Tata Mc Graw Hill Publishing Company, New Delhi (2004)
7. Microprocessors and Microcontrollers 8085,8086 and 8051, Amar K.Ganguly, Anuva Ganguly, Narosa Publishing House, New Delhi.
8. The 8051 Microcontroller and Embedded systems, Muhammad Ali Mazidi and Janice Mazidi, Pearson Education (2000).
9. The 8051 Microcontroller, Kenneth Ayala, Cengage Learning India Private Limited, New Delhi (2005).
10. Microprocessor, Microcomputer and their application, A.K. Mukhopadhyay, Narosa Publishing House, New Delhi (2012)

M.Sc., PHYSICS

ELECTIVE II - NANO PHYSICS (21PPHE02)

UNIT I: NANO SCALE SYSTEMS

Introduction to Nanoscale - Size-Dependent properties - Size effect - Surface tension, wettability - specific surface area and surface area to volume ratio - Reason for change in optical properties, electrical properties and mechanical properties - nanoscale catalysis - Principles of Top-Down and Bottom-Up approaches - Electrical, Optical, Thermal, Mechanical and Magnetic properties of nanoparticles.

UNIT II: SYNTHESIS OF NANO STRUCTURE MATERIALS

Gas phase condensation - Vacuum deposition - Physical vapor deposition (PVD) - Chemical vapor deposition (CVD) - Sol-Gel - Ball milling - spray pyrolysis - plasma based synthesis process (PSP) - hydrothermal synthesis - Etching technologies: wet and dry etching - photolithography - Drawbacks of optical lithography for nanofabrication - electron beam lithography - ion beam lithography - dip-pen nanolithography.

UNIT III: QUANTUM DOTS

Quantum Dots-properties - Excitons and excitonic Bohr radius - difference between nanoparticles and quantum dots - Preparation through colloidal methods - Epitaxial methods-MOCVD and MBE growth of quantum dots - current-voltage characteristics - magneto tunnelling measurements - Absorption and emission spectra of quantum dots - Photo luminescence spectrum.

UNIT IV: CHARACTERIZATION:

Nano SEM - Scanning Conducting microscopy (SCM) - High-resolution Transmission Electron Microscopy (HRTEM) - single nanoparticle characterization - Scanning capacitance microscopy - Principle and working of Atomic Force Microscopy (AFM) and Scanning tunnelling microscopy (STM) - Principle of Transmission Electron Microscopy (TEM) - applications to nanostructures-nano mechanical characterization-nano indentation - Particle size estimation by XRD/SPM/STM/AFM techniques.

UNIT V: APPLICATIONS OF NANOTECHNOLOGY:

Nano diodes, Nano switches, molecular switches, Nano-logic elements - Single electron transistors - small metallic tunnel junctions - Nanoparticles based solar cells and quantum dots based white LEDs - CNT based transistors-Surface acoustic wave (SAW) devices, microwave MEMS, field emission display devices - Super hard nano composite coatings and

applications in tooling - Biochemistry and medical applications: lab-on-a-chip systems. Nano Boat - Nano submarines - DNA engineering.

BOOKS FOR STUDY AND REFERENCE:

1. Nanotechnology, S. Shanmugam, TBH Edition.
2. Physics and Chemistry of Metal cluster components, De Jongh J, Kulwer Academic Publishers, Dordrecht, (1994).
3. Nanoscale Materials in Chemistry, Enneth J. Klabunde, KWiley & Sons, Publcn, (2001).
4. Nano Systems, Dexler E, John Wiley, CNY, (1992).
5. Nanotechnology: Principles and Practices, Sulabha K.Kulkarni, Capital Publishing Company.
6. Principles of Nanoscience and Nanotechnology, M.A.Shah, Tokeer Ahmad.
7. Nano Technology, Rakesh Rathi, S.Chand & Company Limited, New Delhi (2009)
8. Nanotechnology, AIP Press, Springer-Verlag, Gregory Timp Editor, New York, (1999).
9. Nanoscale characterization of surfaces & interfaces, N. John Dinardo, Weinheim Cambridge: Wiley-VCH (2000).
10. Hand Book of Nano Science, Engineering and Technology - The Electrical Engineering Handbook Series.

M.Sc., PHYSICS

ELECTIVE III - FUNDAMENTALS OF INSTRUMENTATION (21PPHE03)

UNIT I: GENERALIZED CHARACTERISTICS OF INSTRUMENTS

Static characteristics: accuracy, precision, repeatability, reproducibility, resolution, sensitivity, linearity, drift, span, range. Dynamic characteristics: transfer function, zero order instruments, first order instruments - step, ramp, frequency responses - second order instruments-step-ramp response - dead time elements. Types of Errors: gross, systematic, random.

UNIT II: VACUUM SYSTEMS

Principle and operation of various pumps: rotary, diffusion, sorption, turbo molecular, ionization and cryo-pumping. Gauges: McLeod, diaphragm, thermocouple, Pirani, Penning, Ionisation and hot and cold cathodes - design of high vacuum systems - high pressure cells - measurements at high pressures.

UNIT III: THERMAL SYSTEMS

Temperature scales - liquefaction of gases, achieving low temperature - design of cryostats. High temperature furnaces: resistance, induction and arc furnaces - high temperature measurements - pyrometers - total and selective radiation pyrometers - optical pyrometer.

UNIT IV: DETECTORS AND SPECTROSCOPY

Detectors: Pyroelectric, thermoelectric, photo conducting, photoelectric, photomultiplier, scintillation types of detectors, photon counters. Spectroscopy: principles of atomic absorption spectroscopy - instrumentation-single and double beam spectrometers-theory and components of nuclear quadrupole resonance technique-applications.

UNIT V: ELECTRONICS AND EXPERIMENTAL METHODS

Error analysis: linear and nonlinear curve fitting, chi-square test. Signal conditioning: impedance matching, filtering, noise reduction, shielding and grounding, lock-in detector.

BOOKS FOR STUDY & REFERENCE:

1. A Course in Mechanical Measurement and Instrumentation, A.K. Sawhney and Puneet Sawhney, Dhanpat Rai & Sons, New Delhi (2000).
2. Electronic communication, Dennis Roddy and John Coolen, PHI Private Ltd., (1999).
3. Instrumentation Devices and Systems, C.S.Rangan, G.R. Sharma and V.S.V. Mani, Tata McGraw-Hill, New Delhi (1983).
4. Instrumental Methods of Analysis, H.H. Willard, L.L.Merrit and John A. Dean, CBS Publishers & Distributors (1986).
5. Instrumental methods of analysis, Gurdeep Chatwal and Sham Anand, Himalaya Publishers, New Delhi (2003)

M.Sc PHYSICS

ELECTIVE IV-LASER PHYSICS AND NON-LINEAR OPTICS (21PPHE04)

UNIT I: LASERS-FUNDAMENTALS AND TYPES

Basic Construction and Principle of Lasing-Einstein Relations and Gain Coefficient - Creation of a Population Inversion - Three-Level System - Four-Level System - Threshold Gain Coefficient for Lasing-Laser Types - He-Ne Laser - CO_2 Laser - Nd:YAG Laser-Semiconductor Laser.

UNIT II: LASER OPERATION

Optical Resonator - Laser Modes - Axial modes - Transverse Modes - Modification in Basic Laser Structure - Basic Principle of Mode Locking - Active Mode Locking - Passive Mode Locking - Q switching - Pulse Shaping.

UNIT III: LASER BEAM CHARACTERISTICS

Wavelength – Coherence - Mode and Beam Diameter – Polarizations - Introduction to Gaussian Beam width – Divergence - Radius of Curvature - Rayleigh Range - Gouy Phase Shift - 3-D Gaussian Beams - ABCD Law for Gaussian Beam - Complex Radius of Curvature- Tensorial ABCD Law.

