PERIYAR UNIVERSITY
PERIYAR PALKALAI NAGAR
SALEM – 636 011

DEGREE OF MASTER OF SCIENCE

M.Sc. PHYSICS

CHOICE BASED CREDIT SYSTEM

REQULATIONS AND SYLLABUS

(FOR THE CANDIDATES ADMITTED FROM THE ACADEMIC YEAR 2017– 2018 ONWARDS)

1. OBJECTIVES OF THE COURSE

The recent developments in Physical Sciences had 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 thereto 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 (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 96 Credits.The break-up of credits for the programme is as follows:

Core Courses	: 74 credits
Elective Courses	: 16 credits
Compulsory Course	: 2 credits
Extra Disciplinary Course	: 4 credits

6. STRUCTURE OF THE COURSE

Semester	Course	Course Title	Hours per week	Credit	Exam Hrs	Marks		
						Int.	Ext.	Total
I	Core Course - I	Classical and Statistical Mechanics	6	4	3	25	75	100
	Core Course - II	Mathematical Physics	6	4	3	25	75	100
	Core Course - III	Quantum Mechanics I	6	4	3	25	75	100
	Core Course - IV	Practical – I General Physics Experiments	6	6	4	25	75	100
	Elective Course - I	Elective – I	6	4	3	25	75	100
II	Core Course - V	Condensed Matter Physics	6	4	3	25	75	100
	Core Course - VI	Electronics	6	4	3	25	75	100
	Core Course - VII	Microprocessors and Microcontrollers	5	4	3	25	75	100
	Core Course - VIII	Practical – II Electronics Experiments	6	6	4	25	75	100
	Elective Course-II	Elective – II	5	4	3	25	75	100
	Human Rights	Human Rights	2	2	3	25	75	100
III	Core Course - IX	Electromagnetic Theory	5	4	3	25	75	100
	Core Course - X	Computational Methods and Programming	5	4	3	25	75	100
	Core Course - XI	Quantum Mechanics - II	5	4	3	25	75	100
	Core Course - XII	Practical -III Microprocessor, Microcontroller and Programming Experiments	6	6	4	25	75	100
	Elective Course-III	Elective - III	5	4	3	25	75	100
	EDC	Extra Disciplinary Course	4	4	3	25	75	100
IV	Core Course - XIII	Molecular Spectroscopy	5	4	3	25	75	100
	Core Course - XIV	Nuclear and Particle Physics	5	4	3	25	75	100
	Core Course - XV	Communication Electronics	5	4	3	25	75	100
	Elective Course - IV	Elective - IV	5	4	3	25	75	100
	Core Course - XVI	Project	10	8	-	-	-	200
		Total	**120**	**96**				**2300**

6. EXAMINATIONS

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 semester.

Distribution of marks:

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

External	:	75 Marks
Passing Minimum	:	38 Marks
Internal	:	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 2 tests)	:	5 Marks
2. End Semester Model Exam	:	10 Marks
3. Assignments	:	5 Marks
4. Seminar	:	5 Marks
TOTAL	:	**25 Marks**

(c) The following are the distribution of internal marks for practical papers.

1. Minimum 10 experiments	:	10 Marks
2. Model Exam	:	10 Marks
3. Attendance	:	5 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. 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	: 15 Marks
Circuit Diagrams / Diagrams	: 7 Marks
Observation-Tabulation and Readings	: 20 Marks
Calculations	: 15 Marks
Presentation	: 3 Marks
Result	: 5 Marks
TOTAL	**: 75 Marks**

Project:

Students are required to submit a dissertation (Project report) at the end of Semester - IV and also required to make presentation of the project work during viva voce Examination. The bifurcation of marks for project will be as follows:

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

7. QUESTION PAPER PATTERN

The following question paper pattern shall be followed for the candidates admitted from the academic year 2017 - 2018.

Time	: 3 Hours
Maximum	: 75 Marks

Section A – (10×1 = 10 Marks) – Answer all questions – 10 multiple choice questions with four options – 2 each from every unit.

Section B – (5×5 = 25 Marks) – Answer all questions – Either or Type – 5 questions – 1 each from every unit.

Section C – (5×8 = 40 Marks) – Answer all questions – Either or Type – 5 questions –1 each from every unit.

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 2017 – 2018, for students who are admitted to the first year of the course during the academic year 2017 – 2018 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	U	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 were credited

For a semester:

GRADE POINT AVERAGE [GPA] $= \Sigma_i C_i G_i / \Sigma_i C_i$

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

For the entire programme:

CUMULATIVE GRADE POINT AVERAGE [CGPA] $= \Sigma_n \Sigma_i C_{ni} G_{ni} / \Sigma_n \Sigma_i C_{ni}$

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

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 – 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	

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.

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 and affiliated to the Periyar University and earns has passed the Examinations as have been prescribed.

14. ELECTIVE COURSES

Elective courses will be chosen by the respective colleges from the list of Elective Papers.

List of Elective papers

1. Bio - electronics and Bio Sensors
2. Optoelectronic devices
3. Nano Physics
4. Energy Physics
5. Non Linear Dynamics
6. Materials Synthesis and Characterization
7. X- ray Crystallography and Bio-Physics
8. Ultrasonics and its applications

15. EXTRA DISCIPLINARY COURSES

The students from other postgraduate programmes 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 third semester.

List of Extra Disciplinary Courses

1. Electronic Appliances
2. Medical Physics
3. Geo Physics
4. Lasers and Applications

16. TRANSITORY PROVISION

Candidates who have undergone the Course of Study prior to the Academic Year 2017- 2018 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 2021 thereafter they will be permitted to take the Examination only under the Regulations in force at that time.

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I YEAR - I SEMESTER

CORE COURSE I : CLASSICAL AND STATISTICAL MECHANICS

UNIT - I : Lagrangian Formulation and Hamilton Principle

Mechanics of a system of particles: constraints of motion, generalized coordinates, D'Alembert's principle and Lagrange's Equations – dependent forces and the dissipation function – Applications of Lagrange's formulation linear harmonic oscillator – simple pendulum – isotropic oscillator – Calculus of variations – Hamilton's principle – Lagrange's equation from Hamilton's principle – Hamilton's canonical equations – Canonical equations from a variational principle – Principle of least action.

UNIT - II : Canonical Transformation and Hamilton - Jacobi Theory

Canonical transformation and its examples – Poisson's brackets – Equations of motion – Angular momentum – Poisson's Bracket relations – infinitesimal canonical transformation – Hamilton-Jacobi equations for principal and characteristic functions – the harmonic oscillator problem – Action-angle variables for systems with one-degree of freedom – The Kepler problem in action angle variables.

UNIT – III : Action angle, variable adiabatic invariance of action angle variable and relativity

Theory of small oscillations in Lagrangian formulation – normal coordinates – Vibrations of a linear tri-atomic molecule – Independent co-ordinates of rigid body – Ortho normal transformations – Eulerian angles – Eulerian theorem – Coriolis force – angular momentum and kinetic energy of a rigid body – the inertia tensor – principal axis transformation – Euler equations of motion – Torque free motion of rigid body – motion of a symmetrical top – Special theory of relativity – Lorentz transformations – Relativistic kinematics and mass – energy equivalence.

UNIT – IV : Classical Statistics

Phase space, micro canonical, canonical and grand-canonical ensembles – comparison of various ensembles – Liouville's Theorem, micro and macro states – Stirling's formula – Entropy in statistical mechanics – connection between statistical and thermodynamic quantities – Perfect gas in micro canonical ensemble – entropy of perfect gas and Gibbs' paradox. Ideal gas in canonical and grand canonical ensembles – comparison between ensembles.

UNIT –V : Quantum Statistics

Maxwell - Boltzmann statistics – Bose- Einstein quantum statistics – Fermi Dirac statistics– Bose Einstein gas – degeneracy and Bose Einstein condensation – Fermi Dirac gas – Electron gas in three dimensions – specific heat anamoly of metals and its solution – thermionic emission – Blackbody radiation and Planck's distribution law – Cluster expansion for a classical gas – virial equation of state – Van der Waals gas – Phase transition of second kind. Ising Model in one and two dimensions.

Books for Study and reference:

1. Classical Mechanics, H. Goldstein, C.Poole and J.Safko, Pearson Education Asia, New Delhi (2002).
2. Classical Mechanics of Particles and Rigid Bodies, K.C. Gupta, New Age International New Delhi (1997).
3. Classical Mechanics, S.N. Biswas, Books and Allied Ltd, Kolkata (1998).
4. Statistical Mechanics, K Huang, John Wiley and Sons, New Delhi (1975).
5. Statistical Mechanics, B.K. Aggarwal and M. Eisne, New Age International, New Delhi (1998).
6. Elementary Statistical Mechanics, Gupta and Kumar, Pragati Prakashan, Meerut (2005).
7. Statistical Mechanics, R.K. Pathria and Paul D Beale, Academic Press (2000).

CORE COURSE II: MATHEMATICAL PHYSICS

UNIT I : Vector spaces and Analysis

Linear vector spaces, Schmidt orthogonalisation, linear operators, dual space, ket and bra notation, Hilbert space, Metric space, Function spaces, Riesz –Fisher theorem (no proof),basis, orthogonal expansion of separable Hilbert spaces, Bessel inequality, Parsevals formula, Orthogonal curvilinear coordinates-gradient, divergence, Curl and Laplacian. Evaluation of line, surface, volume integrals.

UNIT II : Matrices and Tensors

Linear operators, matrix algebra, similarity transforms, diagonalization, eigenvalues and eigenvectors, orthogonal, Hermitian, unitary matrices and Pauli matrices. Tensors in index notation, Kronecker and Levi Civita tensors, inner and outer products, contraction, symmetric and antisymmetric tensors, quotient law, metric tensors, covariant and contravariant tensors.

Unit III : Fourier series, Fourier transforms, Laplace transforms

Fourier series – Dirichlet's conditions – Fourier series of even and odd functions – Complex form of Fourier series – Fourier integral and it's complex form – Fourier transforms – Fourier sine and cosine transforms – Convolution theorem and Parseval's identity. Laplace transform of elementary functions – Inverse Laplace transforms – Methods of finding Inverse Laplace transforms – Heaviside expansion formula – Solutions of simple differential equations.

UNIT IV: Complex Analysis

Functions of a complex variable – The derivative and Cauchy Reimann differential equations – Line integrals of complex functions – Cauchy's integral theorem - Cauchy's integral formula – Taylor's series – Laurent's series – Residues – Cauchy's residue theorem – Singular points of an analytic function – The point at infinity – Evaluation of residues – Evaluation of definite integrals by contour integration - Method of steepest descent (Sterlings formula)- summation of series using residue theorem.

UNIT V: Differential Equations and Special functions

Power series solutions for second-order ordinary differential equations. Singular points of ODEs. Sturm-Liouville problems. Partial differential equations: Laplace, Poisson and Helmholtz equations; diffusion and wave equations. Basic properties (recurrence and orthogonality relations, series expansion, Generating Function) of Bessel, Legendre, Hermite and Laguerre functions.

BOOKS FOR STUDY AND REFERENCE:

1. G. Arfken and H.J. Weber, Mathematical methods for Physicists, Academic Press (1995).
2. K.F. Riley, M.P. Hobson and S.J. Bence, Mathematical Methods for Physics and Engineering, Cambridge University Press (1998).
3. T. Lawson, Linear Algebra, John Wiley and Sons (1996).
4. R.V. Churchill, Complex variables and applications, McGraw Hill (1990).
5. A.W. Joshi, Matrices and Tensors in Physics, New Age, New Delhi (2006).
6. E. Kreyszig, Advanced Engineering Mathematics, John Wiley and Sons, New York (1999).
7. W. Bell, Special functions for Scientists and Engineers, Dover Publications, Inc., Mineola, New York (2004).
8. Mary. L. Boa, Mathematical Methods in the Physical Sciences, 3rd Edition, John Wiley and Sons (2005).
9. Schaum's outline series: (i) Vector and tensor analysis (ii) Linear Algebra (iii) Differential Equations, McGraw Hill (1974).

CORE COURSE III: QUANTUM MECHANICS - I

UNIT I: Formalism of quantum Mechanics

Expectation values of dynamical quantities – probability current density– Ehrenfest theorem- Schroedinger equation in momentum representation – Momentum operator – Hamiltonian operator – Hermitian operator and its properties – Dirac Delta function – Completeness property of Eigen functions – superposition of Eigen states – Parity operator – Commutator algebra –Schwarz inequality – Heisenberg's uncertainty relation derived from operators and its applications.

UNIT II: Perturbation theory for stationary states

First and second order perturbation theory in Non– degenerate and degenerate cases – Application to perturbed Harmonic oscillator- the perturbation energy term is proportional to x, x^2 and x^4 – Stark effect in hydrogen atom – Variation method – Application to ground state of He and hydrogen atom –WKB approximation – probability of penetration of barrier.

UNIT III: Angular Momentum

Orbital angular momentum – Spin angular momentum – Total angular momentum – Commutation rules for angular momentum operators – Eigen value spectrum J^2, J_z J_x, and J_y – Raising and lowering operators: J_+ and J_- – Matrix representation of Angular momentum – spin matrices and wave functions – Addition of angular momenta – Clebsch-Gordon co-efficients –Its properties and its evaluation.

UNIT IV: Matrix Representation

Hilbert space – Unitary transformation and their properties – Equation of motion – Representation of State vector and equation of motion: Schroedinger picture – Heisenberg picture – The Interaction picture – correspondence with classical mechanics – Dirac's Bra and Ket vector notation – coordinate and Momentum representation – Matrix theory of Harmonic Oscillator.

UNIT V: Time dependent approximation methods

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

Books for Study and Reference:

1. Quantum Mechanics, Satya Prakash, Kedarnath Ramnath, Meerut (1994).
2. Quantum Mechanics, S.L.Gupta, V.Kumar, H.V.Sharma and R.L.Sharma, Jai Prakashnath and Co, Meerut.
3. A Text Book of Quantum Mechanics, P. M. Mathews and K. Venkatesan, Tata McGraw Hill, New Delhi (1987).
4. Quantum Mechanics, L. Pauling and E.B.Wilson, McGraw Hill, New York (1935).
5. Quantum Mechanics, Leonard I. Schiff, McGraw, Hill (1968).
6. Quantum Mechanics, E. Merzbacher, Third Edition, John Wiley and Sons (2004).
7. Introduction to Quantum Mechanics, David J.Griffiths, Second Edition, Addison Wesley (1999).

