UNIVERSITY OF KOTA

SCHEME OF EXAMINATION

AND

COURSES OF STUDY

Department of Pure & Applied Physics
Faculty of Science

Five year Integrated B.Sc.-M.Sc. (Physics)

Fifth Semester (July-December, 2015)
Sixth Semester (January-May, 2016)

UNIVERSITY OF KOTA
MBS Marg, Near Kabir Circle, KOTA (Rajasthan)-324 005
INDIA

Edition: 2015

Course Structure with Distribution of Marks

Year / Semester	Serial Number, Code & Nomenclature of Paper			Duration of Exam.	Teaching Hrs/Week & Credit			Distribution of Marks			Min. Pass Marks	
	Number	Code	Nomenclature		L	P	C	Conti. Assess.	Sem. Assess.	Total Marks	Conti. Assess.	Sem. Assess.
III Year V Semester	5.1	MAT07	Linear Programming & Its Applications	3 Hrs	4		4	20	80	100	07	29
	5.2	MAT08	Real Analysis	3 Hrs	4		4	20	80	100	07	29
	5.3	PHY13	Elementary Quantum Mechanics	3 Hrs	4		4	20	80	100	07	29
	5.4	PHY14	Heat & Mass Transfer	3 Hrs	4		4	20	80	100	07	29
	5.5	SEM03	Seminar		2		2	50		50	20	
	5.6	PHYL05	Laboratory Practices	6 Hrs		12	6		150	150		60
	Total				**18**	**12**	**24**	**130**		**600**		
III Year VI Semester	6.1	MAT09	Discrete Mathematics	3 Hrs	4		4	20	80	100	07	29
	6.2	MAT10	Complex Analysis	3 Hrs	4		4	20	80	100	07	29
	6.3	PHY15	Nuclear & Particle Physics	3 Hrs	4		4	20	80	100	07	29
	6.4	PHY16	Solid State Physics	3 Hrs	4		4	20	80	100	07	29
	6.5	PHY17	Atomic & Molecular Physics	3 Hrs	4		4	20	80	100	07	29
	6.6	PHYL06	Laboratory Practices	6 Hrs		12	6		150	150		60
					20	**12**	**26**	**100**		**650**		

Objectives of the Course:

Innovation and Employability-Physics is concerned with the study of the universe from the smallest to the largest scale, why it is the way it is and how it works. Such knowledge is basic to scientific progress. Although physics is a fundamental science it is a very practical subject. Physicists have to be able to design and build new instruments, from satellites to measure the properties of planetary atmospheres to record-breaking intense magnetic fields for the study of condensed matter. Many of the conveniences of modern life are based very directly on the understanding provided by physics. Many techniques used in medical imaging are derived directly from physics instrumentation. Even the internet was a spin-off from the information processing and communications requirement of high-energy particle physics.

The Department of Pure and Applied Physics has been started the integrated course from July, 2013. Our five year Integrated Master's programme involves the students in a holistic experience of Physics education and instills the spirit of research in the formative years of their careers. This flagship programme of University is a pioneering model in Indian science and education, imparting education in Physics while simultaneously encouraging a participation in research. This course shall provide the thorough knowledge of Pure and Applied branches of Physics with extensive theoretical and experimental knowledge in major areas of Physics such as Material science, Plasma science, Advanced Electronics, Energy Studies etc. at Masters' level. This course also emphasizes on the Communication & Presentation skills of the students. The students after completing the course shall be placed in premier research institutes and companies in India and abroad, qualify NET/GATE/JEST examinations and eligible for M.Tech., PhD and teaching.

Duration of the Course:

The course Integrated B.Sc.-M.Sc. in Physics shall consist of five academic years divided in to ten semesters. The important feature of the course is that if the student desires to leave the course after three years, he/she shall get degree of B.Sc. (Hons).