UNIT IV: FOCUSING OF LASER BEAM

Diffraction - Limited spot size - M^2 Concept of Beam Quality - Spherical Aberration - Thermal Lensing Effects - Depth of Focus - Tight focusing of laser beam - Angular Spectrum Representation of Optical near Field - Aplanatic Lens - Focusing of Higher - order laser modes - Radially Polarized Doughnut Mode - Azimuthally Polarized Doughnut mode.

UNIT V: NON-LINEAR OPTICS

Introduction - Nonlinear Optical Media - The Nonlinear Wave Equation - Scattering Theory Born Approximation - Second-order Nonlinear Optics-Second - Harmonic Generation (SHG) and Rectification - Electro-Optic Effect – Three Wave Mixing - Frequency and Phase Matching - Third Harmonic Generation-Optical Kerr Effect - Self-Focusing - Four-Wave

Mixing (FWM) - Optical Phase Conjugation (OPC) - Use of Phase Conjugators in Wave Restoration.

BOOKS FOR STUDY & REFERENCE:

1. Nonlinear Optics - D.L. Mills - Basic Concepts, Springer, Berlin (1998).
2. Lasers and Nonlinear Optics - B.B. Laud, New Age International (P) Ltd., New Delhi (2011).
3. An introduction to Laser Spectroscopy, David L.Andrews and Andrey A.Demidov, Springer (India) Private Limited, New Delhi.
4. Nano Materials: Processing and Characterization with Lasers - Subhash Chandra Singh, Haibo Zeng, Chunlei Guo (2012).
5. Principles of Nano Optics - L. Novotny and B. Hecht-Cambridge University Press (2006).
6. Laser Material Processing- M. Steen, J.Mazumder- Springer (2010).
7. Laser and Non-Linear Optics, B.B. Laud, New Age International Publishers, New Delhi (2011)
8. Laser Fundamentals, William T.Silfvast, Cambridge University Press, New Delhi (2009)
9. An introduction to Laser Theory and Application, M.N.Aravamudhan, S.Chand & Co., Private Ltd. (2012)

ELECTIVE V - PHYSICS OF NON-CONVENTIONAL ENERGY RESOURCES (21PPHE05)

UNIT-I: NON-CONVENTIONAL ENERGY SOURCES & SOLAR RADIATION

Various non-conventional energy resources - Classification, merits and demerits - Sun as source of energy - Solar constant - solar radiation at the Earth's surface - direct and diffused radiation - spectral power distribution of solar radiation - depletion of solar radiation - measurement of solar radiation - Solar radiation data.

UNIT-II: APPLICATIONS OF SOLAR ENERGY

Physical principles of the conversion of solar radiation into heat - solar flat plate liquid and air collectors and their materials - effect of various parameters on performance - Solar water heating - space heating and space cooling - agricultural and industrial process heat - Solar distillation - Solar pumping - Solar furnace - Solar cookers - Solar greenhouse - Solar dryer.

UNIT III: SOLAR CELLS

Solar cells for direct conversion of solar energy to electric power - single crystal silicon solar cell - principle and working of a solar cell - Solar cell electrical characteristics - equivalent circuit-Solar cell parameters - Poly crystalline silicon solar cells - Thin film solar cells (CdTe, CIGS, GaAs) - Perovskite Solar cells - Organic solar cells - Dye sensitized solar cells - Quantum dot solar cells.

UNIT-IV: WIND ENERGY & GEOTHERMAL ENERGY

Nature of the wind - power in the wind - basic components of wind energy conversion system (WECS) - horizontal axis wind turbine - generating systems - scheme for electric generation - applications of wind energy.

Origin of Geothermal energy - hydrothermal resources - vapor dominated systems - wet steam system - environmental considerations - applications of geothermal energy.

UNIT-V: BIO-MASS ENERGY AND OCEAN ENERGY

Biomass conversion technologies - wet and dry process - photosynthesis - biogas generation - basic process and energetics - advantages of anaerobic digestion - classification of biogas plants.

Origin and nature of Ocean tidal energy - tidal energy power - ocean tidal energy conversion schemes - wave energy - heaving float type and pitching type wave energy converters -ocean thermal energy - open cycle OETC system.

BOOKS FOR STUDY AND REFERENCE:

1. Non-Conventional Energy Sources, G.D.Rai, Khanna Publishers, New Delhi (2011).
2. Non-Conventional Energy Resources, B.H.Khan, Tata Mc Graw-Hill Education (2018).
3. Solar Energy, S.P.Sukhatme, J.K.Nayak, Tata Mc Graw-Hill Education Private Ltd., New Delhi (2011).
4. Renewal Energy Resources, John Twideu and Tony Weir, BSP Publications (2006).
5. Energy Resources: Conventional & Non-Conventional, M.V.R.Koteswara Rao, BSP Publications (2006).
6. Non-conventional Energy Resources, D.S.Chauhan, New Age International (P) Ltd.,
7. Renewal Energy Technologies: A Practical Guide for Beginners C.S. Solanki-PHI Learning

ELECTIVE VI - ELECTRONIC COMMUNICATIONS (21PPHE06)

UNIT-I: PROPAGATION OF WAVES AND TRANSMISSION LINES

Fundamentals of electromagnetic waves - Power density - Electric field strength - Ground waves - Sky waves - Radio horizon - Ionospheric layers - Skip wave - Space waves - Fundamentals of transmission lines - Characteristics of impedance losses in transmission line - standing waves - Reactance properties of transmission lines - Smith chart.

UNIT-II: WAVE GUIDES, ANTENNAS AND RESONATORS

Wave Guides - Attenuation in parallel plane guides - Attenuation for TE waves, TM waves and TEM waves - Rectangular and Circular wave guides - Field configurations for dominant TM and TE modes - Wave guide couplings matching and attenuation - Cavity resonator. Basic considerations of antennas - Wire radiators in space - antenna parameters - Effect of ground on antennas - Different types of antennas - Impedance matching to antenna - Directional high frequency antennas - Microwave antennas - Wideband, Special purpose antennas - Antenna arrays.

UNIT-III: MICROWAVE DEVICES AND RADARS

Cavity resonators, Multicavity and Reflex klystrons - Cavity magnetron - Traveling wave tube - Circulators, Magic TEE and Hybrid rings. Elements of a Radar System - Radar Equation - Radar Performance Factors - Radar Transmitting Systems - Radar Antennas - Duplexers - Radar Receivers and Indicators - Pulsed Systems

UNIT-IV: SATELLITE COMMUNICATIONS

Introduction - Kepler's Laws - Geostationary orbit - Power systems - Attitude Control - Satellite Station keeping - Antenna Look Angles - Limits of visibility - Frequency plans and polarization - Transponders - Uplink power budget calculations - Down link power budget calculations - Overall link budget - Digital carrier Transmission - Multiple-access Methods.

UNIT-V: MOBILE COMMUNICATION

Evolution of Mobile communication - Multiplexing - Modulation - Spread spectrum & hopping -fading and Doppler spread - Cellular systems - Medium access control - Principles of SDMA, FDMA, TDMA & CDMA and their comparison - GSM - Radio interface - Localization and calling - Handover - Security & Authentication - GPRS - Protocol architecture - UMTS & IMT- 2000 - Mobile IP - IP packet delivery - Optimization - Dynamic host configuration Protocol - Mobile ad hoc networks.