CORE COURSE IV: PRACTICAL - I

GENERAL PHYSICS EXPERIMENTS

ANY FIFTEEN EXPERIMENTS

1. Young's modulus – Elliptical fringe method.
2. Young's modulus – Hyperbolic fringe method.
3. Determination of Stefan's constant.
4. Determination of Rydberg's constant – Hydrogen spectrum and Solar spectrum.
5. Determination of resistivity of a semiconductor by Four Probe Method.
6. Measurement of Hall Coefficient of the semiconductor.
7. Determination of band gap in a semiconductor material.
8. B.H. Curve – Anchor ring.
9. Thermistor – Determination of Temperature coefficient and band gap energy.
10. Fabry – Perot Etalon using spectrometer.
11. Determination of magnetic susceptibility of liquid by Guoy's method.
12. Determination of susceptibility of a paramagnetic solution by Quincke's method.
13. Charge of an Electron by spectrometer.
14. Determination of wavelength of a laser by Michelson Interferometer method.
15. Compressibility of a Liquid using Ultrasonic interferometer.
16. Solar spectrum – Hartmann's Interpolation formula.
17. Permitivity of a liquid using R.F.Oscillator.
18. 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.
19. Determination of refractive index of the liquids using He-Ne / Laser.
20. Determination of numerical aperture of an optical fiber.

21. G.M. Counter –Characteristics and Inverse square law.

22. Zeeman Effect – e/m of an electron with a laser source.

23. Iron / Copper arc spectrum.

24. Brass / Alloy arc spectrum.

25. AlO / CN band spectrum.

I YEAR - II SEMESTER

CORE COURSE V: CONDENSED MATTER PHYSICS

UNIT - I: Bonding and Crystallography

Bonding : Ionic bonding – calculation of lattice energy-calculation of madelung constant in ionic crystals – Born Haber cycle – Crystals of inert gases – Vanderwaal's interaction – London interaction – Compressibility and bulk modulus.

Crystallography : 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.

UNIT - II: Lattice Vibrations and Thermal properties

Vibration of monatomic lattices – Lattices with two atoms per primitive cell – Quantization of lattice vibrations – Phonon momentum – Inelastic scattering of neutrons by phonons – Lattice heat capacity – Einstein model – Density of mode in one-dimension and three Dimension – Debye model of the lattice heat capacity.

UNIT – III: Free Electron theory, Energy Bands and Semiconductor Crystals

Band theory of solids – Bloch theorem – Kronig - Penney model – Effective mass – 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: Diamagnetism, Paramagnetism and Ferro magnetism

Diamagnetism and Anti ferromagnetism – 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.

UNIT - V: Dielectrics, Ferroelectrics and Superconductivity

Macroscopic electric field – Local electrical field at an atom – Dielectric constant and Polarizability – Clausius-Mossotti equation – Ferroelectric crystals – Polarization Catastrophe – Ferroelectric domains – Superconductivity – Meissner effect – Thermodynamics of Superconducting transition – London equation – Coherence length – BCS theory – Flux Quantization – Type-I and Type-II Superconductors –Josephson tunneling effect – DC and AC Josephson effect – SQUID – Recent developments in high Temperature Superconductivity – Application of superconductors.

BOOKS FOR STUDY AND REFERENCE:

1. Solid State Physics, S.L.Gupta and V.Kumar, Pragati Prakashan (2002).
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, Fifth Edition, Wiley Eastern, New Delhi (1977).
4. Solid State Physics, N.W. Asherof and N.D. Mermin, Harcourt Asia Pvt. Ltd, Singapore (2001).
5. Solid State Physics, J. S. Blakemore, Second edition, Cambridge University Press, Cambridge, London (1974).
6. An Introduction to X-ray Crystallography, M.M. Woolfson, Cambridge University Press, Cambridge, London (1991).
7. Introduction to High-Temperature Superconductors, Thomas P. Sheahen, Plenum Press, New York (1994).
8. Solid State Physics, S.O. Pillai, New Age International Pvt. Ltd., New Delhi (1999).

CORE COURSE VI: ELECTRONICS

UNIT – I: Integrated Circuits

Integrated Circuits –Types of Integrated Circuits – Analog and Digital Integrated Circuits – Basic monolithic ICs – epitaxial growth – masking – etching impurity diffusion – fabricating monolithic resistors, diodes, transistors, inductors and capacitors – circuit layout – contacts and inter connections –The continuity equation for a diode – Application of the continuity equation for an abrupt PN junction under forward and reverse bias – Einstein equation.

UNIT – II: Special Semiconductor Devices

JFET – Structure and working – VI Characteristics under different conditions – biasing circuits – CS amplifier design – AC analysis – MOSFET – Depletion and Enhancement type MOSFFT – UJT characteristics – relaxation oscillator – SCR characteristics – application in power control – DIAC, TRIAC.

UNIT – III: Operational Amplifier and Applications

Solving simultaneous and differential equations – Voltage to current and current to voltage conversions – active filters: low pass, .high pass, band pass and band rejection filters – Wien bridge, phase shift oscillators – Triangular, saw-tooth and square wave generators – Schmitt's trigger – sample and hold circuits – Voltage control oscillator.

UNIT - IV: IC 555 Timer and Applications

IC 555 Timer – Internal architecture and working – Monostable Operation – Applications in monostable mode – Linear ramp generator – Frequency divider – Astable operation – Applications in astable mode – phase locked loops – Monolithic phase locked loops.

UNIT – V: Counters and Converters

Basic D to A conversion: weighted resister DAC – Binary R-2R ladder DAC – Basic A to D conversion: counter type ADC – successive approximation converter – dual slope ADC – JK flip flop and T flipflop – Counters – 4 bit synchronous and asynchronous counters as up and down counters – BCD counter – Shift registers – serial and parallel shift registers.

BOOKS FOR STUDY AND REFERENCE:

1. T.F. Schubert and E.M.Kim, Active and Nonlinear Electronics, John Wiley Sons, New York (1996).
2. L. Floyd, Electronic Devices, Pearson Education, New York (2004).
3. Dennis Le Crissitte, Transitors, Prentice Hall India Pvt. Ltd (1963).
4. J. Millman and C.C. Halkias, Integrated Electronics, McGraw Hill, New Delhi (1972).
5. A. Mottershed, Semiconductor Devices and Applications, New Age International Publishers (2003).
6. M. Goodge, Semiconductor Device Technology, Mc Millan (1983).
7. S.M. Sze, Physics of Semiconductor Devices, Wiley, New York (1985).
8. Millman and Taub, Pulse, Digital and Switching Waveforms, McGraw Hill (1965)
9. Ben G. Streetman, Solid State Electronic Devices, Prentice Hall, New Jersey (1999).
10. R.A. Gayakwad, Op-Amps and Linear Integrated Circuits, Prentice Hall India Pvt. Ltd (1999).

CORE COURSE VII: MICROPROCESSORS AND MICROCONTROLLERS

UNIT – I: Architecture and Programming of 8085

Architecture of 8085 – Organization of 8085: Control, data and address buses – registers in 8085 – Addressing modes of 8085 – Instruction sets of 8085: Instruction types – data transfer, arithmetic, logical, branching, stack and I/O instructions. Timing and sequencing: Instruction cycle, machine cycle, halt state, wait state – Timing diagram for op-code fetch, memory read and write cycles. Interrupts: Types of Interrupts – hardware and software interrupts – masking and unmasking interrupts – Assembly language programming, Simple programs using arithmetic and logical operations

UNIT - II: Architecture of 8086

Memory organization, Register organization: General purpose, index, pointer, segment and flag registers – Bus structure: data bus, address bus, effective and physical address and pipelining. Addressing modes of 8086: Register data – immediate, direct and indirect addressing.

UNIT – III: Applications of Microprocessors

Microprocessor based process control – closed loop control – open 1oop control. Example for closed loop control – crystal growth control – Microprocessor based temperature monitoring systems – limit setting – operator panel – block diagram – Analog to digital conversion using ADC 0809 – interfacing 8255 – Block diagram.

UNIT - IV: Architecture of Microcontroller 8051

Introduction – comparison between microcontroller and microprocessors – Key features of 8051 – memory organization – input and output ports – Data memory and program memory – Special function registers – control registers – counters and timers – interrupt structure.

UNIT – V: Programming the Microcontroller 8051

Instruction set of 8051 – Arithmetic – Logical – Data transfer instructions – Addressing modes – Register addressing – direct and indirect addressing modes – Assembly language programming – simple programs to illustrate arithmetic and logical operations – Sum of numbers – biggest and smallest number in an array – software time delay.

BOOKS FOR STUDY AND REFERENCE:

1. Aditya P. Mathur – Introduction to Microprocessors – Tata McGraw Hill Company – Third Edition.
2. Ramesh S. Gaonkar – Microprocessor, Architecture, Programming and Application with 8085 – Wi1ey Eastern.
3. Douglas V. Hall – Microprocessors – Interfacing, Programming and Hardware – Tata McGraw Hill – New Delhi.
4. Kenneta J. Ayala – The 8051 Microcontroller – Penram International – India.
5. Lance A. Leventhal – Introduction to Microprocessors Software, Hardware, Programming – Prentice Hall of India.
6. Kenneth L. Short – Microprocessor and Programmed Logic – Prentice Hall of India.
7. Gilmore – Microprocessors – Tata McGraw Hill – New Delhi.
8. A.P. Godse and D.A. Godse – Microprocessors and Microcontrollers – Technical Publications, Pune (2010).

CORE COURSE VIII: PRACTICAL - II

ELECTRONICS EXPERIMENTS

ANY TWENTY EXPERIMENTS

1. Construction of single stage and multi stage RC coupled transistor amplifier.
2. Characteristics of JFET and Construction of JFET amplifier.
3. Characteristics of Silicon Controlled Rectifier.
4. Study the characteristics of UJT and construction of UJT Relaxation oscillator.
5. Study the characteristics of DIAC and TRIAC.
6. Characteristics of Tunnel diode and Gunn diode.
7. Characteristics of LED and Photo diode.
8. Laser diode and Photo transistor characteristics.
9. Design of Schmit Trigger and Construction of Astable multivibrator circuit using IC 555 and IC 741.
10. Design and study of monostable and bistable multivibrator circuits using IC 555.
11. Construction of adder, subtractor, differentiator and integrator circuits using IC 741.
12. Design of second order Butter worth active filter circuits: low pass, high pass, band pass and band rejection using IC 741.
13. Design of square wave, saw tooth wave and triangular wave generators using IC 741.
14. Construction of D/A converter – R-2R method and Binary weighted method.
15. Construction of A/D converter using comparator and study its performance.
16. Construction of half adder and full adder circuit using NAND gates.
17. Construction of half subtractor and full subtractor circuits using NAND gates.
18. V-I Characteristics of a Solar Cell.
19. Flip flops – RS, JK, Master Slave and T flip flops.
20. Study of Counters: Ripple, MOD 3, MOD 5 Counters.

21. BCD and UP/ DOWN Counters.
22. Construction of Shift registers using IC 7476: serial in - serial out, parallel in - parallel out, shift left and shift right.
23. Analog computer circuit design – solving simultaneous equations.
24. Multiplexer and Demultiplexer.
25. Decoders and Encoders.

II YEAR - III SEMESTER

CORE COURSE IX : ELECTROMAGNETIC THEORY

UNIT – I: Electrostatics

Coulomb's Law – Electric field intensity – Field due to point and continuous charges – Gauss' Law and its applications – Electric potential – Electric field and equi potential plots. Electric field in free space, conductors, dielectric – Dielectric polarization– Dielectric strength – Electric field in multiple dielectrics – Molecular polarisability and electric susceptibility – Electrostatic energy in dielectric medium – Clausius - Mossotti equation – Laplace and Poisson equations, boundary value problems.

UNIT – II: Magnetostatics

Lorentz Law of force, magnetic field intensity – Biot - Savart Law - Ampere's Law – Magnetic field due to straight conductors, circular loop, infinite sheet of current – Magnetic flux density (B) – B in free space – Magnetic force – Torque – Inductance – magnetic field of magnetic materials – Magnetic dipole – Magnetic circuits – Boundary conditions.

UNIT – III: Electrodynamic fields

Faraday's laws, induced EMF – Transformer and motional EMF – Forces and Energy in quasi – stationary Electromagnetic Fields – Maxwell's equations: differential and integral forms – Displacement current – Relation between field theory and circuit theory. Vector and scalar potentials – Gauge transformation – Lorentz gauge – Coulomb gauge – Conservation laws for a system of charges – Poynting theorem.

UNIT – IV: Electromagnetic waves

Generation – Electro Magnetic Wave equations – Wave parameters; velocity, intrinsic impedance, propagation constant – Electromagnetic waves in free space, dielectrics and conductors; Reflection and refraction, polarization, Fresnel's Law, interference, coherence, and diffraction; Dispersion relations in plasma skin depth, Poynting vector Wave guides- Propagation of waves in a rectangular wave guide-inhomogeneous wave equation and retarded potentials- field and radiation due to an oscillating electric dipole.

UNIT – V: Plasma physics

Definition of plasma: It's occurrence in nature; Dilute and dense plasma; Uniform but time – dependent magnetic field: Magnetic pumping; Static non-uniform magnetic field: Magnetic bottle and loss cone; MHD equations, Magnetic Reynold's number; Pinched plasma: Bennett's relation; Qualitative discussion on sausage and kink instability.