Eligibility for Admission:

The basic eligibility for admission to the course is XII with Physics, Chemistry and Mathematics with minimum marks for GEN category candidates of Rajasthan-60%; Other state-65%; SC/STOBC/SOBC- Minimum Pass Marks. The admission in the course is based on merit of XII class.

Structure of the Programme:

The Integrated B.Sc.-M.Sc. programme consists of:

(i) Core and applied courses of theory as well as practical papers which are compulsory for all students.

(ii) Dissertation / Project Work / Practical training / Field work which can be done in an organization (Government, Industry, Firm, Public Enterprise, *etc.*) approved by the Department.

Attendance:

Every teaching faculty handling a course shall be responsible for the maintenance of attendance Register for candidates who have registered for the course. The teacher of the course must intimate the Head of the Department at least seven calendar days before the last instruction day in the semester about the attendance particulars of all students. Each student should earn 75% attendance in the courses of a particular semester failing which he or she shall not be permitted to appear in the End-Semester Examinations. However, it shall be open

to the authorities to grant exemption to a candidate who has failed to obtain the prescribed 75% attendance for valid reasons and such exemptions should not under any circumstance be granted for attendance below 65%.

Teaching Methodologies:

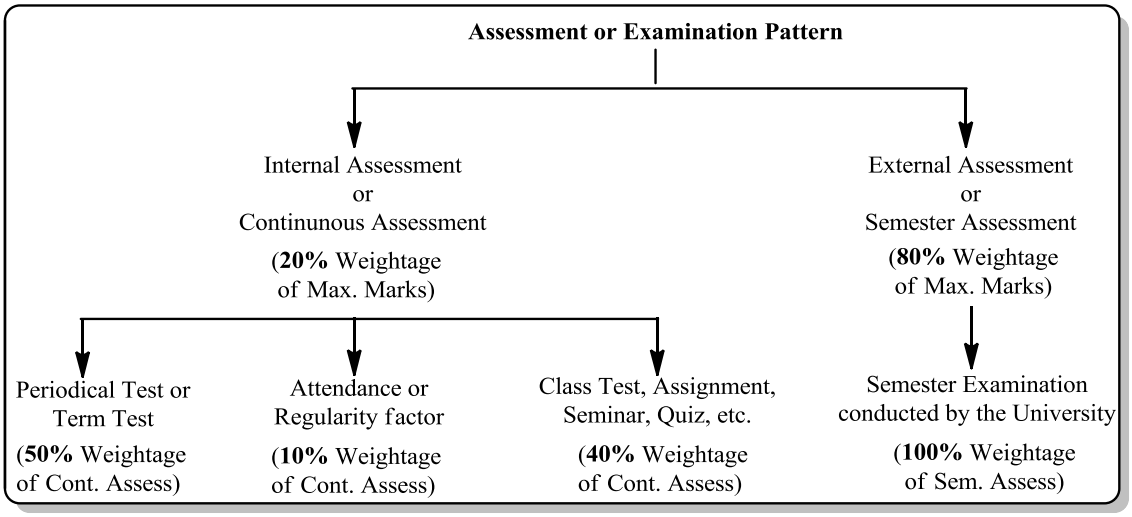
The classroom teaching would be through conventional lectures or power point presentations (PPT). The lecture would be such that the student should participate actively in the discussion. Student seminars would be conducted and scientific discussions would be arranged to improve their communicative skills. In the laboratory, instructions would be given for the experiments followed by demonstration and finally the students have to do the experiments individually.

Maximum Marks:

Maximum marks of a theory and practical paper shall be decided on the basis of their contact hours per week. One teaching hour per week shall carry 25 maximum marks and therefore, four teaching hours per week shall carry 100 maximum marks for each theory paper/course. Each four contact hours per week for laboratory or practical work shall be equal to two contact hours per week for theory paper, therefore, for 12 contact hours per week for practical work shall be equal to 06 contact hours per week for theory paper and shall carry 150 maximum marks.