BOOKS FOR STUDY AND REFERENCE:

1. Electronic Communication Systems, G. Kennedy and Davis, McGraw Hill Education Private Ltd, New Delhi.
2. Principles of Electronic Communication systems, Louis E. Frenzel, Tata - McGraw-Hill, New Delhi (2008).
3. Electromagnetic Waves & Radiating Systems, Edward C. Jordan and Keith G. Balmain, Prentice-Hall of India P Ltd., New Delhi (2004).
4. Antennas, John D.Kraus, McGraw Hill (2002).
5. Mobile Communication, Jochen H. Schiller, Pearson Education (2004).
6. Microwaves, K.C.Gupta, Wiley Eastern Ltd. (1995).
7. Antennas and Wave Propagation, A.Amsaveni, Anuradha Publications (2006).
8. Mobile Communication Engineering, W.C.Y.Lee, McGraw Hill (1998).
9. Principles of Communication Systems, Herbert Taub, Donald L.Schilling, Tata Mc Graw-Hill Publishing Company Ltd., New Delhi (2008)
10. Communication Systems, R.P.Singh, S.D.Sapre, Tata McGraw-Hill Publishing Company Ltd., New Delhi (2001)

ELECTIVE VII - MODERN OPTICS AND IMAGING (21PPHE07)

UNIT-I: WAVE NATURE AND LIGHT PROPAGATION

Electromagnetic wave propagation, Harmonic waves, phase velocity, group velocity, energy flow - Poynting vector - Wave motion - equation - superposition of waves, interference, diffraction, basics of coherence theory, temporal and spatial coherence - Multi-wave interference - Michelson and Fabry-Perot interferometer - Scattering and polarization - types.

UNIT-II: OPTICAL ENGINEERING AND NON-LINEAR OPTICS

Image formation (first-order optics), aberrations, prisms and mirrors, stops and apertures, basic optical devices, the design of optical systems: general, aplanatic points, solid immersion lens, numerical aperture increasing lens. Fourier optics - Thin lens as phase transformation - Thickness function -Various types of lenses.

Non-linear Optics: Principle - Nonlinear wave equation - second harmonic generation - phase matching - frequency conversion-electro optic effect-Soliton.

UNIT-III: FIBER OPTICS COMMUNICATION & OPTICAL FIBER SENSORS

Evolution of fiber optic systems – optic fiber transmission link - optic fiber modes and configurations - fiber types - single mode fibers - graded index fiber - Fiber materials - Fiber fabrication - Fiber optic cables-LED and lasers source - Transmitter modulator - Modulation of an LED - Laser Diodes - Laser diode Rate Equations - Modulation of Laser diodes - Temperature effects - acousto-optic, electro optic modulator - AM, FM, DCM modulation - detection and demodulation radiation detection.

Optical Fiber Sensors: General features, types of OFS, intrinsic and extrinsic sensors, intensity sensors, temperature and pressure measurements - reflective OFS and applications.

UNIT - IV: HOLOGRAPHY & PHOTO DETECTORS

Basic Principles of Holography - Recording of amplitude and phase-recording medium - Reconstruction of original wave front-Image formation by wave front reconstruction- Gabor Hologram- Limitations of Gabor Hologram-Off axis Hologram.

Photo Detectors: Physical principles of Photodiodes-Pin Photo Detector-Avalanche Photodiodes - Photodetector Noise - Comparison of Photo Detectors.

UNIT - V: OPTICAL MICROSCOPY & IMAGING TECHNIQUES

Basics of Optical Microscopy, bright field and dark field microscopy, polarizing microscopy, phase contrast microscopy, fluorescence microscopy, light sheet fluorescence microscopy, nonlinear optical microscopy, two photon fluorescence microscopy.

BOOKS FOR STUDY AND REFERENCE:

1. Fundamental Optics - Francis Jerkins and Harvey White, McGraw Hill Inc., New Delhi, (2011).
2. Modern Optical Engineering - W.J. Smith, McGraw-Hill, (2000).
3. Lasers and Non-Linear optics - B.B. Laud, Wiley, (1992).
4. Introduction to Optical Microscopy - J. Mertz, Roberts & Company Publishers, (2010).
5. Introduction to Optics - F.L. Pedrotti and L.S.Pedrotti, Prentice Hall International, Wilmington, (2006).
6. Principles of Optical Electronics, A.Yariv, John Wiley, New York, (1984).
7. Physics of Optoelectronics, Michael A.Parker, CRC Press, (2005).
8. Optoelectronic Devices, Optical Fiber Communications & Fiber Optic Metrology, Amar K.Ganguly, Books and Allied (P) Ltd., Kolkata (2007).
9. Physical Optics and Lasers, D.N.Tripathi, R.B.Singh, Kedar Nath and Ram Nath Co., Meerut (2018)
10. Optical Fiber Communications, John M.Senior, Pearson Education Ltd., New Delhi (2008)

ELECTIVE VIII-CRYSTAL GROWTH & THIN FILM PHYSICS (21PPHE08)

UNIT I: BASIC CONCEPTS, NUCLEATION AND KINETICS OF GROWTH

Ambient phase equilibrium - Super saturation - Equilibrium of finite phases - Equation of Thomson -Gibbs - Types of nucleation - Formation of critical nucleus - Classical theory of nucleation - Homo and heterogeneous formation of 3D nuclei - Rate of nucleation - Growth from vapor phase, solutions and melts - Epitaxial growth - Growth mechanism and classification - Kinetics of growth of epitaxial films - Mechanisms and controls for nanostructures in zero and one dimensions.

UNIT II: CRYSTALLIZATION PRINCIPLES AND GROWTH TECHNIQUES

Classes of crystal system - Crystal symmetry - Solvents and solutions - Solubility diagram - Super solubility - Expression for super saturation - Metastable zone and induction period - Miers T-C diagram - Solution growth - Low and high temperatures solution growth - Slow cooling and solvent evaporation methods - Constant temperature bath as a crystallizer.

UNIT III: GEL, MELT AND VAPOR GROWTH TECHNIQUES

Principle of gel technique - Various types of gel - Structure and importance of gel - Methods of gel growth and advantages - Melt technique - Czochralski growth - Floating zone - Bridgman method - Horizontal gradient freeze - Flux growth - Hydrothermal growth - Vapor-phase growth - Physical vapor deposition - Chemical vapor deposition - Stoichiometry.

UNIT IV: THIN FILM DEPOSITION TECHNIQUES

Vacuum evaporation - Hertz-Knudsen equation - Evaporation from a source and film thickness uniformity - E-beam, pulsed laser and ion beam evaporations - Glow discharge and plasmas - Mechanisms and yield of sputtering processes - DC, rf, magnetically enhanced, reactive sputtering - Spray pyrolysis - Electro deposition - Sol-gel technique.

UNIT V: CHARACTERIZATION TECHNIQUES

X-ray diffraction - Powder and single crystal - Fourier transform infrared analysis - Elemental dispersive X-ray analysis - Transmission and scanning electron microscopy - UV-vis-NIR spectrometer - Chemical etching - Vickers micro hardness - Basic principles and operations of AFM and STM - X-ray photoelectron spectroscopy for chemical analysis - Ultraviolet photoemission spectroscopy analysis for work function of the material - Photoluminescence – Thermoluminescence.

BOOKS FOR STUDY AND REFERENCE:

1. Crystal Growth for Beginners: Fundamentals of Nucleation, Crystal Growth and Epitaxy, I.V. Markov, (2004)
2. Crystal Growth Process and Methods, P.Santhanaragavan and P. Ramasamy, KRU Publications, Kumbakonam, (2001).
3. Thin Film Fundamentals, A. Goswami, New Age, New Delhi, (2008).
4. Instrumental Methods of Analysis, H.H. Willard, L.L.Meritt, J.A. Dean, F.A. Sette, CBS Publishers, New Delhi, (1986).
5. Materials Characterization Techniques, S. Zhang, L. Li and A. Kumar, CRC Press, Bota Racon, (2009).
6. Crystal Growth Process, J.C. Brice, John Wiley, New York, (1986).
7. Materials Science of Thin Films, M. Ohring, Academic Press, Boston, (2002)
8. Characterization of Materials, Volume-I, E. N. Kaufmann, John Wiley, New Jersey, (2012).