BOOKS FOR STUDY AND REFERENCE:

1. Mathew N. O. Sadiku, Elements of Electromagnetics, Oxford University Press Inc. First India edition (2007).
2. Ashutosh Pramanik, Electromagnetism , Theory and Applications, Prentice-Hall of India Private Limited, New Delhi (2006).
3. J.A. Bittencourt, Fundamentals of Plasma Physics, Third Edition, Springer Publication (2004).
4. David J Griffiths, Introduction to Electromagnetics, Third Edition, Prentice Hall of India Pvt.Ltd. , New Delhi (2002).
5. T.V.S. Arun Murthy, Electromagnetic fields, S. Chand, New Delhi (2008).
6. Joseph. A. Edminister, Theory and Problems of Electromagnetics, Second Edition, Schaum Series, Tata McGraw Hill (1993).
7. William. H. Hayt, Engineering Electromagnetics, Tata McGraw Hill edition (2001).
8. John R.Reitz, Foundations of Electromagnetic Theory, Sixth Edition, Narosa Publishing House, New Delhi (2000).
9. K.L. Goswami, Introduction to Plasma Physics, Central Book House, Calcutta.

CORE COURSE X: COMPUTATIONAL METHODS AND PROGRAMMING

UNIT – I: C++ programming

Constants, variables and their declarations – Input, output and comparison operators– if, if. else, switch, while, do-while, for, break statements – main, void, exit, swap functions – Arrays – passing by value and passing by reference.

UNIT – II: Curve fitting and interpolation

Curve fitting: Method of least squares – Normal equations – Straight line fit – Exponential and power – law fits. Newton interpolation polynomial: Linear Interpolation – Higher order polynomials – First- order divided differences – Gregory - Newton interpolation polynomials-Lagrange interpolation – Truncation error.

UNIT – III: Solutions of Linear and Nonlinear Equations

Simultaneous linear equations: Gauss elimination method – Jordan's modification – Inverse of a matrix by Gauss- Jordon Method – Roots of nonlinear equations: Newton-Raphson method – Iterative rule – Termination criteria – Pitfalls – Order of convergence

UNIT - IV: Numerical integration and Differentiation

Newton-Cotes quadrate formula – Trapezoidal, Simpson's 1/3 and 3/8 rules – Errors in the formulas. Differentiation: First –order derivative:-Two and four-point formulas second –order derivative: Three and five-point formulas.

UNIT – V: Numerical solution to ordinary Differential Equations

First-order equations: Euler and improved Euler methods – Formulas – Local and global truncation errors – Fourth-order Runge-Kutta method – Geometric description of the formula– Errors versus step size –Second order equation – Euler methods and Fourth order Runge - Kutta method.

BOOKS FOR STUDY AND REFERENCE:

1. J. R. Hubbard, Programming with C++, McGraw Hill, New Delhi (2006).
2. J. H. Mathews, Numerical Methods for Mathematics, Science and Engineering, Prentice - Hall of India, New Delhi (1998).

3. M.K.Jain, S.R.K.Iyengar and R.K.Jain, Numerical Methods for Scientific and Engineering Computation, New Age International, New Delhi (1993).
4. S.D. Conte and C.Boor, Elementary Numerical Analysis, Third Edition, McGraw Hill, Singapore (1981).
5. B.H. Flowers, An Introduction to Numerical methods in C++, Oxford University Press, Oxford (2009).
6. V. Rajaram, Programming in C, Prentice - Hall of India, New Delhi (1994).
7. E. Balagrusamy, Numerical methods, Tata McGraw Hill, New Delhi (1999).
8. E. Balagurusamy, Programming in C, Tata Mc Graw Hill Publishing Company Limited, New Delhi (2008).
9. Programming with C - Schaum's outline series, Tata McGraw Hill Publishing Company Limited, New Delhi (2004).

CORE COURSE XI : QUANTUM MECHANICS – II

UNIT I: Systems of identical particles

Indistinguishability of identical particles – Symmetric and anti Symmetric wave function – Exchange operator – Distinguishability of identical particles – Bosons and Fermions – Pauli's Exclusion principles – Collision of identical particles – Ensemble of identical particle systems– Density operator – Density matrix – Properties – Symmetric and Anti symmetric wave function of hydrogen molecule. .

UNIT II: Scattering Theory

Differential and Total cross-section – Scattering amplitude – Green's function: formal expression for scattering amplitude – Born approximation and its validity – scattering by coulomb and Screened coulomb potentials – Square-well potential – Exponential – Gaussian potential – Partial wave analysis – Phase Shifts – Scattering amplitude in terms of phase shift– Low energy scattering: Scattering length and effective range-scattering by a perfectly rigid sphere.

UNIT III: Emission and absorption of radiation

Semi – Classical theory of radiation: Einstein coefficients – atom field interaction –Transition probabilities for stimulated emission and absorption and spontaneous emission of radiation – Electric dipole transition – Selection rules and polarizability – Quantum theory of radiation: Radiation field Hamiltonian – Radiation field as an assembly of oscillators – emission and absorption rates.

UNIT IV: Atomic and molecular Structure

Approximations in atomic structure – Central field approximation – Thomas Fermi Statistical model – Hartree - Fock Equation – The method of self consistent field – Residual electrostatic and spin orbit interaction – Alkali atoms – Doublet separation – Coupling schemes – Hydrogen molecule – Covalent bond.

UNIT V: Relativistic Wave equation

The Klein – Gordon Equation – Charge and current densities in four vector – KG equation in electromagnetic field – The Dirac relativistic equation: The Dirac matrices – Free particle solutions – Meaning of negative energy states– Electromagnetic potential: magnetic moment of the electron – Existence of electron spin - Spin orbit energy.

Books for Study and Reference:

1. Quantum Mechanics, Satyaprakash, KedarNath Ram Nath.
2. Quantum Mechanics, Ajay Ghatak and S.Loganathan, Macmillan India Ltd.
3. Quantum Mechanics, P.M. Mathews and K. Venkatesan, Tata McGraw Hill.
4. Quantum Mechanics, Leonard I. Schiff, McGraw Hill.
5. Quantum Chemistry, R.K. Prasad, New Age International Pvt. Ltd.
6. Quantum Mechanics, Gupta, Kumar, Sharma, Jai Prakash Nath and Co.
7. Quantum Mechanics, Third Edition, E. Merzbacher, John Wiley Interscience Publications.
8. Quantum mechanics, Franz Schwabl, Narosa Publications.
9. Molecular Quantum mechanics, Third Edition, P.W.Atkins and R.S.Friedman, Oxford University Press publication.

CORE COURSE XII: PRACTICAL - III
MICROPROCESSOR, MICROCONTROLLER AND PROGRAMMING EXPERMENTS

ANY TWENTY EXPERIMENTS WITHOUT OMITTING ANY PART

MICROPROCESSOR (8085)

1. 16 bit Addition, Subtraction, Multiplication and Division.
2. Number conversion: (i) BCD to Binary (ii) Binary to BCD (iii) ASCII to HEX (iv) HEX to ASCII using 8085.
3. Ascending and descending order of numbers.
4. Square and square root of a given number.
5. Factorial of a given number and largest and smallest number in a set of numbers.
6. ADC and DAC Interfacing.
7. Digital Thermometer.
8. Stepper Motor Interface.
9. Traffic Light Control Interface.
10. Digital Clock.

MICROCONTROLLER (8051)

1. 16 bit Addition, Subtraction, Multiplication and Division.
2. Generation of square, triangular, saw tooth, staircase and sine waves.
3. DC Motor Control Interface.
4. HEX key board Interface.
5. Switching an array of LEDS.

C^{++} PROGRAMMING

1. Matrix addition, subtraction and multiplication.
2. Eigen values of a given matrix.
3. Transpose and inverse of a matrix.
4. Evaluating a root of non - linear equation by Newton - Raphson method.
5. Solution of simultaneous equations.

6. Straight line fit using the method of least squares.
7. Exponential fit using the method of least squares.
8. Newton’s and Lagrange’s Interpolation.
9. Numerical integration by Simpson’s rule and Trapezoidal rule.
10. Solution of Differential equation by Fourth order Runge - Kutta Method.

II YEAR - IV SEMESTER

CORE COURSE XIII: MOLECULAR SPECTROSCOPY

UNIT – I: Infrared Spectroscopy

Principle and theory of Infrared spectroscopy – Far and Near IR absorption spectroscopy –Mid and Near IR reflectance spectroscopy- Photo acoustic IR spectroscopy – Dispersive IR spectrometer – IR Imaging – FTIR spectroscopy – Vibrational frequencies and qualities analysis – sampling methods – Instrumentation- Applications.

UNIT – II: Raman Spectroscopy

FT Raman spectroscopy – degree of depolarization – structure determination using IR and Raman spectroscopy – Resonance Raman spectroscopy – Coherent anti – Stokes Raman spectroscopy – Inverse Raman and surface Enhanced Raman spectroscopy – principles, techniques and applications – nonlinear Raman spectroscopy.

UNIT – III: Florescence and Phosphorescence Spectroscopy

Electronic Excitation of Diatomic Species – Vibrational Analysis of Band Systems of Diatomic Molecules – Deslandre's Table – Intensity Distribution – Franck Condon Principle – Rotational Structure of Electronic Bands – Resonance and Normal Fluorescence – Intensities of Transitions – phosphorescence Population of Triplet State and Intensity – Experimental Methods – Applications of Florescence and Phosphorescence.

UNIT – IV: NMR and NQR Spectroscopy

NMR Spectroscopy**:** Quantum Mechanical and Classical Description – Bloch Equation – Relaxation Process – Experimental Technique – Principle and Working of High Resolution NMR Spectrometer – Chemical Shift.
NQR Spectroscopy**:** Fundamental Requirements – General Principle – Experimental Detection of NQR Frequencies – Interpretation and Chemical Explanation of NQR Spectroscopy.

UNIT – V: ESR and Mossabauer Spectroscopy

ESR Spectroscopy : Basic Principles – Experiments – ESR Spectrometer – Reflection Cavity and Microwave Bridge – ESR Spectrum – Hyperfine Structure.
Mossabauer Spectroscopy : Mossabauer Effect – Recoilless Emission and Absorption – Doppler

velocity shift – Mossabauer Spectrum – Experimental Methods – Hyperfine Interaction – Chemical Isomer Shift– Magnetic Hyperfine and electric Quadrupole Interaction.

BOOKS FOR STUDY AND REFERENCE:

1. C.N. Banwell, Fundamentals of Molecular Spectroscopy, Tata McGraw Hill (1994).
2. B.P. Straughan and Walkar, Spectroscopy, Vol. 1, Chapman and Hall (1976).
3. B.P. Straughan and Walkar, Spectroscopy, Vol. 2, Chapman and Hall (1976).
4. D.N. Sathyanarayana, Vibrational Spectroscopy and Applications, New Age International
5. Publications (2004).
6. G. Aruldas, Molecular Structure and Spectroscopy, Prentice Hall of India Pvt. Ltd., New Delhi (2001).
7. Raymond Chang, Basic Principles of Spectroscopy, McGraw Hill, Kogakusha, Tokyo (1980).
8. D.A. Long, Raman Spectroscopy, McGraw Hill, New York (1977).
9. A. Beiser, Concepts of Modern Physics, McGraw Hill, New York (1995).

CORE COURSE XIV: NUCLEAR AND PARTICLE PHYSICS

Unit – I: Nuclear Structure

Nuclear size, shape and distribution of charge – spin and magnetic moment – determination of nuclear mass – Binding Energy – Semi empirical mass formula – Nuclear stability – Mass parabolas – Nuclear Shell model – Liquid drop model – Optical Model – Collective Model.

Unit – II: Nuclear forces

Exchange forces – Yukawa's meson theory – Yukawa potential – Ground state of deuteron – Low energy n-p scattering – effective range – Scattering length, phase shift – spin dependence and charge independence of nuclear forces.

Unit – III: Nuclear Reactions

Types of reactions and Energetics of nuclear reactions – conservation laws – Q - value – Scattering and reaction cross sections – Compound nucleus – Reciprocity theorem – Breit and Wigner Dispersion formula – stripping and pickup reactions. Expression in terms of Green's function – Born approximation and its validity – Screened Coulomb potential – Alpha particle scattering – Rutherford's formula.

Unit – IV: Radioactive Decays

Alpha decay – Geiger - Nuttal law - Gamow's Theory – Neutrino hypothesis – Fermi theory of beta decay – Selection rules – Gamma decay – Selection rules – Internal conversion – Nucler isomerism – Basic principles of particle detectors – Ionization chamber – Proportional counter – BF3 counters **-** and G.M counters – Solid state detectors – Scintillation and semiconductor.

Unit – V: Elementary Particles

Types of interactions between elementary particles – Leptons – Hadrons – Mesons – Hyperons – Pions – Gell – Mann Okubo mass formula for octet and decaplet – SU(2) – SU(3) Multiplet – Quark model – Color and flavor – weak and strong interactions.

BOOKS FOR STUDY AND REFERENCE:

1. R.P. Roy and B.P. Nigam, Nuclear Physics, Age International Ltd, New Delhi (2005).
2. B.L. Cohen, Concepts of Nuclear Physics, Tata McGraw Hill, New Delhi (1983).
3. H. Semat, Introduction to Atomic and Nuclear Physics, Chapman and Hall, New Delhi (1983).
4. W.S.C. Williams, Nuclear and particle Physics Claredon Press, London (1981).
5. K.S. Krane, Introductory Nuclear Physics, John Wiley, New York (1 9 8 7) .
6. S.B. Patel, Nuclear Physics: An introduction, Wiley- Eastern, New Delhi (1991).
7. D.C. Tayal, Nuclear Physics, Himalaya Publishing house, New Delhi (2004).
8. D. Griffiths, Introduction to Elementary particles, Wiley International Edition, New York (1987).

CORE COURSE XV: COMMUNICATION ELECTRONICS

UNIT - I: Antennas and Wave Propagation

Radiation field and Radiation resistance of a short dipole antenna – Grounded λ/4 Antenna– Ungrounded λ/2 Antenna – Antenna Arrays – Broadside and End Side Arrays – Antenna Gain-Directional High Frequency Antennas – Sky Wave Propagation – Ionosphere – Ecles and Larmor Theory – Magneto Ionic Theory – Ground Wave Propagation.