Scheme of Examinations:

The examination shall be divided into two parts in which first part is continuous assessment or internal assessment and second part is semester assessment or external assessment. The continuous assessment for each theory paper shall be taken by the faculty members in the Department. Periodical test or term test for internal assessment shall be one and half hour duration and shall be taken according to academic calendar which shall be notified by the Department/University. The semester assessment shall be three hours duration to each theory paper and six hours duration to each practical paper and shall be taken by the University at the end of each semester. Assessment pattern and distribution of maximum marks is summarized as given below:



The evaluation of the seminar shall be based on the internal assessment process only.A student cannot repeat the assessment of periodical test or term test. However, if for any compulsive reason the student could not attend the test, other tool for assessment may be

framed by the teacher in consultation with the Head of the Department. If the regularity factor is similar for all the students in that case it may be merged with the term test weightage.

Question Paper Pattern:

(A) Continuous or Internal Assessment:

20% weightage of Maximum Marks (20 Marks out of 100 Maximum Marks)

(i) Periodical Test / Term Test:

DEPARTMENT OF PURE & APPLIED PHYSICS
UNIVERSITY OF KOTA, KOTA
First/Second Internal Test 20……

Duration of Exam: 1.30 Hr **Max. Marks: 10**
Class: Integrated B.Sc.-M.Sc. (Physics) **Semester:**
Subject: **Paper:**
No. of Students: **Teacher:**

Note: The question paper contains three sections as under:
Section-A : One compulsory question with 05 parts. Please give short answers in 20 words for each part.
Section-B : 02 questions to be attempted having answers approximately in 250 words.
Section-C : 01 question to be attempted having answer in about 500 words.

SECTION A

Q.1(a)		½
(b)		½
(c)		½
(d)		½
(e)		½
	SECTION B	
Q.2		2
Q.3		2
Q.4		2
Q.5		2
	SECTION C	
Q.6		31/2
Q.7		31/2

(ii) Attendance:

Marks shall be given by the faculty member in each paper according to its weightage.
Max. Marks: 2

(iii) Class Test:
Duration of Exam: 1.00 Hr **Max. Marks: 8**

Note: All questions are compulsory and marks are given at the end of the each question. (Two or three sub-divisions may be given in the question)

Q. No. 1. ….....…… (without option).
3 Marks

Q. No. 2. ……..
Or
…….
3 Marks

Q. No. 3. ……..
Or
…….
2 Marks

Or
Assignment:
(May be divided in parts or questions or may not be. It shall be depending on the nature of assignment).

Max. Marks: 8

Or
Seminar:
(May be divided in parts or questions or may not be. It shall be depending on the nature of assignment).

Max. Marks: 8

Or
Quiz:
(May be divided in parts or questions or may not be. It shall be depending on the nature of quiz).

Max. Marks: 8

Or
Any Other Tool for Assessment

Max. Marks: 8

(B) Semester or External Assessment:

80% weightage of Max. Marks (80 Marks out of 100 Max. Marks)

Duration of Examination: 3 Hours **Max. Marks: 80**

Note: The syllabus is divided into five independent units and question paper will be divided into three sections. Section-A will carry 15 marks with one compulsory question of equally divided 10 short answer type questions (about 20 words) and examiners are advised to set two short questions from each unit. Section-B will carry 25 marks with equally divided 5 long answer type questions (about 250 words) and examiners are advised to set two questions from each unit and students are instructed to attempt five questions by selecting one question from each unit and Section-C will carry 40 marks with equally divided 2 very long answer type questions (about 500 words) and examiners are advised to set four questions from entire

syllabus but not more than one question from each unit and students are instructed to attempt any two questions out of four questions.