LIST OF EXTRA DISCIPLINARY COURSES (EDC)

EDC PAPER I - ENERGY PHYSICS (21PHEDC)

UNIT I: INTRODUCTION TO ENERGY SOURCES

Energy sources and their availability - Types of energy sources - World energy futures - Prospects of renewable energy sources - Measurement and estimation of solar radiation.

Use of nanostructures and nanomaterials in fuel cell technology - Outline of solar cell developments - Physical sources of sunlight -Types of solar energy converter - Solar energy measuring instruments.

UNIT II: SOLAR CELLS

Solar cells for direct conversion of solar energy to electric powers - Solar cell parameter - Solar cell electrical characteristics - Efficiency - Single crystal silicon solar cells - Polycrystalline silicon solar cells - Concepts of quantum dot solar cells - Dye sensitized solar cell - Organic solar cells - hybrid solar cell - Cadmium sulphide solar cells - other types of advanced solar materials and solar cell devices.

UNIT - III: SOLAR ENERGY - APPLICATIONS

SOLAR HEATERS: Types of solar water heater - Solar heating system - Collectors and storage tanks - Solar ponds - Solar cooling systems. Solar distillation - Solar pumping - Solar furnace - Solar cooking - Solar green house.

UNIT - IV: WIND ENERGY

Wind energy - basic principle and components of wind energy conversion system - types of wind machines - scheme of electric generation-applications of wind energy-Hydrogen energy - hydrogen production - storage-utilization of hydrogen gas-hydrogen as an alternative fuel for motor vehicles - safety and management.

UNIT - V: BIOMASS ENERGY

Biomass conversion Technologies - wet and dry process - Photosynthesis.

Biogas Generation: Introduction - basic process and energetic - methods for maintaining biogas production - advantage of anaerobic digestion.

Classification of Biogas plants: continuous and batch type - the dome and drum types of Biogas plants - biogas from waste fuel - properties of biogas - utilization of biogas.

BOOKS FOR STUDY & REFERENCE:

1. Energy - An Introduction to Physics - R.H.Romer, W.H.Freeman. (1976)
2. Principles of Solar Engineering - Kreith and Kreider, McGraw Hill Pub, 1978.
3. Applied Solar Energy, A.B.Meinel&A.P.Meinel, Addison Wesley Publishing Co.(1976).
4. Solar Energy, M.P.Agarwal, S. Chand and Co., New Delhi (1983).
5. Non-Conventional Energy Sources, G.D.Rai, Khanna Publications, Delhi (2009).
6. Renewable Energy Resources-John Twidell &Tony Weir,Taylor & Francis Group,2006.
7. The Physics of Solar Cells by Jenny Nelson (Published by Imperial college press)
8. Solar Energy utilization - G.D. Rai - Khanna Publishers - Delhi 1987.
9. Solar Energy, G.N.Tiwari, Narosa Publishing House, New Delhi (2008)

EDC PAPER II - NANO SCIENCE (21PHEDC)

UNIT - I: INTRODUCTION TO THE NANOWORLD

Introduction - Historical perspective on Nanomaterial - Classification of Nano materials - Quantum mechanics of low dimensional systems - Bound states and density of states: 3D, 2D, 1D and 0D - Quantum confinement - Quantum wells, wires and dots - size dependent properties - Mossbauer effect - surface Plasmon resonance - single electron tunnelling.

UNIT - II: METALS, SEMICONDUCTORS AND CERAMICS NANOCRYSTALS

Reduction of size - Synthesis of metal nanoparticles and structures - Routes to arrangements - Background on Quantum Dot semiconductors-background on reverse Micellar solution - Synthesis of Semiconductors - Cadmium Telluride Nano crystals - Cadmium sulfide Nano crystals - Alloy Semiconductors - Chemical, Physical and Mechanical properties of Ceramics.

UNIT - III: NANO PARTICLES AND MAGNETISM

Magnetism in particles of reduced size and dimensions - Single domain particles and superparamagnetism - magnetism in clusters of non-magnetic solids - magnetic behaviour of small particles - diluted magnetic semiconductors (DMS)-Intermetallic compounds - Importance of nanoscale magnetism.

UNIT - IV: CHEMICAL AND CATALYTIC ASPECTS OF NANOCRYSTALS

Nano materials in Catalysis - Nanostructured Adsorbents - Nanoparticles as new Chemical reagents - Specific Heat of Nano crystalline materials - melting points of Nanoparticle materials.

UNIT - V: APPLICATION OF NANOMATERIALS

Molecular Electronics and Nano electronics, Nano boats, Biological applications, band gap engineered quantum devices - Nano mechanics - carbon nanotube emitters, photo electro chemical cells - photonic crystal and Plasmon wave guides - Structural and Mechanical materials - Colorants and Pigments.

BOOKS FOR STUDY & REFERENCE:

1. Nanoscale Materials in Chemistry - Kenneth J.Klabunde, A John Wiley & Sons, Inc., Publication (2009).
2. Nanoscience and Nanotechnology: Fundamentals to Frontiers - M.S.Ramachandra Rao, Shubra Singh, Wiley (2013).
3. Introduction to Nanotechnology - Charles P.Poole, Frank J. Owens, Wiley - India, 2009.
4. Nanostructures and Nanomaterials synthesis, properties and applications – Guozhong Gao, Imperial College Press, London (2004).
5. Introduction to Magnetism and Magnetic Materials - D.Jiles, Chapman and Hall, London (1991).

EDC PAPER III - MEDICAL PHYSICS (21PHEDC)

UNIT I: BIOELECTRIC SIGNALS & TRANSDUCERS

Bioelectric Signals - Electrodes - Surface, Needle and Micro Electrodes - Biosensors - Pulse Sensors. Thermistors - Photo electric type – Transducer - Photo voltaic Cells - Photo emissive Cells - Diode-Detectors - Optical Fibers.

UNIT II: BLOOD PRESSURE MEASUREMENTS

Sphygmomanometer: Measurement of heart rate - Basic Principles of ECG - Management of respiratory motion - Basic Principles of Electroneurography (ENG).

UNIT -III: MAGNETIC RESONANCE IMAGING

Magnetic Resonance Imaging (MRI): Basic Principles of 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.

UNIT IV: X-RAYS

Basic of X-ray - Production of X-ray - X-ray Image - Applications of X-ray Examinations - Basic Principles of X-ray Tomography.

Interaction of gamma rays and X-rays with matter-types of interaction with matter - over all interaction of photons with matter.

UNIT V: THERMOGRAPHY

Endoscopes – Thermography - Liquid Crystal thermography - Microwave thermography - Basic Principles of Ultrasonography – Laser - Uses of Lasers in Medicine.

BOOKS FOR STUDY & REFERENCE:

1. Biomedical Instrumentation, Dr. M. Arumugam, Anuratha Agencies (2002).
2. Hand book of Biomedical Instrumentations, R.S. Khandpur, TMG, New Delhi (2005).
3. Bio-Medical Electronics and Instrumentation, K.Venkata Ram, Galgotia Publications, New Delhi (2001).

EDC PAPER IV - ELECTRONIC APPLIANCES (21PHEDC)

UNIT I: ELECTRONIC COMPONENTS

Components - Resistors - Condensers - Resistance Value - Capacitor Value - Diodes – transistors - IC's - Transformers and their classification.

UNIT II: ELECTRICAL APPLIANCES

Electrical Bulbs - Florescent Lamps - Inverter - Basic of UPS - Stabilizers - Voltage regulators - Iron Box - Heaters - Electrical Oven - Wet Grinder - Mixer - Refrigerators - Air Conditioners - Freezers - Washing Machines.