UNIT – II: Pulse Code and Digital Modulation Techniques

Sampling theorem – Low Pass and Band Pass signals, PAM, Channel BW for a PAM signal. Natural sampling: Flat – top sampling, Signal recovery through Holding, Quantization of signals, PCM transmission, quantization of noise, differential PCM Delta Modulation, Adaptive Delta modulation, CVSD. Signal to noise ratio in PCM and Delta Modulations – ASK, FSK, BPSK, DPSK, QPSK, QASK, MSK and QAM.

UNIT – III: Microwave Electronics

Microwave Generation – Multicavity Klystron – Reflex Klystron – Magnetron – Travelling Wave Tubes (TWT) and other Microwave Tubes – MASER – Gunn Diode.
Broad Band Communication Systems: Multiplexing – Frequency division – Time division. Short and medium Haul systems: Coaxial cables – fiber optic link – Microwave link – Tropospheric Scatter links. Long Haul system: Submarine cables.

UNIT - IV: Radar and Television

Elements of a Radar System – Radar Equation – Radar Performance Factors – Radar Transmitting Systems – Radar Antennas – Duplexers – Radar Receivers and Indicators – Pulsed Systems – Other Radar Systems. Colour TV Transmission and Reception – Colour mixing principle – Colour Picture Tubes –Delta Gun picture tube – PIL colour picture tube – Cable TV, CCTV and Theatre TV.

UNIT - V: Optical Fibers

Propagation of Light in an Optical Fiber: Acceptance Angle – Numerical Aperture – Step and Graded Index Fibers – Optical Fiber as a Cylindrical Wave Guide – Wave Guide Equations – Wave Equations in Step Index Fibers – Fiber Losses and Dispersion – Applications.

Satellite communication: Orbital Satellites, Geostationary Satellites, Orbital Patterns, satellite system link models, satellite system parameters, satellite system link equation, Link budget – INSAT Communications Satellites.

BOOKS FOR STUDY & REFERENCE:

1. Hand book of Electronics, Gupta and Kumar, Pragati Prakashan, Meerut (2008).
2. Electronic Communication System, George Kennedy and Davis, Tata McGraw Hill, Fourth Edition (1988).
3. Principles of Communication Systems, Second Edition, Taub and schilling, Tata McGraw Hill (1991).
4. Electronic Communications, Fourth Edition, Dennis Roddy and John Coolen, Prentice Hall of India (1999).
5. Electronic Communication Systems, Second Edition, Wayne Tomasi, Pearson Education, Asia (2001).
6. Microwave and Radar Engineering, Fourth Edition, M. Kulakarni, Umesh Publications, New Delhi (2012).
7. Monochrome and Colour TV, R.R. Gulati, New Age International Publication (2002).

LIST OF ELECTIVE COURSES

ELECTIVE COURSE I: BIOELECTRONICS AND BIOSENSORS

UNIT - I: Introduction

Nature of Biomedical signals; Bio Electronic potentials; Necessity of Bio Electronics; Components; Scope and Application; Basics of cell biology; Structure of the cell, the nervous system and the neuron; function of enzymes; nucleus and role of DNA and RNA, adhesion of cell to surfaces.

UNIT - II: Bio electronic device production

Elements in contact with the surface of a biomaterial: blood composition, plasma proteins, cells, tissues – Phenomena at the bio interfaces. Molecular and cellular processes with living environment, blood-materials interaction, short and long term reactions to the body – Testing of biomaterials: in vitro, in vivo preclinical and in vivo clinical tests – Technologies of biomaterials processing, as implants and medical devices; improvement of materials biocompatibility by plasma processing.

UNIT – III: Materials in clinical devices

Metals: Sulzer recall of prosthetic hip implant – Composition of stainless steel and Fe/Co/Ti alloys; Mechanical – properties – Hard Materials: Bio ceramics and Bio glasses, Carbons, Polymers as Biomaterials – Biodegradable Polymers – Composites. Biological reactions to implants – Natural Biomaterials – Collagen – Potential advantages and Developments towards a bio molecular computer, development of molecular arrays as memory stores – molecular wires and switches; mechanisms of unit assembly.

UNIT – IV: Biosensors

Introduction to Biosensors – Types of sensors – target analytes – various recognition – signals and device types – basic design consideration – calibration – dynamic range – signal to noise – sensitivity – selectivity – interference – immobilization – adsorption – encapsulation– covalent attachment – device integration: micro scale and nano scale – Bio MEMS – nano wires – Quantum dots – magnetic beads, PEBBLE sensors.

UNIT - V: Electrical signal transduction

Seismic (mass) and thermal sensors: Electromechanical resonance – electrochemical forces – Henry's and ideal gas laws – Surface acoustic wave (SAW) devices – atomic force microscopy – manometric sensors – thermometric detection – Electrochemical sensors: Redox potentials, membrane potential, Gauss's Law, basic electrochemistry; conductimetric sensors; potentiometric sensors (ISE's and ISFETs); amperometric sensors; Charge sensing with FET.

BOOKS FOR STUDY AND REFERENCE:

1. H. Boenig, Fundamentals of Plasma Chemistry and Technology, Technomic Publishing Co.Inc. Lancaster Basel (1990).
2. Itamar Willner and Eugenii Katz, Bioelectronics: From Theory to Applications, John Wiley (2005).
3. S. Bone and B. Zebba, Bioelectronics, Wiley (2012).
4. J. Koryta, Ions, Electrodes and Membranes, Second Edition, John Wiley (1991).
5. B. D. Ratner and A. S. Hoffman, Biomaterials Science: An Introduction to Materials in Medicine, Academic Press, New York (1996).
6. B.R. Eggins, Chemical Sensors and Biosensors, John Wiley and Sons (2002).
7. E.A. Hell, Biosensors, John Wiley and Sons, New York (1997).
8. J. B. Park and J.D. Bronzion, Biomaterials: Principles and Applications, CRC Press (2003).
9. J. W. Gardner, V.K. Varadan, and O. O. Awadelkarim, Micro Sensors, MEMS and Smart Devices, Wiley (2001).
10. Sujatha V. Bhat, Biomaterials, Narosa Publishing House, New Delhi (2002).

ELECTIVE COURSE II: OPTO ELECTRONICS

UNIT – I: INTRODUCTION

Propagation of electromagnetic waves in dielectric wave guides – fibers – boundary conditions – phase velocity and group velocity – Dispassion – cut off frequencies - EM field in core and cladding – single mode and multimode fibers.

UNIT – II: ACTIVE DEVICES

LED's lasers – Laser principles – spontaneous and stimulated emission – coherence – gain equation – three level, four level lasers- examples of lasers (He-Ne) Ruby, diode – homojunctioin and heterojunction diode lasers.

UNIT – III: FIBRE OPTICSCOMMUNICATION

LED and lasers source – Transmitter modulator – acousto – optic, electro optic modulator – AM, FM, DCM modulation – detection and demodulation radiation detection – PIN, APD and PM tube.

UNIT – IV: OPTICAL FIBER SENSORS

General features, types of OFS, intrinsic and extrinsic sensors, intensity sensors, shuttes based multimode OFS, simple fiber based sensors for displacement, temperature and pressure measurements – reflective OFS and applications, Fiber Bragg grating based sensors.

UNIT – V: INTERFEROMETRIC FOS

Basic principles, interferometric configurations, Mach – Zendes. Michelson and Fabry – Perrot configurations – components and construction of interferometric FOS, applications of interferometric FOS, Sagnac interferometer, fibers gyro, OTDR and applications.

BOOKS FOR STUDY AND REFERENCE

1. H.G. Unger, Planar Optical Waveguides and Fibres, Oxford University Press, Oxford 1977.
2. A. Yariv, Principles of Optical Electronics, John Wiley, New York, 1984.
3. H.A. Haus, Waves and Fields in Optoelectronics, Prentice Hall, New Jersey, 1984.

4. Ajoy Ghatak, Optics, Second Edition, Tata McGraw Hill, 2013.
5. B.P. Pal, Fundamentals of Fiber Optics in Telecommunications and Sensor Systems, New Age International, New Delhi, 1992.
6. P. K. Rastogi, Optical Measurement Techniques and Applications, Artech House, 1997.
7. Dave Birtalan, William Nunley, Optoelectronics: Infrared-Visible-Ultraviolet Devices and Applications, Second Edition, CRC Press, 2009.
8. Michael A. Parker, Physics of Optoelectronics, CRC Press, 2005.

ELECTIVE COURSE III: NANO PHYSICS

UNIT – I: Basic Properties of Nanoparticle

Particle size; Top down and bottom up ideas, particles shape; Size effect and properties of nano-particles; Particle density; Melting point; Surface tension; Wettability; Specific surface area and pore; Composite structure; Crystal structure; Surface characteristics; Mechanical properties; Electrical properties; Magnetic properties; Optical properties; Concept of vacuum technology.

UNIT – II: Quantum Phenomena

One dimensional quantum or electron leak; Quantized electron energy; Time dependent perturbation theory; Transition to continuum (Fermi's Golden rule);Density of states (DOS); Spin effects (Kondo resonance, Zeeman splitting) spectroscopy.

UNIT – III: Nanofabrication and Nanopatterning

Sol-Gel synthesis, Hydrothermal Growth, Optical, X-ray, and electron beam lithography, self -assembled organic layers, scanning tunneling microscopy, atomic force microscopy.

UNIT – IV: Nano Systems

An artificial and tunable atom (quantum dot); Quantum wire; Quantum Hall effect; Carbon nano-tube; Tunnel diode; Molecular transistor; Single electron transistor; Spin polarized transistor; Thin films; Self assembly.

Unit – V: Applications of Nanomaterial

Optoelectronic properties of molecular materials, nanotechnology devices: OLEDs, OTFTs. Bioelectronics and biosensors: charge transport, DNA and protein functional systems, electronic noses and biosensors.

BOOKS FOR STUDY AND REFERENCE

1. Roland Wiesendanger – Scanning Probe Microscopy and Spectroscopy – Methods and Applications – Cambidge University Press (1994).
2. Joel I. Gersten, Frederick W. Smith – The Physics and Chemistry of Materials; John Wiley and Sons (2001).

3. Bhushan Bharat, Fuchs Harald, Tomitori Masahiko – Applied Scanning Probe Methods IX Characterization – Springer (2008).
4. John C. Vickerman; Surface Analysis (The principal Techniques); John Wiley and Sons (2003).
5. E. Wolf ; Nanophysics and Nanotechnology: An Introduction to Modern Concepts in Nanoscience Second Edition, Wiley-VCH (2006).
6. D. Briggs, M.P. Seah; Practical Surface Analysis-Auger and X-ray Photoelectron Spectroscopy, Wiley Interscience (1990).
7. Sergei N. Magonov, Myung-Hwan Whangbo; Surface Analysis with STM and AFM: Experimental and Theoretical Aspects of Image Analysis, VCH Publishers (1996).
8. John H. Davies, The Physics of Low Dimensional Semiconductors: An Introduction, Cambridge University Press (1998).
9. M.S.Ramachandra Rao, Shubra Singh, Nanoscience and Nanotechnology: Fundamentals to Frontiers, Wiley (2016).

ELECTIVE COURSE IV: ENERGY PHYSICS

UNIT – I: Introduction to Energy Sources

Energy sources – Types of energy sources – World energy futures- Energy sources and their availability – Prospects of renewable energy sources.

UNIT - II: Solar Cells

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 – Cadmium sulphide solar cells.

UNIT – III: Applications of Solar Energy

Solar water heating – space heating and space cooling – solar photo voltaics – agricultural and industrial process heat – solar distillation – solar pumping– solar furnace – solar cooking – solar green house.

UNIT - IV: Wind Energy

Base principles of wind energy conversion wind data and energy estimation – Base components of wind energy conversion systems (WECS) types of wind machines – Generating systems – scheme for electric generation – generator control – load control – applications of wind energy.

UNIT - V: Energy from Biomass

Biomass conversion Technologies – wet and Dry process – Photosynthesis-Biogas Generation: Introduction – basic process and energetic – Advantages of anaerobic digestion – factors affecting bio digestion and generation of gas – Classification of Biogas plants**:** Continuous and batch type – the done and drum types of Bio gas plants – biogas from wastes fuel – properties of biogas – utilization of biogas.

BOOKS FOR STUDY AND REFERENCE:

1. F. Kreith and J.F. Kreider, Principles of Solar Engineering, Tata McGraw Hill (1978).
2. A.B. Meinel and A.P.Meinel, Applied Solar Energy, Addison Wesley Publishing Co. (1976).
3. M.P.Agarwal, Solar Energy, S. Chand and Co., New Delhi (1983).
4. S.P.Sukhatme, Solar Energy, Tata McGraw Hill (1997).
5. G.D. Rai, Non-conventional Energy sources, Khanna Publications, Delhi (2009).

ELECTIVE COURSE V: NONLINEAR DYNAMICS

UNIT – I: Introduction to Nonlinear Dynamical Systems

The notion of nonlinearity – superposition principle and its validity – linear and nonlinear oscillators – autonomous and non autonomous systems – equilibrium points – phase space classification of equilibrium points.

UNIT – II: Chaos

Simple bifurcations – the logistic map – period doubling phenomenon – onset of chaos – bifurcation scenario in Duffing oscillator – chaos in conservative systems – Poincare surface of section – Henon – Heiles systems – Lyapunov exponents.

UNIT – III: Solitons

Nonlinear dispersive system – cnoidal solitary waves – the scott Russles Phenomenon and K – dV equation – Fermi – Pasta – Ulam Numerical experiment – Numerical experiment of Zabusky and kruskal – birth of soliton.

UNIT – IV: Tools to solve Non – linear Equations

Integrability and methods to solve equations the notion of Integrability – Painleve analysis – Lax pair – Inverse Scatting Transform method – Bilinearization procedure – examples – Koteweg – de – Vires – Nonlinear Schordinger equations.

UNIT – V: Application of Non – Linear Dynamics

Applications – Chaos and secure communications – soliton in condensed matter system – Non linear optics and biological systems.