SECTION-A: 10x1.5=15
(Answer all questions)
(Two question from each unit with no internal choice)
Q. No. 1
(i) ……..…… **1.5 Mark**
(ii) ……..…… **1.5 Mark**
(iii) ……..…… **1.5 Mark**
(iv)……..…… **1.5 Mark**
(v)……..…… **1.5 Mark**
(vi)……..…… **1.5 Mark**
(vii)……..…… **1.5 Mark**
(viii)……..…… **1.5 Mark**
(ix)……..…… **1.5 Mark**
(x)……..…… **1.5 Mark**

SECTION-B: 5x5=25
(Answer all questions)
(One question from each unit with internal choice)
(Maximum two sub-divisions only)
Q. No. 2. . ……..……
Or
……..……
5 Marks
Q. No. 3. ……..……
Or
……..……...
5 Marks
Q. No. 4. ……..……
Or
……..……
5 Marks
Q. No. 5. ……..……
Or
……..……...
5 Marks
Q. No. 6. ……..
Or
……..
5 Marks

SECTION-C: 2x20=40
(Answer any two questions)
(Maximum four sub-divisions only)
Q. No. 7. ……
20 Marks
Q. No. 8. ……
20 Marks
Q. No. 9. ……
20 Marks
Q. No. 10. …… **20 Marks**

Distribution of Marks for Practical Examinations:

Duration of Exam: 06 Hours **Maximum Marks: 150**

S. No.	Name of Exercise	Marks
1.	Exercise No. 1	50
2.	Exercise No. 2	50
3.	Viva-voce	25
4.	Practical Record	25
	Total Marks	**150**

Rules regarding determination of results:

Each semester shall be regarded as a unit for working out the result of the candidates. The result of the each semester examination shall be worked out separately (even if he/she has appeared at the paper of the lower semester along with the papers of higher semester) in accordance with the following conditions:

(a) The candidate shall be declared to have passed the examination if he/she secures minimum 36% marks in each theory (internal and external separately) paper(s) prescribed for the semester.

(b) For the practical, project work and seminar, a candidate should secure at least 40% marks in internal and external separately. The evaluation of the seminar shall be based on the internal assessment process.

(c) A student must secure at least 40% marks in the aggregate of the internal and external components of the theory papers individually prescribed for the semester.

(d) A candidate who does not fulfil either of the aforesaid conditions i.e. (a)-(c) shall be declared as failed in that particular paper, which he/she can reappear in the next year examination as a due paper. However, the internal marks shall be carried forward for the total marks of the due examination.

(e) If a candidate fails in the internal assessment, he/she shall be declared failed in that paper(s) of odd/even semester. In such a case he/she shall reappear in the same paper as due paper in odd/even semester examination of next year and for the marks obtained by him/her out of external component shall be raised proportionally to the marks out of total marks for working out the results.

(f) A candidate failing or absenting in one or more theory paper(s) as well as also in practical, project work at a semester examination shall be permitted to join the courses of study for the next higher even semester and eligible to re-appear in that paper(s) along with higher semester (next year) examinations provided that he/she must have cleared at least 60% of the papers (including practical, seminar, project as one paper) prescribed for the fifth and the sixth semester examinations taken together for promotion to the seventh semester.

(g) A candidate for a semester examination shall be offered all the papers prescribed for that semester examination and in addition he/she shall be required to take due papers of any lower semester examination(s) provided that the number of chances to clear theory, practical, project work paper shall be limited to two only.

(h) If a student who has been promoted to the next semester wishes to improve his/her performance can be permitted to do so in case of the theory papers only belonging to the immediately preceding semester. In such a case he/she shall have to appear in these papers along with the papers of his/her own semester.

(i) The marks secured in the Gen Hindi, Gen English, Elementary Computer applications and Environment studies shall not be counted in awarding the division to a candidate.

The candidate shall have to clear the compulsory subjects in the three chances and non-appearance or absence in the examination of compulsory subjects shall be counted as chance and shall be declared fail in that examination.

(j) The grace marks scheme shall be applicable as per University norms.