UNIT III: ELECTRONIC APPLIANCES

Basics of Radio – TV - CD Players - LCD Projectors - Digital Camera - Scanners - Video Conferencing.

UNIT IV: COMPUTERS

Block diagram of a Computer - Input Device - Memory Device - Control Unit - Arithmetic logic unit - Output device - Microprocessor - RAM - ROM.

UNIT V: COMMUNICATION ELECTRONICS

Basics of Telephones - Mobile Phones - Wireless Phones – Antenna – Internet - Satellites.

BOOKS FOR STUDY & REFERENCE:

1. S. S. Kamble, Electronics & Mathematical Data Book, Allied Publishers Ltd., (1997).
2. William David Cooper, Electronic Instrumentation and Measurement Technique, Second Edition, Prentice Hall, New Delhi (2007).

MODEL QUESTION PAPER PATTERN
M.Sc., PHYSICS DEGREE EXAMINATION
FIRST SEMESTER
CLASSICAL MECHANICS, THERMODYNAMICS & STATISTICAL MECHANICS

Time: 3 Hours Maximum: 75 Marks

Part – A (15 x 1 = 15 Marks)

Answer **ALL** the questions

Choose the Correct Answer:

1. For a conservative system, the potential energy does not depend upon
   a. force b. generalized velocity c. generalized coordinates d. all of above
2. The number of degrees of freedom for N particles with k constraint relations is
   a.3N-3k b.3N+k c. 3N-k d. k-3N
3. If the Lagrangian of a system does not depend on time explicitly, then
   a. Hamiltonian is conserved b. Hamiltonian cannot be constant
   c. Potential energy is constant d. Kinetic energy is constant
4. The action and angle variables have the dimension of
   a. energy and angle b. force and angle
   c. angular momentum and angle d. are dimensionless quantities
5. Which of the following theory provides a powerful tool to study the motion of periodic systems?
   a. Hamilton's theory b. Hamilton-Jacobi theory
   c. Lagrange theory d. principle of least action
6. For a transformation to be canonical
   a. Poisson bracket changes sign b. Poisson bracket becomes equal to unity
   c. Poisson bracket becomes zero d. Lagrange and Poisson brackets remain invariant
7. The transformation for body set of axes to space set of axes is an
   a. an orthogonal b. not an orthogonal c. unitary d. sometimes orthogonal
8. If a rod of 1 metre length is moving along its length with a velocity 0.6c, then length of the rod as it appears to an observer on the earth is
   a. 0.7m b. 0.8m c. 0.8 cm d. 0.2m
9. The most general displacement of a rigid body is
   a.translational b.rotational
   c.translational and rotational d.translational and vibrational
10. In a Carnot cycle, the algebraic sum of the entropy changes for the cycle is
    a. always positive b. always less than unity
    c. always zero d. either zero or less than that
11. If ρ is density of phase points in phase space, then $\partial\rho/\partial t = 0$ is called
    a.Einstein's theorem b.Liouville's theorem
    c.Maxwell's theorem d.none of these
12. Phase space means superposition of
    a. all momentum spaces b. all position spaces
    c. position and momentum space d. volume elements
13. Pauli's exclusion principle not applies to
    a. B-E Statistics b. F-D Statistics c. Classical Statistics d. both a and c

14. At short wavelength, Planck's radiation formula reduces to
a.Wien's law b.Stefan's law c.Rayleigh-Jean's law d.Kirchoff's law
15. Only one phase point can cccupy one phase cell according to
a. Classical Statistics b. Bose-Einstein Statistics
c. Fermi-Dirac Statistics d. All of these

Part - B (2 x 5 = 10 Marks)

Answer Any TWO Questions out of FIVE
All Questions carry equal marks.

16. Derive D'Alemberts principle using principle of Virtual work.
17. What are the Poisson's and Lagrange's brackets? Show that Lagrange's bracket is invariant under Canonical transformation.
18. A particle of rest mass m_o moves with speed $C/\sqrt{2}$.
Find i). its mass ii). its momentum iii). Total energy iv). its kinetic energy
19. Starting from B-E distribution law, derive Planck's law of black body radiation.
20. State the basic assumptions on which the classical, Fermi-Dirac and Bose-Einstein statistics are developed.

PART-C (5 x 10 = 50 Marks)

Answer **ALL** the questions
All Questions carry equal marks.

21. a). Derive Lagrange's equations from D'Alemberts Principle.

(OR)

b). State and prove the principle of Least action.

22. a). What are Canonical transformations? Discuss how the transformation equations can be obtained from generating functions of type F_1 and F_2.

(OR)

b). State and prove Hamilton-Jacobi equation for Hamilton's principal function and explain how it can be used to solve Kepler's problem for a particle in an inverse square central force field.

23. a). Derive the Lorentz space-time transformation formula. Discuss the length contraction and time dilation.

(OR)

b). Derive Euler's equations of motion of a rigid body. Hence show that for a torque free rotational motion of a symmetric body, the magnitude of the angular velocity is constant.

24. a). Derive the Maxwell-Boltzmann distribution law and obtain expressions for the most probable energy and most probable speed of a gas molecule.

(OR)

b). Derive Maxwell's four fundamental thermodynamical relation.

25. a). Deduce Fermi-Dirac distribution law. Hence obtain an expression for the energy of a Fermi gas at absolute zero and point out its physical significance.

(OR)

b). Explain the term Degeneracy and B-E Condensation. Bring out clearly the essential differences between Bose-Einstein and Fermi-Dirac Statistics.

MODEL QUESTION PAPER PATTERN
M.Sc., PHYSICS DEGREE EXAMINATION
FIRST SEMESTER
ELECTRONICS

Time: 3 Hours Maximum: 75 Marks

PART–A (15 x 1 = 15 Marks)

Answer **ALL** the questions

Choose the Correct Answer:

1. An ---------- is a set of electronic circuits on one small flat piece of semiconductor.
   a). Integrated circuits b). Transistor c). Diode d). UJT
2. Which of the following is most difficult to fabricate in an IC?
   a).Diode b).Transistor c).FET d). Capacitor
3. An UJT has _____
   a). Two P-N junction b). One P-N junction
   c). Three P-N junction d). Four P-N junction
4. The most popular form of IC package is -----
   a).DIL b). Flat pack c).T 0-5 d). none of the above

5.cannot be fabricated on an IC.
   a).Transistor b). Diodes c). Resistor d). large inductors and transformers

6. Metallization is used for
   a). Inter connection b). production c). packaging d). Etching
7. Which is not the internal circuit of an Operational amplifier
   a).Differential amplifier b). level transistor c). output driver d). clamper
8. How a triangular wave generator is derived from square wave generator?
   a). connect oscillator at the output b).connect voltage follower at the input
   c).connect differentiator at the output d).connect integrator at the output

9. Name the filter that has two stop bands
   a).Band pass filter b).Low pass filter c).High pass filter d). Band reject filter

10.If Q=0, the output is set to be _____
   a).set b).reset c).previous state d). current state

11.Mod 5 Synchronous counter is designed using J-K flip flops, the number of count skipped by it will be
   a). 2 b). 3 c). 5 d). 0

12.A BCD counter has
   a).3 distinct states b).8 distinct states c). 10 distinct state d).16 distinct states

13.Which of the following memories are non volatile memories?
   a).ROM b). PROM c). Ferrite core memory d). none of the above

14.RAM is also known as
   a).RWM b). PROM c). EAROM d). EPROM

15. PROM are available in
   a).Bipolar version only b). MOS version only
   c). both Bipolar and MOS version d). None of the above

PART-B (2 x 5 = 10 Marks)

Answer Any **TWO** Questions out of FIVE
All Questions carry equal marks.

16. The collector current of a transistor is 100 mA and its β is 75. Calculate the value of base current and emitter current.