BOOKS FOR STUDY AND REFERENCE:

1. M. Lakshmanan and S. Rajasekar, Nonlinear dynamics Integrability Chaos and Patterns, Springer – Verlag, Berlin (2003).
2. P.G. Drazin, Nonlinear systems, Cambridge University Press, Cambridge (1992).
3. P.G. Drazin and R.S.Johnson, Solitons, An introductions, Cambridge University Press, Cambridge (1989).
4. M.J. Ablowitz and P.A Clarkson, solutions, Nonlinear Evolution Equations and Inverse Scattering, Cambridge University Press, Cambridge (1991).

ELECTIVE COURSE VI: MATERIALS SYNTHESIS AND CHARACTERIZATION

UNIT – I: Nucleation and Growth

The crystalline state - concept of crystal growth – historical review – Importance of crystal growth – crystal growth theory : classical theory – Gibbs – Thomson equation- kinetic theory of nucleation – Energy of formation of a nucleus – kinetics of thin film formation – Film growth – five stages – Nucleation theories – Incorporation of defects and impurities in films – Deposition parameters and grain size – structure of thin films.

UNIT – II: Growth Techniques

Solution growth technique: Low temperature solution growth: solution –Solubility – constant temperature bath an crystallizer – seed preparation and mounting – slow cooling and solvent evaporation methods.

Gel growth technique: Principle – various types – structure of gel – Importance of gel – Experimental procedure – Advantage of gel method.

Melt technique: Bridgman technique – Czochralski technique – Experimental arrangement – Growth process.

Vapour technique: Physical vapour deposition – chemical vapour deposition (CVD) – chemical vapour transport.

Unit – III: Thin Film Deposition Techniques

Thin films – Introduction to vaccum technology – deposition techniques – physical methods – resistive heating, electron beam cun and laser gun evaporation – sputtering: Reactive sputtering, radio frequency sputtering – chemical methods – spray pyrolsis – preparation of transport conducting oxides.

Unit – IV: Characterization Technique

X-ray Diffraction (XRD) – power and single crystal – Fourier transform infrared analysis – FT-Raman analysis – Elemental dispersive x-ray analysis (EDA–X) – scanning electron microscopy (SEM) – UV –VIS Spectrometer Vickers micro hardness – Auger emission spectroscopy. Photo luminance (PL) – UV-Vis-IR spectrometer – AFM – Hall effect – SIMS – X-ray – photoemission spectroscopy (XPS) – dynamic light scattering – Ellipsmety method.

Unit – V: Applicaions

Micro electrochemical systems (MEMS) – optoelectronic devices: LED, LASER and solar cell – polymer films – Fabrication and characterization of thin film transistor, capacitor, resistor, inductor and FET – Sensor – quanum dot – Applications of ferromagnetic and super conducting films: Data storage, Giant magneto resistance (GMR).

BOOKS FOR STUDY AND REFERENCE:

1. K. Sangawal, Elementary Crystal Growth, Shan Publisher, UK (1994).
2. P. Santhana Ragavan , P.Ramasamy, Crystal Growth and Processes, KRU Publications, Kumbakonam (2000).
3. J.C.Brice, Crystal Growth Process, John Wiley Publications, New York (1996).
4. L.I. Maissel and R. Clang, Hand book of Thin Films Technology, McGraw Hill (1970).
5. J. L. Vossen and W. Kern, Thin Films Process, Academic Press (1978).
6. M. Ohring, The Materials Science of Thin Films, Academic Press (1992).
7. M. William and D. Steve, Instrumental Methods of Analysis, CBS publishers, New Delhi (1986).
8. H.H. Williard, L.L. Merritt, M.J. Dean, and F.A. Settle, Instrumental Methods of Analysis, Sixth Edition, CBS Publishers and distributors, New Delhi (1986).
9. R.W.Berry, P.M.Hall and M.T.Harris, Thin Film Technology, Van Nostrand, New York (1968).
10. A. Goswami, Thin Film Fundamentals, New Age International (P) Ltd. Publishers, New Delhi (1996).

ELECTIVE COURSE VII : X-RAY CRYSTALLOGRAPHY AND BIOPHYSICS

UNIT –I: X-ray and crystals

Origin of X-rays – conventional generators-construction and geometry sealed tube- rotating anode generator-choice of radiation-Synchrotron radiation - Lattice planes-Miller indices - X-ray diffraction - Crystal systems and symmetry – unit cell – space lattices- non primitive lattices – point groups–space groups – analysis of space group symbols - Crystallization – growing crystals – choosing a crystals – crystal mounting- alignment – measurement of crystal properties.

Data collection techniques for single crystals: Laue method- single crystal diffraction cameras: rotation and Oscillation method – Ewald construction - Single crystal diffractometers: Instrument geometry-crystal in a diffracting position – Data collection strategy: determination of unit cell – orientation matrix - Intensity Data collection - Unique data –equivalent reflections –selection of data.

UNIT-II: Data Reduction

Integration of intensity - Lorenz and Polarization corrections – absorption – deterioration or radiation damage – scaling – Interpretation of Intensity.

Structure factors and Fourier syntheses: Structure factor –Friedel's Law – exponential and vector form – generalized structure factor – Fourier synthesis –Fast Fourier transform – Anomalous scattering and its effects. Calculation of structure factors and Fourier syntheses.

UNIT-III: Phase Problem

Methods of solving Phase Problem: Direct methods – Patterson methods –Heavy atom methods. Refinement of crystal structures: Weighting – Refinement by Fourier syntheses – Locating Hydrogen atoms identification of atom types – least squares – goodness of fit –least square and matrices-correlation coefficients – Relationship between Fourier and Least squares – Practical consideration in least squares methods – Random and systematic errors– Molecular geometry – absolute configuration – thermal motion.

UNIT-IV: Cell: Its organelles and molecules

Basic structure of prokaryotic and eukaryotic cells – mitochondiria and the generation of ATP – Chemical composition of living systems – molecular components of cell – chemical structure of carbohydrate–Lipids-proteins– Nucleic acids–hetro macro molecules.

Molecular interactions: Molecular forces – forces hold macro molecules together – intermolecular weak forces – van der waals – inductive force – dispersion force – Lenard-Jones potential – hydrogen bond – hydrophobic forces – acid, bases and pH, pK, pl and buffering.

UNIT-V: Macromolecular Structure

Nucleic acid structure – conformation of monomers and polymers – double helical structure of DNA – polymorphism of DNA – DNA super coiling – structure of transfer RNA. Protein structure – amino acids – primary structure – peptide bond – secondary structure – α-helix and β- sheet – tertiary and quaternary structure – Virus structure.

BOOKS FOR STUDY AND REFERENCE:

1. X-ray Structure Determination, Second Edition, Stout and Jensen, John Wiley Publications.
2. Fundamentals of Crystallography, Second Edition, C. Giacovazzo, Oxford Press.
3. Structure Determination by X-ray Crystallography, Second Edition, Ladd and Palmer.
4. Molecular Biophysics, Structure in motion, M. Duane, Oxford University Press.
5. Introduction to Molecular Biophysics, J.A. Tuszynski and M.Kurzynsk, CRC Press.
6. Principles of Physical Biochemistry, K.E. Van Holde, N.C. John and P.S. Ho, Prentice Hall Publications.
7. Biophysics, M.V. Volkenshtein, Mir Publications, Moscow.
8. Practical Protein Crystallography, Duncan E. McRee, Academic Press Publications.
9. Elements of X-ray crystallography, Leonid V. Azaroff, McGraw Hill Publications.
10. Biophysics An Introduction, Rodney M. J. Cotterill, John Wiley Publication.
11. Biophysics,Vasantha Pattabhi and N.Gautham, Narosa Publishing House.
12. Biophysics, Roland Glace, Springer Publications.
13. Elementary Biophysics An Introduction, P. K. Srivastava , Narosa Publishing House.

ELECTIVE COURSE VIII: ULTRASONICS AND ITS APPLICATIONS

UNIT - I: Source of Ultrasonic waves

Piezo electric - magnetostrictive transducers, electromechanical coupling factors and transducer efficiency - Transducers and band width characteristics - Equivalent electrical circuit of piezoelectric vibrators. Detection of ultrasonic waves: - Mechanical, thermal, electrical and optical methods.

UNIT - II : Techniques used in ultrasonic investigations

Interferometer, Optical, pulse, sing-around, radiation pressure and streaming methods – Measurement of propagation constants in different media – Relative merits of the techniques – Diffraction effects of sound velocity and absorption measurements – Hypersonic velocity and absorption measurements.

UNIT – III: Propagation of ultrasonic waves in liquids

Propagation of ultrasonic waves in liquids: mixtures. Excess compressibility and the relation to excess volume – Excess intermolecular free length – relative association. Sound velocity and compressibility of electrolytic solutions – Dispersion of sound in liquids – Different mechanisms of the absorption of sound – Relaxation phenomenon.

UNIT - IV: Dielectric measurements

Continuous wave and pulse techniques for measuring elastic constants of solids - Determination of elastic constants of cubic crystals – Dielectric behavior of materials – Dipole moment of polar and non – polar molecules – dielectric relaxation time – permittivity of solutions – breakdown – Strength of Glasses – Dielectric properties of liquid mixtures at different temperatures – Dielectric absorption.

UNIT – V: Applications

Acoustical grating – sonar – depth of sea – measurement of velocity of blood flow and movement of heart – Ultrasonic imaging – High resolution images – Non destructive testing – Principle – Methods – Liquid penetrant method - - Ultrasonic flaw detector – X- ray Radiography and Fluoroscopy – Thermography - Applications of Ultrasonics in NDT.

BOOKS FOR STUDY AND REFERENCE:

1. Fundamentals of Ultrasonics, J. Blitz, Second Edition, Plenum Press, New York,1967.
2. Physical Acoustics, W.P. Mason, 1959.
3. Sonics by P.P. Hueter and R.H. Bolt, Wiley, New York, 1955.
4. Molecular Acoustics, J. Matheson, Wiley, New York, 1971.
5. Ultrasonics: Fundamentals, Technologies and Applications, Third Edition, Dale Ensminger, Leonard J. Bond, CRC Press, 2011.

LIST OF EXTRA DISCIPLINARY COURSES

1. ELECTRONIC APPLIANCES

UNIT – I: ELECTRONIC COMPONENTS

Components – Resistors – Condensers – resistance Value – Capacitor Value – Diodes – transistors – IC's.

UNIT – II: ELECTRICAL APPLIANCES

Basic of UPS – Stabilizers – Voltage regulators – Iron Box – Heaters – Electrical Over – 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 – Satelites.

BOOKS FOR STUDY AND REFERENCE:

1. S. S. Kamble, Electronics & Mathematical Data Book, Allied Publishers Ltd., 1997.
2. William David Cooper, Electronic Instrumentation and Measurement Technique, Second Edition.

2. MEDICAL PHYSICS

Unit – I: Bioelectric Signals

Bioelectric Signals – Electrodes – Surface, Needle and Micro Electrodes – Biosensors – Pulse Sensors.

Unit – II: Transducers

Thermistors – Photo electric type – transducer – photo voltaic cells – Photo emissive cells – Diode - Detectors – Optical fibers.

Unit – III: Blood Pressure measurements

Sphygmomanometer: Measurement of heart rate – Basic Principles of EGC – Basic Principles of Electroneurography (ENG) – basic Principles of MRI.

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.

Unit – V: Thermography

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

BOOKS FOR STUDY AND REFERENCE:

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

3. GEOPHYSICS

UNIT – I: ORIGIN OF EARTH

Petrology – Evolution and composition of earth – Major subdivisions of earth's Sphere – Atmosphere – Hydrosphere – Lithosphere – Interior of earth – Composition of earth crust - Relative abundance of earth's crust.

UNIT – II: GEOMAGNETISM

Origin of earth's magnetism – elements of earth's magnetic field – inclination, declination and dip- earth's magnetic field – Diurnal, annual and secular variations – magnetosphere.

UNIT – III: SEISMOLOGY

Basic principles of elasticity and wave motion – primary wave (P-waves) and elasticity wave (S- wave) – density within the earth – pressure distribution – variation of 'g' and elastic constants - earth quakes – Elementary ideas about Ritter's scale.

UNIT – IV: GEO – THERMAL EFFECT

Fundamental concept of Thermal conductivity – heat flow measurement on ground level and ocean – heat flow gravity variation – temperature of the primitive earth – inner core – melting point – adiabatic temperature gradient.

UNIT – V: GRAVIMETRY

Fundamental concepts of gravitational field – gravitational anomalies – use of gravitational anomalies in geophysical prospecting – petroleum and mineral survey – factors affecting gravitational field due to magnetic storms and cosmic ray showers - Hammond and Faller method of absolute gravity measurement – principle and working.

BOOKS FOR STUDY AND REFERENCE:

1. Pedology, Concept and Applications, J.Sehgal, Kalyani publishers, 4863/2B, Bharat Ram Rode , 24, Daryaganj, New Delhi – 110 002
2. Introduction to Geophysics (mantle, core and crust), George G. Garland, W.B.Saunder's company, Philadelphia, London and Toranto.
3. Physics and Geology, Jacobbs, Russel and Wilson – International Students Edition, Tata McGraw Hill, New Delhi

4. Rock Magnetism, Nagata, McGraw Hill Publications, New Delhi.
5. Geology, Debrin, McGraw Hill Publications, New Delhi.
6. Physics and Geology, A.J. Aitken, Tata McGraw Hill Publications, New Delhi.
7. Biography of the earth (Its past, present and future), George Gamove, Macmillon company Ltd., Canada.

4. LASERS AND APPLICATIONS

UNIT –I: Introduction

Review of elementary quantum physics, Schrodinger equation, Properties of Laser Beams-monochromativity, temporal and spatial coherence, Directionality, Brightness, Radiation Trapping Super radiance, Super fluorescence, Amplified Spontaneous Emission, Non-radiative delay. Absorption, spontaneous emission and stimulated emission processes, relation between Einstein's A and B coefficients, population inversion, pumping, gain, optical cavities.