Classification of Successful Candidates:

Candidates who secure 60% of the aggregate marks in the whole examination shall be declared to have passed the examination in First Division. Candidates who secure 50% marks or more but less than 60% of the aggregate marks in whole examination shall be declared to have passed the examination in Second Division. Candidates who secure 40% marks or more but less than 50% of the aggregate marks in whole examination shall be declared as pass.

Candidates who obtain 75% of the marks in the aggregate shall be deemed to have passed the examination in First Division with Distinction provided they pass all the examinations prescribed for the course at the first appearance. Candidates who pass all the examinations prescribed for the course in the first instance and within a period three academic years from the year of admission to the course only are eligible for University Ranking. A candidate is deemed to have secured first rank provided he/she

(i) Should have passed all the papers in first attempt itself.

(ii) Should have secured the highest marks.

V Semester

5.1- Linear Programming & Its Applications

Unit 1

Linear Programming Problem: Definition, Formulation of LPP, constraints and mathematical form, Graphical Method of solution of two variable linear programming problems, theory of convex sets.

Unit 2

Simplex Method and its application to simple linear programming problems, Big-M and Two-Phase Method, Degeneracy, Resolution of degeneracy. Limitation of LPP.

Unit 3

Duality in LPP, important theorems of duality, important results in Duality, Dual Simplex Method, Integer Programming: Definition, Gomory's Method.

Unit 4

Transportation: Definition, Solution by Simplex Method, Assignment: Definition, Solution by Simplex Method.

Unit 5

Game Theory: Definition, 2 person zero-sum Game, fundamental theorem of games, Game with mixed strategies Solution by using Simplex Method.

Text/Reference Books:

1. Mathematical programming Techniques: N.S. Kambo, Affiliated East-West Press Ltd.
2. Linear Programming and Game Theory: Dipak Chatterjee, Prentice Hall India, 2005.
3. Operations Research: Kanti Swarop, P.K. Gupta and Man Mohan, Sultan Chand, 1997.
2. Operations Research an Introduction: Hamdy A. Taha, Prentice Hall India, 1997.

5.2- Real Analysis

Unit 1

The set of real numbers as a complete ordered field, incompleteness of Q, Archimedean and denseness properties of R. Modulus, Intervals Definition of a sequence, Theorems on limit of sequence, bounded and monotonic sequences, nested interval theorem, Cauchy's sequence, Cauchy's convergence criterion.

Unit 2

Convergence of series of non-negative terms, their various tests (Comparison; D'Alembert's ratio, Cauchy's n^{th} root, Raabe's, Gauss, Logarithmic, Demorgan and Bertand's, Cauchy's condensation proof of tests not required) for convergence, Alternating series, Leibnitz's test, Series of arbitrary terms, absolute and conditional convergence, Abel's and Dirichlet's tests.

Unit 3

Equivalent sets. Finite and infinite sets denumerable sets, Countable and uncountable sets. Interior point of a set, open set, limit point of a set, Bolzano-Weierstrass theorem. Closed set. Dense in itself and perfect sets. Cantor's ternary set.

Unit 4

Definition of limit of a function. Continuity of a function - Cauchy's and Heine's definitions with their equivalence. Types of discontinuities. Properties of continuous functions defined on closed intervals. Uniform continuity. Differentiability, Rolle's theorem, Lagrange's and Cauchy's mean value theorems and their geometrical interpretations. Taylor's theorem with various forms of remainders. Darboux's intermediate value theorem for derivatives.

Unit 5

Darboux sums and their properties. Riemann integral, Integrability of continuous and monotonic functions. Mean value theorems of integral calculus, The fundamental theorem of integral calculus, Improper integrals and their convergence comparison tests. Abel's and Dirichlet's tests.

Text/Reference Books:

1. Shanti Narayan : Elements of real analysis, S.Chand & company Ltd., New Delhi.
2. Shanti Narayan : A Course of Mathematical Analysis, S.Chand & Company Ltd. New Delhi.
3. S.C. Malik, Mathematical Analysis, Wiley Estern Ltd. New Delhi.
4. S.C. Malik, Principles of Real Analysis, New Age International Ltd., New Delhi.
5. Hari Kishan, Real Analysis, Pragati Prakashan Meerut.
6. J.N. Sharma & A.R. Vasistha, Mathematical Analysis, Krishna Prakashan Mandir, Meerut.