17. Describe the fabrication of monolithic diodes.

18. Explain the construction and working of a Triangular wave generator using Op- amp.

19. Assume that the reverse gate voltage of JFET changes from 5.0 V to 4.9 V and the drain current changes from 1.2 mA to 1.5 mA. What is the value of transconductance?

20. Define flip flop. Explain the function of a J-K flip flop with circuit diagram.

PART - C (5 x 10 = 50 Marks)

Answer **ALL** the questions
All Questions carry equal Marks.

21. a). Explain the UJT Relaxation oscillator with necessary diagram.

(OR)

b). What are the characteristics of JFET? Explain it with diagram.

22. a). Briefly explain the fabrications of monolithic IC's.

(OR)

b). Explain the operation of an astable multivibrator with necessary circuit diagram using IC-555 timer.

23. a). Explain the working of 4-bit R-2R ladder network D/A converter with an op-amp circuit.

(OR)

b).Solve the second order differential equation using Op-amp.

24. a). Explain in detail on the operation of basic phase locked loop.

(OR)

b).Explain the principle and operation of Read and Write memory.

25. a).Draw the block diagram of up/down counter and explain its functions.

(OR)

b).Design half adder and full adder circuits using gates and verify their truth tables.

MODEL QUESTION PAPER PATTERN
M.Sc., PHYSICS DEGREE EXAMINATION
THIRD SEMESTER
ELECTROMAGNETIC THEORY & PLASMA PHYSICS

Time: 3 Hours Maximum: 75 Marks

PART–A (15 x 1 = 15 Marks)

Answer **ALL** the questions

Choose the Correct Answer:

1. When the distance between two charged particles is halved, the force between them becomes a. one-fourth b. one-half c. double d. four times
2. The flux density is related to polarization and electric field intensity by the relation
   a. D = E-P b. D =ε_0E + P c. D = E + P d. D = ε_0P + E
3. The outward flux of E through any closed surface S is equal to
   a. net charge inside b. $1/\varepsilon_0$ times the net charge inside
   c. ε_0 times the net charge inside d. none of these
4. The dielectric constant of a material at optical frequencies is mainly due to
   a. ionic polarizability b. electronic polarizability
   c. dipolar polarizability d. ionic and dipolar polarizability
5. The magnetic field at a point due to a elemental conductor carrying current at a distance r from the element is given by
   a. Faraday's law b. Ampere's law c. Coulomb's Law d. Biot-Savart's law
6. Maxwell using the concept of displacement current modified which of the following laws
   a. Faradays law b. Gauss law c. Ampere's law d. Biot-Savart's law
7. The Poynting theorem is a mathematical statement of the conservation of
   a. momentum b. charge c. electromagnetic energy d. current
8. The displacement current arises due to
   a. positive charges only b. negative charges only
   c. time varying electric field d. both positive and negative charges
9. Magnetic induction vector is equal to a.div A b. curl A c. grad A d. div B
10. The field of magnetic vector B is always
    a. irrotational b. non-solenoidal c. solenoidal d. rotational
11. Magnetic induction $\vec{B}$ at a point (r,θ,ϕ) due to an oscillating dipole_____
    a. varies as $\frac{1}{\sin\theta}$ b. varies as $\sin\theta$ c. varies as $\sin^2\theta$ d. varies as $\frac{1}{sin^2\theta}$
12. In terms of electromagnetic potentials (A and ϕ) the field vectors E and B are given by
    a. B=Curl A and E=-grad $\phi + \partial A/\partial t$ b. B=-Curl A and E=grad $\phi+\partial A/\partial t$
    c. B=Curl A and E=grad $\phi - \partial A/\partial t$ d. B= Curl A and E=-grad $\phi-\partial A/\partial t$
13. The power radiated by an electric oscillating dipole is proportional to the frequency given by a. ω b. ω^2 c. ω^3 d. ω^4
14. The ratio of magnitude of electric field intensity to the magnitude of magnetic field intensity is called
    a. attenuation constant b. phase constant
    c. extrinsic impedance d. intrinsic impedance

15. Plasma is created by Magnetic fields which is known as…
    a.stable state b.shifted state c.metastable state d.all of above

PART-B (2 x 5 = 10 Marks)

Answer Any **TWO** Questions out of FIVE
All Questions carry equal marks.

16. A region is specified by the potential function given by $V = 2x^2+5y^2-3z^2$. Calculate the electric field strength at point (2,3,4) in this region.
17. State and explain Biot-Savart law.
18. Derive Maxwell's equations in differential form from the integral form.
19. A specimen of iron is uniformly magnetized by a magnetizing field of 500 A/m. If the magnetic induction in the specimen is 0.2 Wb/m^2, find the relative permeability and the susceptibility.
20. Write the properties of Plasma. Discuss about the principles of Plasma generation.

PART - C (5 x 10 = 50 Marks)

Answer **ALL** the questions
All Questions carry equal Marks.

21. a). Explain the Electronic polarisation, Orientational polarization and Ionic Polarisation. Write down the Clausius-Mossotti relation connecting the quantity with the dielectric constant of the material.

(OR)

b). Establish Gauss's theorem for an electrostatic field. Deduce Laplace and Poisson's equations.

22. a). State and Prove Ampere's Circuital law.

(OR)

b). Derive an expression for magnetic scalar potential and magnetic vector potential.

23. a). Write down Maxwell's equations in differential and integral forms and explain their physical meaning.

(OR)

b). Obtain the Poynting's theorem for conservation of energy in an electromagnetic field. Discuss significance of Poynting's vector.

24. a). Using of the Maxwell's field equations, derive the equation for plane electromagnetic waves in free space.

(OR)

b). Derive expressions for electric and magnetic field due to an Oscillating dipole. Calculate the total power radiated by it.

25. a). Explain how the hazardous wastes are removed?

(OR)

b). Discuss about Plasma reactors for surface treatment.

MODEL QUESTION PAPER PATTERN
M.Sc., PHYSICS DEGREE EXAMINATION
FOURTH SEMESTER
CORE-X: NUCLEAR & ELEMENTARY PARTICLE PHYSICS

Time: 3 Hours Maximum: 75 Marks

PART–A (15 x 1 = 15 Marks)

Answer **ALL** the questions

Choose the Correct Answer:

1. According to Nuclear collective model, the shape and quadrupole moment of odd-odd nuclei are respectively
   a. spherical and finite b. non-spherical and finite
   c. non-spherical and zero d. spherical and zero
2. An element has binding energy 8 eV per nucleon. If it has total binding energy of 128 eV, then the no. of nucleons are a. 32 b. 16 c. 64 d. 8
3. The empirical formula for the nuclear radius is
   a. $R=r_o A^{-2/3}$ b. $R = r_o A^{1/3}$ c. $R=r_o A^{2/3}$ d. $R = r_o A^{-1/3}$
4. The exchange of _____is responsible for the nuclear binding force.
   a. pions b. kaons c. neutrinos d. all of these
5. The binding energy of the deuteron is
   a. 2.224 MeV b. 2.224 eV c. 22.24 MeV d. nota
6. Nuclear force is
   a. short range and charge dependent b. long range and charge dependent
   c. short range and charge independent d. long range and charge independent
7. What is the particle 'Y' in the given nuclear reaction?
   $_4Be^9 + _2He^4 \text{----------} ^6C^{12} + Y$
   a. electron b. positron c. proton d. neutron
8. The chain reaction can be set up only if the mass of the fissionable material is
   a. equal to the critical mass b.greater than the criticial mass
   c. less than the critical mass d.nota.
9. Cadmium rods are used in a nuclear reactor for
   a. speeding up slow neutrons b. absorbing protons
   c. slowing down fast neutrons d. absorbing neutrons
10. The theory which explain continuous β ray spectrum is
    a. Wheeler's theory b. Bohr theory
    c. Koufmann theory d. Fermi theory
11. Cyclotron is used to accelerate
    a. electrons only b. positive ions only
    c. neutrons only d. both positive and negative ions
12. The machine in which frequency of electric field is constant and magnetic field is varied is called
    a. betatron b. cyclotron c. proton synchrotron d. synchrotron

13. The elementary particles having mass more than the nucleons are called
    a. neutrons b. photons c. hyperons d. mesons
14. The formation of electron-positron pair from gamma ray is an example of
    a. weak interaction b. strong interaction
    c. electro-magnetic interaction d. gravitational interaction
15. Which of the elementary particle as believed to contain three identical '**s**' quarks? a. omega hyperons b.pions c.Kaons d.baryons

PART-B (2 x 5 = 10 Marks)

Answer Any **TWO** Questions out of FIVE
All Questions carry equal marks.