UNIT - II : Pumping process

Optical pumping and pumping efficiency - Electrical pumping and pumping efficiency. Passive Optical Resonators, Rate Equations, Three -level Laser, Four-level Laser, Methods of Q- switching: Electro optical shutter, mechanical shutter, Acousto - optic Q-switches, Mode locking.

UNIT- III : Main components of Laser

Main components of Laser, principle of Laser action, introduction to general lasers and their types. Three and four level Lasers, CW and Pulsed Lasers, atomic, ionic, molecular, excimer, liquid and solid state Lasers and systems, short pulse generation and measurement. Spatial Frequency Filtering – Holography – Applications of holography – HNDT (Holographic Non-Destructive Testing) holographic storage – optical disk storage – Laser speckle and speckle meteorology – SNDT (Speckle Non-Destructive Testing).

UNIT - IV: Lasers in Science

Saturation spectroscopy – excited state spectroscopy – nonlinear spectroscopy – time domain and its applications – stimulated Raman Emission – Laser fusion – Isotope separation – Medical applications, photo-chemical applications. Multiphoton photo-electric effects, Two-photon, Three-photon and Multiphoton Processes Raman Scattering, Stimulated Raman Effect.

UNIT -V: Lasers in industry

Materials processing – drilling, cutting, welding – alloying – glazing – oblation – Laser chemical vapour deposition (LCVD) – Laser thermal deposition – hardening, annealing – Laser Tracking – Lidar.

BOOK FOR STUDY AND REFERENCE:

1. K.R. Nambiar, Lasers Principles, Types and Applications, New Age International Publishers (2004).
2. S. A. Ahmad, Laser concepts and Applications, New Age International (2013).
3. B.B. Laud, Lasers and Non-linear Optics, New Age International, New Delhi (2007).
4. K. Thyagarajan and A.K. Ghatak, Lasers Theory and Applications, Mcmillan (1981).
5. K. Koebner, Industrial Applications of Lasers, Wiley (1984).
6. J.T. Cuxon and D.E. Parker, Industrial Lasers and their Applications, Prentice Hall (1985).
7. B. Culshaw,Optical Fiber Sensing and Signal Processing, Peter Peregrinus Ltd.,(1984).
8. F.C. Appard, Fiber Optics Handbook for Engineers and Scientist, McGraw Hill (1989).

MODEL QUESTION PAPER PATTERN

M.Sc. DEGREE EXAMINATION, NOVEMBER 2017

FIRST SEMESTER

PHYSICS

CLASSICAL AND STATISTICAL MECHANICS

Time: Three hours Maximum: 75 marks

SECTION – A (10×1=10 marks)
Answer ALL Questions

Choose the correct answer:

1. If the total external force vanishes, the total linear momemtum is conserved.
   a). Theorem of conservation of linear momentum.
   b). Theorem of conservation of torque.
   c). Theorem of conservation of energy.
   d). Theorem of conservation of forces.

2. If the constrains are independent of time, they are termed as
   a). Scleronomic b). Holonomic c). Non holonomic d). Rheonomic.

3. Poisson brackets are ----------------- under a canonical transformation.
   a). Variant b). Invariant c). Equivalent d). Constant.

4.Volume in phase space is under
   a).Canonical transformation b).Hamiltonian c).Jacobi identity d). Lagrangian.

5. Velocity of light added to the velocity of light gives velocity of light.
   a). Relativistic law of addition of velocities.
   b). Lorentz transformation
   c). Galilean transformation
   d). Classical mechanics.

6.The curve traced out by the point of contact on the ellipsoid is
   a). Polhode b). Herhode c). Velocity d). Displacement.

7. The rate of density of phase point in phase space is zero.
   a). Liouville's Theorem b). Probability Density
   c). Microscopic States d). Macroscopic States.

8. An ensemble in which each system has same fixed energy as well as the number of particles.

a). Canonical ensemble b). Grand Canonical

c). Average energy d). Microcanonical ensemble.

9. Helmholtz free energy is

a). F= E-TS b). F= V-SV c). F= L-TS d). F= K- WS

10. Particle with half integral spin is

a). Fermi Dirac statistics b).Bose Einstein statistics

c). Classical statistics d). Quantum statistics.

SECTION- B (5×5=25 marks)

Answer ALL Questions

11. a). Obtain the equation of motion of a system of two masses connected by an inextensible string passing over a small pulley.

Or

b).Derive Hamilton's equations from the variational principle. Deduce Hamilton's principle.

12.a). Obtain Canonical transformation equations corresponding to first two types of generating functions.

Or

b). Discuss the Hamilton's – Jacobi Theory. In what circumstances is the characteristic function W more useful than the special function S.

13. a). Discuss in detail about the Coriolis force.

Or

b). Obtain an expression for the relativistic kinetic energy.

14. a). Prove the relation S= K ln Ω where S is the entropy and is the number of microstates in the range E and E+ SE and K is the Boltzmann constant.

Or

b). State and prove Liouville's theorem.

15. a). Discuss the phenomenon of Bose- Einstein condensation.

Or

b). Obtain Planck's formula for radiation.

SECTION – C (5×8 =40 marks)

Answer ALL Questions

16. a). What is D' Alembert's principle? Derive Lagrange's equation of motion from it for a non- conservative system.

Or

b). Find the curve joining two points along which a particle falling from rest under the influence of gravity and travels from the higher to the lower point in the lease time.

17. a).Give an account of the Hamilton-Jacobi theory and illustrate it by applying it to the Kepler's problem.

Or

b). (i) Prove that the Poisson's bracket is invariant under canonical transformation.
(ii) Prove that, if u,v are constants of motion, then (u,v) is also a constant of motion.

18. a). Obtain Euler's equations of motion for a rotating rigid body.

Or

b). Illustrate the technique of obtaining the normal modes and resonant frequencies for a linear symmetrical triatomic molecule.

19. a). What is meant by micro canonical, canonical and grand canonical ensembles?. Compare these three types of ensembles.

Or

b). Discuss about the perfect gas in grand canonical ensemble and derive the expressions for chemical poterntial, entropy and internal energy.

20. a). Derive the distribution law according law to Fermi- Dirac statistics and discuss the various properties of an ideal Fermi gas at high temperature.

Or

b). Deduce the partition function in Maxwell Boltzmann statistics and hence deduce other thermodynamic relations.

MODEL QUESTION PAPER PATTERN

M.Sc. DEGREE EXAMINATION, NOVEMBER 2017

FIRST SEMESTER

PHYSICS

MATHEMATICAL PHYSICS

Time: Three hours | Maximum: 75 marks

SECTION – A (10×1=10 marks)
Answer ALL Questions

Choose the correct answer:

1. The Eigen vectors of a Hermitian Vectors are
   (a). real (b). imaginary (c). complex (d). ± 1
2. The product of two unitary matrices is
   (a). Symmetric (b). antisymmetric (c). orthogonal (d). unitary
3. Which function represents F $(1,1,2,x)$
   (a). $\ln(1+x)$ (b). $\frac{1}{x}\ln(1-x)$ (c). $\frac{1}{x}\ln(1+x)$ (d). $-\frac{1}{x}\ln(1-x)$
4. The Wronskian of the two linearly independent solutions of the Hermite differential equation is proportional to
   (a). $\exp(x)$ (b). $\exp(-x)$ (c). $\exp(-x^2)$ (d). $\exp(x^2)$
5. The value of $p_n(-1)$ is
   (a). 0 (b). 1 (c). -1 (d). $(-1)^n$
6. The modified Bessel's function *Jn(x)* and *kn(x)* are
   (a). Oscillatory in nature (b). Exponential in nature
   (c). Linear in nature (d). Constant in nature.
7. If $f(t)= a_1f_1(t)+a_2f_2(t)+......$, then the Fourier transform of $f(t)$ is given by
   (a). $a_1g_1(\omega)+a_2g_2(\omega)+......$ (b). 0 (c). 1 (d). ∞
8. A function f(x) is detained as half range Fourier Cosine series if
   (a). $a_0 = 0$ and $a_n = 0$ (b). $a_0 = 0$ and $b_n = 0$
   (c). $a_0 = 0$ and $b_2 = 0$ (d). $b_n = 0$, a_0 and a_n exist.
9. If a function of two variables is a solution of Laplace's equation then the function is said to be
   (a). conjugate (b). harmonic
   (c). anharmonic (d). discontinuous.

10. The real and imaginary parts of a complex function *f(z)= u(x, y) + iv (x, y)* that is analytic in domain D have continuous second order differential partial derivatives and satisfy the

(a). Bessel equation (b). Laplace' equations in 2 dimensions

(c). C-R equation (d). Poisson's equation

SECTION- B (5×5=25 marks)

Answer ALL Questions

11. (a). Given $3\begin{pmatrix} x & y \\ z & w \end{pmatrix} = \begin{pmatrix} x & 6 \\ -1 & 2w \end{pmatrix} + \begin{pmatrix} 4 & x+y \\ z+w & 3 \end{pmatrix}$. Find *x, y, z, w.*

Or

(b). Prove that Eigen values of an idempotent matrix are either zero or unity.

12. (a). $y'' - xy' + x^2y = 0$. Solve differential equation by power series method.

Or

(b). Show by means of Wronskian, that a linear, second order, homogenous ODE of the form $y''(x) + p(x)\, y'(x) + Q(x)\, y(x) = 0$ cannot have 3 independent solutions (Assume a third solution and show that the Wronskian vanishes for all *(x)*).

13. (a). Derive Bessel's equation from Legendre's equation.

Or

(b). Derive spherical Bessel functions.

14. (a). Obtain the Laplace transform of half wave rectifier.

Or

(b). Find the Laplace transform of Saw tooth waveform.

15. (a). Find the finite Fourier sine and cosine transforms of the wave functionsf(x) = x^2; $0<x<4$.

Or

(b). Find the Fourier transform of the squared modulus of a function given by self-convolution integral.

SECTION – C (5×8 =40 marks)

Answer ALL Questions

16. (a). Find the matrices method from the following. Let A^T and B^T be the transposes of the matrices A and B respectively.

(i) $(A^T)^T = A$

(ii) $(\lambda A)^T = \lambda A^T$, λ being any scalar (real or complex)

(iii) $(A + B)^T = A^T + B^T$, A and B being conformable for addition.

(iv) $(AB)^T = B^T A^T$, A and B being conformable for multiplication.

Or

(b).(i) State and prove Cayley- Hamiltonian theorem for the square matrices.

(ii) State and prove the reversal law for the transpose of the product of two matrices.
(iii) Show that the diagonal elements of Hermitian matrix are either zero or real.

17. (a). Find the solution of differential equation $y'' - 4y' + 3y = x$ satisfying the initial conditions $y\ (0) = \frac{4}{9}$ and $y'(0) = \frac{D}{3}$.

Or

(b). Find the power, series solution of linear oscillator equation $y'' + \omega^2 y = 0$ in powers of (x) (that is, near $x=0$).

18. (a). Derive Generating function for $J_n\ (x)$.

Or

(b). Show that Legendre's polynomial is orthogonal and find the value of $\int_{-1}^{+1} [P_1\ (x)]^2 dx$.

19. (a). Find the finite sine transform of:

(i). e^{ax} (ii). $sin\ ax$ and (iii). $\frac{x}{n}$

Or

(b). Derive the Fourier transform of functions of two or three variables.

20. (a). Find the Laplace transforms of

(i). sinh at (ii). cosh at (iii). sin at (iv). cos at.

Or

(b). (i). Derive Laplace transform of Gamma function.
(ii). Derive Laplace transform of Bessel function.

MODEL QUESTION PAPER PATTERN

M.Sc. DEGREE EXAMINATION, NOVEMBER 2017

FIRST SEMESTER

PHYSICS

QUANTUM MECHANICS – I

Time: Three hours Maximum: 75 marks

SECTION – A (10×1=10 marks)
Answer ALL Questions

Choose the correct answer:

1). The electron has a speed 1.05×10^4 m/s within the accuracy of 0.01%.Calculate the uncertainty in the position of the electron.(Given $\hbar=1.05\times10^{-34}$ Given joule-sec, $m=9\times10^{-31}$).

a) 1.1×10^{-4} mt b) 1.1×10^{-5} mt c) 1.1 mt d) 1.1×10^{-2} mt

2). Two Eigen functions of Hermitian operators, belonging to different Eigen values, are orthogonal. Say true or false

3). First order stark effect in ground state hydrogen atom is

a) Zero b) one c) $3eEa_0$ d) $-3eEa_0$

4). The condition for the validity of W.K.B approximation is -------------------------

5). $[J_+, J_-]$is equal to

a) $2\hbar J_z$ b) $-2\hbar J_z$ c) $\hbar J_z$ d) $-\hbar J_z$

6). $[J^2,J_-]$is equal to

a) Zero b) one c) $\hbar J_-$ d) $-\hbar J_-$

7). The lowest energy Eigen value of harmonic oscillator is

a) $\frac{1}{2}\hbar\omega$ b) $-\frac{1}{2}\hbar\omega$ c) $n+\frac{1}{2}\hbar\omega$ d) $n-\frac{1}{2}\hbar\omega$

8). Orthogonal wave-functions remain orthogonal under a unitary transformation. Say true or false.

9). For adiabatic approximation $\left\langle m\left|\frac{\partial H}{\partial t}\right|k\right\rangle$ should be

a) Appreciable b) one c) zero d) very small

10). The important result of time dependent perturbation theory is called -------------------

SECTION- B (5×5=25 marks)
Answer ALL Questions

11. a). Derive Schroedinger equation in momentum representation.

Or

b).What is meant by Hermitian operator?.Show that Hermitian operators have real Eigen values.

12. a).Calculate the first order stark splitting of n=2 level of hydrogen atom using first order time independent perturbation theory.

Or

b). State and prove the variational principle for obtaining approximate energies.

13. a). Find angular momentum matrices for j=1?

Or

b). show that $[\sigma_x , \sigma_y] = 2i\sigma_z$ and $[\sigma^2 , \sigma_x] = 0$

14. a).Write short notes on Unitary transformation.

Or

b). Write short notes on Bra and Ket vectors.

15. a). Write short notes on sudden approximation.