5.3- Elementary Quantum Mechanics

Unit 1

Failures of the classical mechanics, black body radiation, Planck's quantum theory, photo electric effect, Einstein's explanation, Compton effect, Wave-particle duality, de Broglie waves, Electron diffraction experiment, group and phase velocities, uncertainty principle, formulation and its applications, finite size of atom, non existence of electrons in nucleus, Gaussian wave packet, Bohr's principle of complementarity,

Unit 2

Schrodinger's equation: its need and justification, time dependent and time independent forms, physical significance of wave function (Schrodinger's and Born's interpretation), boundary and continuity conditions of wave function, probability current density, Postulates of Quantum mechanics, eigen functions & eigen values, degeneracy, parity and orthogonality of eigen function, expectation values of dynamical variables -position, momentum, energy, ehrenfest theorem, operators in quantum mechanics, Definition of an operator, linear and Hermition Operator.

Unit 3

Particle in a one-dimensional box (infinite potential well) - eigen functions and eigen values, Discrete energy levels, generalization to three dimensions and degeneracy of levels, Potential step and rectangular potential barrier, calculation of reflection and transmission coefficients, alpha decay, square well potential problem (attractive), calculation of transmission and reflection coefficients.

Unit 4

Bound state problems: Particle in a one-dimensional box -(finite square potential well), Energy eigen values and eigen functions, simple harmonic oscillator (One dimensional case), Zero point energy, Bohr's correspondence principle, Stern Garlach experiment, spin of electron, spin and magnetic moment, total angular momentum.

Unit 5

Particle in spherically symmetric potential, Schrodinger's equation for one electron atom in spherical coordinates, separation of variables, orbital angular momentum and its quantization, spherical harmonics, Energy levels of hydrogen atom, calculation of average radius, hydrogen atom spectrum, probability density distribution.

Text/Reference Books:

1. Elementary Quantum Mechanics and Spectroscopy - S. L. Kakani, C. Hemrajni and T.C. Bansal, College Book Centre, Jaipur, 1995.
2. Quantum Mechanics - Theory & Applications by A. K. Ghatak & S. Loknathan, McMillan, 1977
3. Perspectives of Modern Physics – Arthur Beiser, McGraw Hill, Auckland,1995.
4. Introduction to Atomic Spectra - H E. White, Tata McGgraw Hill International Edition

5.4- Heat and mass transfer

Unit 1

Introduction to conduction, convection and radiation, rate equations, relationship to thermodynamics, conservation of energy requirement, thermal properties of matter, heat diffusion equation, boundary and initial conditions, one dimensional steady state conduction, two dimensional steady state conduction.

Unit 2

Transient conduction, numerical methods in heat conduction, fundamentals of convection, convection transfer problem, convection boundary layers, laminar and turbulent flow, boundary layer equations, physical significance of the dimensionless parameters, effect of turbulence, convection coefficients.

Unit 3

External forced convection, internal forced convection, natural convection over surfaces, finned surfaces and enclosures, combined natural and forced convection, boiling and condensation.

Unit 4

Radiation fundamentals-processes and properties, radiation exchange between surfaces, view factor, radiation exchange between diffuse, gray surfaces in an enclosure, multimode transfer, volumetric absorption, gaseous emission and absorption.

Unit 5

Analogy between heat and mass transfer, mass diffusion, boundary conditions, steady mass diffusion through a wall, water vapor migration in buildings, transient mass diffusion,

diffusion ina moving medium, mass convection, simultaneous heat and mass transfer, cooling of electronic equipment.