16. Calculate the Binding energy of an alpha particle and express the result both in MeV and joules.
17. Calculate the energy released in nuclear fusion of a single helium nucleus formed by the fusion of two deuterium nuclei.
18. Explain the energy balance and Q value in a Nuclear reactions.
19. Write a note on K-electron capture.
20. Give an account of fundamental interactions between elementary particles.

PART - C (5 x 10 = 50 Marks)

Answer **ALL** the questions
All Questions carry equal Marks.

21. a). Describe the liquid drop model of the nucleus. How can the semi-empirical mass formula be derived from it.

(OR)

b). (i). Explain the features of nuclear Shell model.
(ii). Explain why electrons cannot be present inside nucleus.

22. a). Write the characteristic properties of nuclear forces.
Discuss the Meson theory of Nuclear forces.

(OR)

b). Discuss the construction and working of Bainbridge and Jordan Mass Spectrograph.

23. a). Discuss the principle and construction of a nuclear reactor.

(OR)

b). Derive Breit and Wigner dispersion formula.

24. a). Explain the Gamow's theory and tunneling effect of alpha decay.

(OR)

b). Describe a GM Counter. Explain its working. What are its advantages & disadvantages?

25. a). State and explain the various conservation laws governing the elementary particles.

(OR)

b). Explain the classification of elementary particles according to (i). interactions (ii). mass. Write a notes on anti-particles.

MODEL QUESTION PAPER PATTERN
M.Sc., PHYSICS DEGREE EXAMINATION
FIRST SEMESTER / SECOND SEMESTER
ELECTIVE COURSE: MICROPROCESSORS AND MICROCONTROLLER

Time: 3 Hours Maximum: 75 Marks

PART–A (15 x 1 = 15 Marks)

Answer **ALL** the questions

Choose the Correct Answer:

1. MOV A,C is executed by
   a) 1 machine cycle b) 2 machine cycles c) 3 machine cycles d) 4 machine cycles
2. The Compiler is
   a) faster than interpreter b) slower than interpreter
   c) an interpreter d) a single-step process
3. The 8085 has_____segments.
   a) 6 memory b) 8 memory c) 4 memory d) 10 memory
4. XCHG is a/an
   a) data transfer instruction b) arithmetic instruction
   c) logical instruction d) I/O and stack instruction
5. IN 00H is an instruction of
   a) direct addressing b) indirect addressing
   c) register addressing d) immediate addressing
6. When a CALL instruction is executed, the stack pointer register is
   a) decremented by 2 b) incremented by 2 c) decremented by 1 d) incremented by 1
7. The 8086 has a
   a) 16-bit data bus and 20-bit address bus b) 8-bit data bus and 20-bit address bus
   c) 16-bit data bus and 16-bit address bus d) 8-bit data bus and 16-bit address bus
8. The segment memory capacity of 8086 is
   a) 1 MB b) 64 KB c) 2MB d) 4 MB
9. The 16-bit register of 8086 consists of
   a) 16 flags b) 8 flags c) 9 flags d) 7 flags
10. The 8051 Microcontroller has
    a) 32 pins for I/O b) 24 pins for I/O c) 16 pins for I/O d) 8 pins for I/O
11. The 8051 Microcontroller has
    a) 128 bytes of on-chip ROM b) 256 bytes of on-chip ROM
    c) 228 bytes of on-chip ROM d) 556 K bytes of on-chip ROM
12. Which of the following instructions is not a logical instruction?
    a) ANL A, #FF b) CPL A c) INC A d) SWAP A
13. A D/A converter's full scale output voltage is 10V and it's accuracy is +0.4%. The maximum error of DAC will be
    a) 20mV b) 30mV c) 40mV d) none of these
14. A digital instrument is used to measure analog voltage and display it in 7- segment display devices. The instrument has
    a) an ADC at input and DAC at the output b) an ADC at input
    c) an DAC at input d) an ADC at output
15. The number of pins in 8255 is
    a) 14 b) 32 c) 16 d) 40

PART-B (2 x 5 = 10 Marks)

Answer Any TWO Questions out of FIVE

All Questions carry equal marks.

16. Explain the interrupt process and the difference between a maskable and non-maskable interrupt
17. Give the operation of the following Intel 8085 instructions.
    a). MOV b). SBB c). NOP d). RAR e). MVI
    f). CMP g). ANI i). JMP j). RST k). RET
18. What are the differences of 8085 and 8086 Microprocessors?
19. Explain the data transfer instruction in 8051 Microcontroller
20. Explain DMA Controller (8257).

PART-C (5 x 10 = 50 Marks)

Answer **ALL** the questions

All Questions carry equal Marks.

21. a) Explain the architecture of 8085 Microprocessor.

(OR)

b) Discuss about the hardware and software interrupts.

22. a) Explain the arithmetic and logical instructions of 8085 Microprocessor.

(OR)

b) Discuss the addressing modes of 8085 Microprocessor.

23. a) Explain the register data and immediate addressing modes of 8086.

(OR)

b) Enumerate the segment and flag registers with diagram.

24. a) Explain the architecture of 8051 Microcontroller.

(OR)

b) Describe the logical instruction set of 8051 with examples.

25. a) Explain the interfacing of 8255 with neat block diagram.

(OR)

b) Explain the A/D converter using 0809.

MODEL QUESTION PAPER PATTERN
M.Sc., PHYSICS DEGREE EXAMINATION
THIRD SEMESTER / FOURTH SEMESTER
ELECTIVE COURSE: PHYSICS OF NON-CONVENTIONAL ENERGY RESOURCES

Time: 3 Hours Maximum: 75 Marks

PART–A (15 x 1 = 15 Marks)

Answer **ALL** the questions

Choose the Correct answer:

1. The high energy yield ratio is called_____energy sources.
   a).primary b).secondary c).supplementary d). all of the above
2. Solar energy, wind energy and water energy are _____energy sources.
   a).primary b). secondary c). supplementary d).all of the above
3. The increase in population and standard of living causes_____crisis.
   a).financial b).energy c).water d).energy and water
4. Three types of solar_____are pressurized, non-pressurized and forced circulation.
   a).water heating b). water cooling c). space heating d). space cooling
5. Space heating are of two types, namely_____and_____.
   a).active and passive b). normal and moderate
   c). collector and detector d). none of the above
6. Two types of absorption air conditioners are_____ water and ammonia water.
   a). lithium bromide b). lithium fluoride c). lithium iodide d). all of the above.
7. The efficiency of the solar cells is _____
   a). 15% b). 20% c). 35% d). 50%
8. _____cell is the source of energy for satellite.
   a).Solar b).Fuel c).Electric d).None of these
9. The current density of a photovoltaic ranges from_____.
   a).30-40 b). 40-50 c). 40-60 d). 60-70
10. The combination of wind turbine and generator is referred as_____.
    a). aerogenerator b). electric generator c). turbine d).none of the above
11. The cost of power generation from wind force is _____Diesel power.
    a).lower than b). higher than c). moderate d). equal to
12. Wind pattern at any particular site remain_____year by year.
    a).variable b). decrease c).increase d).constant
13. The term Bio-mass most often refers to_____.
    a). Inorganic matter b). Organic matter
    c). Chemicals d). Ammonium compounds
14. Bio-mass is useful to reduce_____.
    a).Chemicals b).Fibers c).Bio-chemicals d).Transportation fuels
15. Which one of the following is an example of starch crops biomass feed stocks
    a). sugar cane b). wheat straw c). corn stover d). orchard pruning

PART-B (2 x 5 = 10 Marks)

Answer Any TWO Questions out of FIVE

All Questions carry equal marks.