Or

b). Give the time dependent perturbation for harmonic perturbation.

SECTION – C (5×8 =40 marks)
Answer ALL Questions

16. a).State and derive Ehrenfest theorem.

Or

b). Derive Heisenberg's uncertainty relation between i) position and momentum and ii).energy and time.

17. a). Discuss the perturbation theory for non-degenerate levels in first and second orders.

Or

b). Describe W.K.B method for the solution of Schrodinger wave equation in a potential field and discuss its validity.

18. a). Starting from commutation relation,derive the eigen values of J^2 and J_z.

Or

b). Obtain Clebsch Gordan coefficient when $J_1 = 1/2$ and $J_2 = 1/2$

19. a). Give matrix theory of linear harmonic oscillator.

Or

b). Obtain state vector and equation motion in Heisenberg picture.

20. a). Derive Fermi-golden rule for the transition rate from a given initial state to a final state of continuum.

Or

b). Give an account of adiabatic approximation.

MODEL QUESTION PAPER PATTERN

M.Sc. DEGREE EXAMINATION, NOVEMBER 2017

SECOND SEMESTER

PHYSICS

MICROPROCESSORS AND MICROCONTROLLERS

Time: Three hours Maximum: 75 marks

SECTION – A (10×1=10 marks)
Answer ALL Questions

Choose the correct answer:

1. One of the most common measurements of a microprocessor's power is its ………………………
2. Which of the following is not an ALU function?.
   a. Add b. Power- up- sequence c. shiff left d. complement
3. You are using a 16- bit Microprocessor. It candirectly address 4, 194, 304 memory locations. you would expect the stack pointer in this microprocessor to be ----- bits long

   a. 4 b. 8 c. 16 d. 22 e. 22 f. 32

4. The memory addressing mode that takes the lease time is ----------

5. An advantage of memory- mapped I/O is …………………….

6. The 8051 address ………………. separate memory spaces
   a. 2 b. 6 c. 4 d. 8
7. The 8051 stack pointer is different from general – purpose microprouser stack pointer because it is …………….
8. The 8051 special instruction XCHD
   a. Exchanges data between accumulator and the source
   b. Exchanges data between accumulator and reg. D
   c. Exchanges data between two location
   d. Exchanges the accumulator low – order hibble with the source low- order nibble.

9. The simplest form of I/O. service routine is a (n) …………..routine
   a. Polling b. interrupt c. Memory read d. Memory write.

10. Direct memory access is used to
   a. Transfer data to memory via the accumulator
   b. Transfer data out of memory via the accumulator
   c. Accomplish a high- speed data transfer between system memory and another external device.
   d. a and b are correct.

SECTION- B (5×5=25 marks)
Answer ALL Questions

11. (a) What are the differences between PUSH and POP instructions?

Or

(b) Write an assembly language program to get the sum of a series of8 bit numbers.

12. (a) Explain any three addressing modes of 8086.

Or

(b) What are the segment registers used in 8086? Explain.

13. (a) Explain the open loop control with suitable example .

Or

(b) Explain the mode 1 input mode operation of 8255 in detail.

14. (a) Explain four different timer modes in 8051.

Or

(b) Explain how internal and external memory is handled by 8051.

15. (a) Explain the programming of counter and timer of 8051.

Or

(b) Explain the serial data I/O of 8051 microcontroller.

SECTION – C (5×8 =40 marks)
Answer ALL Questions

16. (a) Explain the architecture of 8055 with neat diagram.

Or

(b) Discuss briefly about the instruction cycle and machine cycle with suitable example.

17. (a) Explain the operations carried out when 8086 executes the instructions XLAT ,INSB and POPBX.

Or

(b) Explain the memory organization of 8086.

18. (a) With neat diagram, discuss about microprocessor based crystal growth control system.

Or

(b) Draw and explain the functional block diagram of programmable peripheral interface 8255.

19. (a) Describe the function of major hardware components of 8051 microcontroller.

Or

(b) Explain in detail the special function registers of 8051.

20. (a) Explain briefly the instruction set with addressing modes of 8051.

Or

(b) Write an assembly language program using 8051 instructions to find the smallest and biggest element in an array.

MODEL QUESTION PAPER PATTERN

M.Sc. DEGREE EXAMINATION, NOVEMBER 2017

THIRD SEMESTER

PHYSICS

QUANTUM MECHANICS – II

Time: Three hours Maximum: 75 marks

SECTION – A (10×1=10 marks)
Answer ALL Questions

Choose the correct answer:

1). The dimension of Spin density matrix is -------------

2). The Particle exchange operator commutes with the Hamiltonian, is it true or false.

3). The Born approximation is applicable whenever potential function is

a) weak b) Large c) Zero d) falls of rapidly

4). In the low energy limit, the scattering cross-section is ------- the geometrical cross section.

a) 4 times b) Twice c) Zero d) Equal to

5). The electric field associated with the emitted radiation will be ------ polarized with its electric vector oscillating in the plane z-axis and the direction of the emitted radiation k.

a) Linearly b) Circularly c) Elliptically d) Plane

6). The electromagnetic field in the closed cavity can be considered as -----------

7). The alkalis can be treated to quite good approximation in terms of the model in which a single electron moves in a spherically symmetric ---------------- potential.

a) Non-Coulomb b) Coulomb c) Central d) Attractive

8). Thomas-Fermi statistical model is applicable to atoms with larger -------------

9). Dirac matrices anti commute with one another in pairs: True or false.

10). Spin- orbit energy appears as an automatic consequence of the ------------------

SECTION- B (5×5=25 marks)
Answer ALL Questions

11. a).What is density matrix?.How is it useful in finding the ensemble average?.

Or

b). Obtain Eigen values and Eigen functions of particle exchange operators?.

12. a). Calculate formal expression for scattering amplitude using Green's function.

Or

b). Derive an expression for scattering length and effective range.

13. a). What are Einstein co-efficient's?. How are they related?.

Or

b). Write short notes on electric dipole transition.

14. a). Discuss in detail Fermi-Thomas model.

Or

b). Write short notes on doublet separation in alkali atoms.

15. a). Prove that a Dirac electron has a magnetic moment.

Or

b). Discuss in detail spin– orbit energy.

SECTION – C (5×8 =40 marks)

Answer ALL Questions

16. a). What are symmetric and antisymmetric wave functions? Construct the same for hydrogen molecule.

Or

b). Obtain Pauli's exclusion principle from Slater's determinant and Explain its with statistical mechanics.

17. a). Explain the method of partial waves to calculate total scattering cross section and the phase shifts.

Or

b). Apply Born approximation to calculate the scattering cross-section from screened coulomb field. Discuss the validity of the result.

18. a). Calculate Einstein's transition probability for induced emission and absorption from semi-classical theory of atom field interaction.

Or

b).Show that quantum mechanically we can visualize the radiation field as an infinite number of simple harmonic oscillators.

19. a). Outline Heitler-London theory of the hydrogen molecule and discuss the results.

Or

b). Explain self consistent field concept and Obtain Hartree Fock equation.

20. a). Find Dirac matrices and obtain plane wave solutions of the Dirac equation.

Or

b). Derive KG equation in electromagnetic field.

MODEL QUESTION PAPER PATTERN

M.Sc. DEGREE EXAMINATION, NOVEMBER 2017

FOURTH SEMESTER

PHYSICS

MOLECULAR SPECTROSCOPY

Time: Three hours Maximum : 75 marks

SECTION – A (10×1=10 marks)
Answer ALL Questions

Choose the correct answer:

1. Finger print region in IR is
   a) 400 to 1400 cm^{-1} b) 1400 to 900 cm^{-1} c) 900 to 600 cm^{-1} d) 600 to 250 cm^{-1}
2. An FTIR instrument record the signal in
   a) Time domain b) Frequency domain c) Both of these d) None of these.
3. Shorter wavelength Raman lines are called
   a) Stokes b) Rayleigh c) anti stokes d) none of the above.
4. FT- Raman activity of a molecule is due to
   a) Change in dipole moment b) Change in magnetic moment c) Change in polarizibility
   d) None of these.
5. Vibrational changes produce a ___________ structure and rotational changes a ________ structure.
6. Fluorescence occurs when a molecule loses its excess energy as a photon

   a) while returning to the electronic ground state from an excited triplet state.
   b) while returning to the electronic ground state from an excited singlet state.
   c) lowers its vibrational energy.
   d) none of the above.
7. In NMR spectroscopy the applied electromagnetic radiation is
   a) Microwave b) UV radiation c) Radiowaves d) None of these.
8. The sequences of pulses applied in NMR spectroscopy is
   a) 90^o-τ-180^o b) 180^o-τ-90^o c) 90^o-τ-90^o d) None of these.

9. ESR is also called as

a) EPR b) NQR c) NMR d) ESR.

10. The region in which NQR spectra is observed is

a) Microwave region b) UV region c) Radiowave region d) visible region.

SECTION- B (5×5=25 marks)
Answer ALL Questions

11. a) Describe the theory of vibrational IR spectra.

Or

b) Explain briefly about the classification of molecules in terms of moment of inertia.

12. a) Define Raman effect and state the condition for a vibration to be Raman active?.

Or

b) What is resonance Raman effect? Distinguish between normal and resonance Raman effect.

13. a) Explain vibrational course structure of a diatomic molecule.

Or

b) Describe the experimental method of fluorescence spectroscopy

14. a) Discuss spin – lattice relaxation in NMR.

Or

b) List the important applications of NMR and NQR.

15. a) Explain briefly the factors responsible for the hyperfine structure in ESR.

Or

b) What is isomer shift? What are the spectral parameters required for evaluating the Mossbauer spectra?.

SECTION – C (5×8 =40 marks)
Answer ALL Questions

16. a) Describe the instrumentation details of IR spectrometer with suitable block diagram.

Or

b) Obtain the expression for the rotation – vibration spectra of a symmetric top molecule.

17. a) Write down the principle, techniques and applications of FT-Raman Spectroscopy.

Or

b) Write the principle and working of Coherent Anti-stokes Raman spectroscopy

18. a) State and explain the Franck Condon principle.

Or

b) Give the application of Florescence and Phosphorescence.

19. a) Give the quantum mechanical description of NMR spectrometer.

Or

b) Explain the applications of structural information of NQR spectroscopy.

20. a) Explain the principle, construction and working of ESR spectrometer.

Or

b) (i) Explain the different parts of Mossbauer spectrometer and it's working.

(ii) Give the biological applications of Mossbauer spectroscopy.

MODEL QUESTION PAPER PATTERN

M.Sc. DEGREE EXAMINATION, NOVEMBER 2017

FOURTH SEMESTER

PHYSICS

NUCLEAR AND PARTICLE PHYSICS

Time: Three hours Maximum : 75 marks

SECTION – A (10×1=10 marks)
Answer ALL Questions

Choose the correct answer:

1. Which of the following particles has the smallest mass?

a). Proton b). Electron c). Neutron d). Nucleus

2. Binding energy is:

a). the amount of energy required to break a nucleus apart into protons and neutrons.
b). the amount of energy required to break a nucleus apart into protons and electrons.
c). the amount of energy required to break a nucleus apart into electrons and neutrons.
d). the amount of energy released when neutrons change energy levels.

3. 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.

4. Angular momentum of deuteron is

a). 1 b). 3/4 c). 1/4 d). ½

5. For breeding to be practical in a reactor η must be greater than

a). 1.2 b). 2 c). 2.2 d). 2.6

6. The emission of an α- particle reduce the atomic mass number

a). 2 b). 4 c). 1 d). 3

7. Which of the following fuel material occurred naturally?
a). U^{235} b). Pu^{239} c). Pu^{241} d). U^{-233}

8. Which of the following correctly balances this decay reaction?

$$^{230}_{90}\text{Th} \rightarrow \; ^{0}_{-1}\text{e} + \_\_\_$$

a). $^{231}Ac_{89}$ b). $^{230}Pa_{91}$ c). $^{230}Ac_{89}$ d). $^{230}Th_{91}$

9. Particles that make up the family of hadrons are
   a). Baryons and mesons. b). Leptons and baryons.
   c). Protons and electrons. d). Muons and leptons.

10. The first antiparticle found was the
   a). Positron b). Hyperon c). Quark d). Baryon

SECTION- B (5×5=25 marks)
Answer ALL Questions

11. a) Define nuclear binding energy and explain the variation of it with atomic number.

Or

b) Calculate the binding energy of alpha particle in MeV from the following data.
Mass of helium nucleus = 4.001506 amu, Mass of proton =1.007276 amu,
Mass of neutron =1.008665 amu.

12. a) Write a note on tensor force.

Or

b) Obtain the expression for the phase shift in low energy n-p scattering.

13. a) Derive the expressions for scattering and reaction cross sections.

Or

b) Write a note on pick up and stripping reactions.

14. a) Describe Fermi's theory of Beta decay.

Or

b) Describe the Principle and working of G.M counter.

15.a) Write a note on π and μ mesons.

Or

b) Write note on week and strong interaction of elementary particle.

SECTION – C (5×8 =40 marks)
Answer ALL Questions

16.a) Give an account of liquid drop nuclear model with its salient features.

Or

b) Discuss Semi Empirical Mass Formula and explain each term.

17. a) What is Yukawa's potential?. Give the Yukawa meson theory of nuclear forces.

Or

b) Explain the ground state of deuteron.

18.a) Write notes on Breit and wigner dispersion formula for nuclear reaction and Q-equation.

Or

b) Describe the types of nuclear fission reactors.

19. a) Discuss Gamow's theory α-decay.

Or

b) Explain briefly internal conversion and nuclear isomerism.

20. a) Account for the Su(3) multipliers using the quark model.

Or

b) What are elementary particles?. Describe briefly the discovery and properties of important elementary particles.