16. What are primary and secondary energy sources?
17. Describe briefly thermal electric conversion from solar energy.

18. What are difference between single crystal silicon solar cells and poly crystalline silicon solar cells?
19. Explain the components of wind electric systems with suitable diagrams.
20. Explain an aerobic digestion and its principle.

PART-C (5 x 10 = 50 Marks)

Answer **ALL** the questions

All Questions carry equal Marks.

21. a).What are the conclusion an alternate energy strategies?

(OR)

b).What are the conventional or non conventional energy sources? Describe briefly.

22. a).Design the principle and construction of a box type solar cooker?

(OR)

b).Briefly explain the principle and construction of a solar distillation?

23. a).Explain the principle and working of a single crystal silicon solar cells.

(OR)

b).Explain principle and working of a polycrystalline silicon solar cells.

24. a).Briefly explain the types of horizontal axis wind machine.

(OR)

b).Discuss the applications of Geothermal energy

25. a).Explain the process of photo synthesis. What are the conditions, which are necessary for it?

(OR)

b).How biogas plants are classified? Explain them briefly.

PRACTICAL MODEL QUESTION PAPER PATTERN

M.Sc PHYSICS DEGREE PRACTICAL EXAMINATION

SEMESTER: I

PRACTICAL – I – GENERAL PHYSICS EXPERIMENTS

Time: 4 Hours **Maximum Marks: 75**

GROUP A: OPTICAL PHYSICS & LASERS

1. Determine the Young's modulus of glass plate and Poisson's ratio of the given glass plate by forming Elliptical fringes.
2. Determine the velocity of Ultrasonic waves in the given liquid using Ultrasonic Interferometer. Also determine the Compressibility of the given liquid.
3. Determine the Refractive index of two liquids using Laser.
4. Determine (i) the thickness of Fabry-Perot Etalon
   (ii) the change in wavelength for shift of one fringe and
   (iii) the change in wavelength of a satellite line associated with a main line
5. Determine the permittivity of a liquid using R.F. Oscillator
6. Determine (i). Thickness of a wire (ii). Diameter of a circular aperture and (iii) Wavelength of He-Ne Laser/Diode laser using diffracting grating.
7. Determine the value of Rydberg's constant using Hydrogen Spectrum.
8. Determine the wavelength of a Laser by Michelson Interferometer.

GROUP B: THERMODYNAMICS, MODERN PHYSICS & SOLID STATE PHYSICS

9. Using the given experimental setup, determine the value of Stefan's constant.
10. Determine the Temperature coefficient and band gap energy of the given thermistor.
11. Determine the resistivity of a Semiconductor by Four Probe Method.
12. Determine the Susceptibility of a paramagnetic solution by Quincke's method.
13. Verify the Inverse square law using GM Counter.
14. Determine the following using Hall effect in Semiconductor:
    (i). Charge of the carriers (ii).Hall voltage
    (iii).Hall Coefficient (iv).Carrier density
15. Determine the magnetic susceptibility of solution at different concentrations using Gouy's Method.

PRACTICAL MODEL QUESTION PAPER PATTERN

M.Sc., PHYSICS DEGREE EXAMINATION

Semester – II

PHYSICS PRACTICAL II – ELECTRONICS EXPERIMENTS

Time: 4 Hours **Maximum Marks: 75**

GROUP A: ANALOG ELECTRONICS

1. Construct an JFET amplifier circuit, based on its output draw the characteristic curve.
2. Study the operation and characteristics of SCR and determine the forward break over voltage.
3. Construct a single stage RC coupled amplifier and study its frequency response.
4. Design adder and subtractor circuits using OPAMP and study their outputs for five different input voltages.
5. Design Schmitt Trigger circuit using IC 741 and study its function.
6. Study the Photo Transistor characteristics behavior using suitable circuit.
7. Construct a Relaxation Oscillator using the given UJT and determine the frequency of oscillations.
8. Construct a monostable multivibrator using IC 555 and measure the pulse width for different R and C values. Also, Construct and study the behaviour of bistable multivibrator using IC 555 timer.

GROUP B: DIGITAL ELECTRONICS

9. Using NAND gates, construct a half-adder and full-adder circuit and verify its outputs.
10. Construct the BCD counter circuit and verify its operation.
11. Construct Flip flops – RS, JK, Master Slave and T flip flops and study their performance.
12. Study the function of Multiplexer and Demultiplexer using suitable circuit.
13. Using suitable circuit, show the output of a Decoders and Encoders.

PRACTICAL MODEL QUESTION PAPER PATTERN

M.Sc PHYSICS DEGREE EXAMINATION

Semester – III

CORE PRACTICAL - III – MICROPROCESSOR PROGRAMMING EXPERIMENTS

Time: 4 Hours **Maximum Marks: 75**

GROUP A: 8085 MICROPROCESSOR PROGRAMMING EXPERIMENTS

1. Write and execute the 8-bit Addition and Subtraction programs in 8085 microprocessor
2. Write and execute the Number conversion programs BCD to Binary and Binary to BCD
3. Write and execute the program for Factorial of a given number
4. Write and execute the program for largest and smallest number in a set of numbers
5. Write and execute the programs for interfacing of DAC with 8085 microprocessors to generate square, saw tooth and triangular waves
6. Write and execute the program for Traffic Light Control Interface with 8085 microprocessor
7. Write and execute the program for design of digital Clock using 8085 microprocessor
8. Write and execute the program for sum of 'n' numbers using 8085 microprocessor
9. Write and execute the program for program to reverse the given string using 8085 microprocessor

GROUP B: 8086 MICROPROCESSOR PROGRAMMING EXPERIMENTS

10. Write and execute the program for largest and smallest number in a set of numbers
11. Write and execute the program for searching a number or character in a string
12. Write and execute the program to determine the sum of elements in an array

PRACTICAL MODEL QUESTION PAPER PATTERN

M.Sc PHYSICS DEGREE EXAMINATION

Semester - IV

CORE PRACTICAL – IV - MICROCONTROLLER & C++ PROGRAMMING EXPERIMENTS

Time: 4 Hours **Maximum Marks: 75**

Group A: 8051 MICROCONTROLLER PROGRAMMING

1. Write and execute the 16-bit Addition and Subtraction programs in 8051 microcontroller
2. Write and execute the program for largest and smallest number in a set of numbers
3. Write and execute the program for generation of square, triangular, saw tooth waves
4. Write and execute the program for Code conversion programs - Micro Controllers
5. Write and execute the program for interfacing Stepper motor control using Microcontrollers
6. Write and execute the program for interfacing Seven segment display using Microcontrollers

Group B: C++ PROGRAMMING

7. Write a C++ programme for Matrix multiplication
8. Write a C++ programme to find Eigen values of a given matrix
9. Write a C++ programme to find the transpose and inverse of a matrix
10. Write a C++ programme to find the straight line fit by the method of least squares
11. Write a C++ programme to find the Numerical integration by Simpson's rules and Trapezoidal rule
12. Write a C++ programme to find the solution of differential equation by Fourth order Runge-Kutta Method