MODEL QUESTION PAPER PATTERN

M.Sc. DEGREE EXAMINATION, NOVEMBER 2017

FOURTH SEMESTER

PHYSICS

NANO PHYSICS

Time: Three hours Maximum : 75 marks

SECTION – A (10×1=10 marks)
Answer ALL Questions

Choose the correct answer:

1. Bragg's law is
   (a). 2n sinθ = dλ (b). 2λ sinθ = nd
   (c). 2d sinθ = nλ (d). λ= n sinθ
2. A dielectric material can be polarized by applying _________ field on it.
   (a). magnetic (b). meson
   (c). gravitational (d). electric
3. The wave function of an electron in a three-dimensional potential well is
   (a). $\psi_n^{(x)} = 2\sqrt{\left(\frac{2}{L}\right)} \sin\left(\frac{n\pi x}{L}\right)$ (b). $\psi_n^{(x)} = \sqrt{\left(\frac{2}{L}\right)} \sin\left(\frac{n\pi x}{L}\right)$
   (c). $\psi_n^{(x)} = \sin\left(\frac{n\pi x}{L}\right)$ (d). $\psi_n^{(x)} = \sqrt{\left(\frac{1}{L}\right)} \sin\left(\frac{n\pi x}{L}\right)$
4. Splitting of energy levels under external magnetic field is called as
   (a). Zeeman effect (b). Raman effect
   (c). Stark effect (d). Rayleigh's effect
5. The total strain energy increases linearly with
   (a). volume (b). thickness
   (c). pressure (d). all the above.
6. Nanostructures of materials confined in all the three dimension are
   (a). thin films (b). quantum well
   (c). Nano tubes (d). quantum dots.
7. The net movement of atoms / molecules from higher concentration to lower concentration is
   (a). Active transport (b). Electrolysis
   (c). Diffusion (d). Osmosis.
8. An interesting phenomenon of transmission of light through patterned metal surface can be explained by
   (a). Spintronics (b). Plasmonics
   (c). Electronics (d). all the above.

9. For cubic crystals, interplanar spacing is

(a). $d_{[hkl]} = \frac{a}{\sqrt{h^2+k^2+l^2}}$ (b). $d_{[hkl]} = \frac{2a}{\sqrt{h^2+k^2+l^2}}$

(c). $d_{[hkl]} = \frac{1}{\sqrt{h^2+k^2+l^2}}$ (d). $d_{[hkl]} = \frac{4a}{\sqrt{h^2+k^2+l^2}}$

10. Semiconductor laser action is based on

(a). Indirect band gap materials (b). Direct band gap materials

(c). Metals (d). Insulators

SECTION- B (5×5=25 marks)
Answer ALL Questions

11. (a). Explain Quantum confinement.

Or

(b). Discuss about Surface Plasmon Resonance in metal nanoparticles.

12. (a). Explain the classification of materials.

Or

(b). An electron is bound in 1-D infinite well of width 1×10^{-10}m. Find the energy values in ground state and first excited state.

13. (a). Discuss about electron beam lithographic technique.

Or

(b). How self-assembly in organic layers occur. Explain with a neat diagram.

14. (a). What are the different types of carbon nanotubes? Give any three excellent properties of carbon nanotubes.

Or

(b). Give the schematic of tunnel diode and explain its working.

15. (a). Name any five applications of nanoscience in biology. What do you understand by 'mechanical surgeon' in nanotechnology?

Or

(b). Elucidate the relation between optical properties and the electronic structure of materials.

SECTION – C (5×8 =40 marks)
Answer ALL Questions

16. (a). Discuss about (i). Laser ablation (ii). Chemical vapour deposition.

Or

(b). Describe about the seven crystal systems in detail.

17. (a). Derive the expression for 3D Density of States.

Or

(b). Explain briefly the principle of time dependent perturbation theory and derive the equation for transition probability.

18. (a). Explain in detail, the working principle of Scanning Tunneling Microscope with a neat diagram.

Or

(b). Explain in detail, the working principle of Atomic Force Microscope with a neat diagram.

19. (a). Derive the expression for Hall voltage and explain the mechanism of Hall effect.

Or

(b).What are thin films?. Discuss in detail about their fabrication techniques.

20. (a). Elucidate the construction, working principle and application of OLEDs and OTFTs with a neat diagram.

Or

(b). Discuss about charge transport, DNA, and protein functional systems in detail.

MODEL QUESTION PAPER PATTERN

M.Sc. DEGREE EXAMINATION, NOVEMBER 2017

FOURTH SEMESTER

PHYSICS

MATERIALS SYNTHESIS AND CHARACTERIZATION

Time: Three hours   Maximum : 75 marks

SECTION – A (10×1=10 marks)
Answer ALL Questions

Choose the correct answer:

1. The net free energy change ______________ with the increase in size of the nucleus
   (a) Increases   (b) Decreases
   (c) Zero   (d) None

2. According to kossel , which is responsible for attachment of homopolar crystals ___________
   (a) Vander Waals forces   (b) Electrostatic forces
   (c) Difference in concentration   (d) Reticular densities

3. The Bridgeman technique cannot be used for material which __________
   (a) Decompose before they melt
   (b) Undergo solid state phase transformation between their melting point and the temperature to which they will be cooled
   (c) Both (a) & (b)   (d) Has Low Melting Point

4. Seed crystals are best prepared by ___________
   (a) Slow cooling   (b) Slow evaporation
   (c) Both (a) & (b)   (d) None

5. In sputtering, gaseous (Ar) atoms are ionized at low pressure by a/ an ___________
   (a) Magnetic field   (b) Electric field
   (c) Both (a) & (b)   (d) Thermal energy

6. Substrate are placed on a heater that provides sufficient thermal energy for ___________
   (a) Crystalline thin film growth   (b) Non-crystalline thin film growth
   (c) Amorphous film growth   (d) All the above

7. The exotherm maxima on the DTA curve indicates _____________
   (a) Decomposition   (b) Phase transition
   (c) Fusion   (d) Dehydration

8. EDAX Analysis is used for identifying

(a) Elemental composition (b) Functional groups

(c) Hydrogen bonding (d) Weight loss.

9. GMR values _______________ with decrease in temperature for cleaner metal lays

(a) Increase (b) Decrease

(c) Constant (d) None.

10. In a quantum dot, the carrier motion is quantized along ______________

(a) All three spatial directions (b) Along two dimensions

(c) Along one dimension (d) Along z-direction

SECTION- B (5×5=25 marks)

Answer ALL Questions

11. a) Explain the types of Bravais lattices of crystal with diagram.

Or

b) Write a brief note on the importance of crystal growth.

12. a) Explain the structure of gel.

Or

b) Discuss slow cooling and solvent evaporation method.

13. a) Describe electron beam gun evaporation technique for thin film deposition on substrate.

Or

b) What are transport conducting oxides? Explain briefly.

14. a) Explain briefly Vicker's micro hardness test.

Or

b) Briefly explain operating modes and components of AFM.

15. a) Write short notes on micro electrochemical systems.

Or

b) What is GMR? Explain its important features..

SECTION – C (5×8 =40 marks)

Answer ALL Questions

16. a) Give the kinetic theory of nucleation.

Or

b) Describe kinetics of thin film formation and explain film growth.

17. a) Give the kinetic theory of nucleation.

Or

b) Explain i) Chemical vapour deposition.

ii) Chemical vapour transport.

18. a) Describe any one chemical method for the deposition of thin film on substrate with neat sketch.

Or

b) Explain reactive and radio frequency sputtering techniques.

19. a) Describe the construction and working of SEM.

Or

b) Describe the working of UV-Vis spectrometer.

20. a) Explain briefly i) Polymer films ii) Quantum dots.

Or

b) Describe the fabrication and characterization of thin film resister and FET.

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MODEL PRACTICAL QUESTION PAPER PATTERN

M.Sc. DEGREE EXAMINATION, NOVEMBER 2017

FIRST SEMESTER

PHYSICS

PRACTICAL – I : GENERAL PHYSICS EXPERIMENTS

Time : 4 Hours. Maximum marks : 75

1. Experimentally study the diffraction at straight edge using laser.

2. Study the interference pattern using an optically plane glass plate and a laser.
.
3. Determine the velocity and compressibility of a given liquid using ultrasonic interferometer.

4. Determine the wavelength of the given monochromatic source and the thickness of a sheet using Michelson interferometer.

5. Determine the following using Hall effect :
(i) Charge of the carriers (ii) Hall voltage (iii) Hall Coefficient
(iv) Carrier density (v) Hall angle (vi) Mobility carriers.

6. Determine the magnetic susceptibility of the given salt by Guoy's method.

7. Determine the elastic constants of glass by Cornu's method, forming elliptic fringes.

8. Using G.M. Counter (i) verify Inverse square law for Gamma rays, (ii) estimate the range of beta and gamma rays and (iii) determine the absorpition coefficient of a metal foil for beta rays.

9. Determine Rydberg's constant by solar spectrum.

10. Determine the wavelength of a Laser by Michelson Interferometer.

11. Determine the Young's modulus and Poisson's ratio of a glass plate by forming Hyperbolic fringes.

12. Using the given experimental setup, determine the value of stefan's constant.

13. Photograph the absorption spectrum of the given specimen. From this determine the wavelength of the absorption band. Check the experimental valves with standard values.

14. Determine the susceptibility of a given liquid by Quinke's method.

15. Obtain the electronic vibrational spectrum of Aluminium oxide and calculate the characteristic wave numbers and the force contant of Aluminium oxide.

16. Determine (i) the thickness of FP 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.

17. Calculate the band gap energy of the given semiconductor. Repeat the experiment for four different tempertures.

18. Photograph the band spectrum of CN. Determine the force constants, moment of inertia, interatomic distance, harmonicity factor and band dissociation energy for CN bands.

19. Determine the compressibility of liquid using Ultrasonic interferometer.

20. Determine the permittivity of a liquid using R.F. Oscillator.

MODEL PRACTICAL QUESTION PAPER PATTERN

M.Sc. DEGREE EXAMINATION, NOVEMBER 2017

SECOND SEMESTER

PHYSICS

PRACTICAL - II: ELECTRONICS EXPERIMENTS

Time : 4 Hours. Maximum marks : 75

1. Design a common source amplifier with FET for a voltage gain about 5. Select input voltage for distortionless output and study its frequency response and also measure the output impedance.

2. Construct a saw tooth generator using the given UJT and determine the frequency of oscillations.

3. By a suitable experiment, study the characteristics of the given Gunn diode. Determine the saturation current and the output power for different attenuation.

4. Design a band-pass filter and demonstrate how this circuit will pass a certain group of frequencies and reject those above and below these limits. Find out the band width and compare with the theoretical value.

5. Design a 4 bit shift register and study its action.

6. Construct a monostable multivibrator using IC 555 and measure the pulse width for different R and C values.

7. Construct a digital to analog converter using op-amp by (i) binary weighted resistor method (ii) R – 2R ladder network.

8. Design a 4 bit up counter using IC 7476/7473 and study its counting sequence.

9. Construct a decimal to BCD encoder using IC 7432 OR gates and study its performance.

10. Construct a 2 to 4 decoder using IC 7400 NAND and IC 7404 NOT gates and study its performance.

11.. Construct the BCD counter circuit and verify its operation.

12. Construct a VCO circuit using IC 555 for 5 V and calculate the output frequency.

13. Construct a saw tooth wave form generator using the given UJT and measure the frequency for different time constants.

14. Design a Schmit trigger using IC 555 and show how this circuit can be used as a squarer.

15. Design a low pass and high pass filters and study their performance.

16. Show and demonstrate how IC 7490 can be used as a scalar of 2 to 10. Combine it with a decoder and a seven segment display to count them.

17. Construct a 4 – 1 multiplexer using NAND gates and realize its operation.

18. Construct a 2 – 4 line demultiplexer and analyse its action.

19. Obtain the voltage – ampere characteristic curve of the UJT and hence calculate the intrinsic stand-off ratio.

20. Set up an analog computer using operational amplifiers to solve the following simultaneous equation.

    $x + y = 1$; $x - y = 3$.

MODEL PRACTICAL QUESTION PAPER PATTERN

M.Sc. DEGREE EXAMINATION, NOVEMBER 2017

THIRD SEMESTER

PHYSICS

PRACTICAL - III : MICROPROCESSOR ,MICROCONTROLLER AND PROGRAMMING EXPERIMENTS

Time : 4 Hours. Maximum marks : 75

1. Using 8085 µp, execute an ALP for 16 bit (i) Addition (ii) Subtraction (iii) Division and (iv) Multiplication.

2. Using 8085 µp, write a program to find the sum of a simple series of 8 bit numbers & store the result in memory.

3. Write an ALP to arrange a set of numbers (i) in ascending order and (ii) in descending order.

4. Write an ALP to find (i) square of a 8 bit number. (ii) square root of 16 bit number.

5. Interface 8085 µp with a CRO through DAC 080, generate square and rectangular waveforms for two different frequencies. Trace the wave form for each input.

6. Using 8085 µp, write a program to convert Farenheit to Centigrade and Centigrade to Farenheit & store the result in memory.

7. Interface 0809 with 8085 µp and thereby convert the Analog signal to Digital for several inputs.

8. Interface a traffic light controller with 8085 µp and execute an ALP to control the same.

9. Interface a stepper motor with 8085 µp and check the clockwise & anticlockwise rotation by half and full steps.

10. Give the assembly language program to perform (i) addition of two 8 bit numbers (ii) subtraction of two 8 bit numbers and verify with 8051 microcontroller.

11. Using 8051, execute an ALP for 16 bit (i) Addition (ii) Subtraction (iii) Division and (iv) Multiplication.

12. Using 8051, write a program to find the sum of a simple series of 8 bit numbers and store the result in memory.

13. Interface a HEX key board with 8051 microcontroller and execute an ALP to control the same.

14. Interface 8051 microcontroller with a CRO, generate square and rectangular waveforms for two different frequencies. Trace the wave form for each input.

15. Design an interfacing circuit with LED'S and 8051 microcontroller and perform the blinking of LED with a delay of about 1 second.

16. Write a matrix addition and subtraction programme using C++ and execute the same to get an output.

17. Write a C++ program for straight line fit using the method of least squares and find an output.

18. Solve a first order differential equation using Runge- Kutta method.

19. Write a program for Lagrange's Interpolation method and execute the same to get an output.

20. Write a program to find the Eigen values of a given matrix and execute the same to get an output.

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