Text/Reference Books:

1. Heat transfer : A practical approach – Yunus A. Cengel
2. Heat transfer – J P Holman McGraw Hill
3. Mass Transfer Operations – Robert E. Treybal
4. Heat and Mass Transfer – Frank P. Incropera and David P. DeWitt

5.6- Laboratory Practices

1. Determine the value of Plank's constant using photocell.
2. Determine the value of Plank's constant using solar cell.
3. Work function of Tungsten, Richardson's equation.
4. Study the absorption spectrum of iodine molecule.
5. Study the Franck Hertz experiment and determine the ionization potential of inert gas.
6. Study the hyperfine structure of spectral lines and Zeeman effect by constant deviation spectrograph.
7. Determine the electric charge (e) using Millikan's oil drop method.
8. Determine the specific charge (e/m) using Thomson method.
9. Determine the specific charge (e/m) using helical method.
10. Determine ballistic constant using constant deflection method.
11. Determine ballistic constant using condenser method.
12. Determine high resistance by leakage method.
13. Determine the magnetic field using ballistic galvanometer and search coil. Determine the mechanical equivalent of heat (J) by using calendar and barn's constant flow calorimeter
14. Determine the thermal conductivity of a bad conductor using lee's disc method.
15. Determine the melting point of given material using platinum resistance thermometer.
16. Plot thermo emf vs temperature graph and find the inversion and neutral temperature.
17. Determine the thermodynamic constant (Cp/Cv) using Clement and Desorme's method.
18. Study of variation of total thermal radiation with temperature and verify the Stefan's law.
19. Determine the value of Stefan's constant.

VI Semester

6.1- Discrete Mathematics

Unit 1

Sets and Multisets, Relations and Functions, Equivalence relations, Partial order relations, Chains and Antichains. Permutations, Combinations, Selection with & without replacement, Permutation and combinations of multisets. Discrete probability, The rules of sum & product.

Unit 2

Basic concepts of graph theory, Multigraph and Weighted graphs, Paths & Circuits. Matrix representation of graphs, Eulerian path and circuits, Hamiltorian path and circuits. Shortest path in weighted graph, Planar graphs.

Unit 3

K-connected and K-edge-connected graphs. Chromatic number, Edge colouring of graphs, Vizing's theorem. Trees and cut sets - Trees, Rooted trees, Path lengths in rooted trees, Spanning tree and cut set, Minimum spanning tree.

Unit 4

Pigeon hole Principle, Inclusion-Exclusion principle. And discrete numeric functions-manipulation of numeric functions. Asymptotic behavior of numeric function. Generating functions, Recurrence relations, linear recurrence relation with constant coefficients and their solutions.

Unit 5

Boolean Algebra, Lattices, Uniqueness of finite Boolean Lattices, Boolean functions and Boolean expression, Propositional Calculus.

Text/Reference Books:

1. Elements of Discrete mathematics: C.L. Liu, McGraw Hill, International editions, 1985.
2. Graph Theory: Narsingh Deo, Prentice Hall of India, 2002.
3. Discrete Mathematics and its Applications: Kenneth H. Rosen, McGraw Hill, 1999.

6.2-Complex Analysis

Unit-1

Complex Numbers , Analytic Functions, Necessary and sufficient condition for a function to be analytic, Polar form of Cauchy Riemann equations , Construction of an analytic functions.

Unit-2

Conformal Transformation and representation, Bilinear Transformation, Transformations $W = Z^2, W = \sqrt{Z}, W = e^Z, W = Z^2,$ and $W = \log Z.$

Unit-3

Complex Integration – Definition, Cauchy's theorem, Cauchy's Goursat's Lemma, Cauchy's theorem, Cauchy's integral formula and its generalized form, Morera's theorem, Liouville's theorem, Taylor's and Laurent's expansion

Unit-4
Singularities: Zeros of an analytic function, Singular points, Different type of singularities, Residue at a pole, Residue at infinity, Cauchy's residue theorem, Computation of residue at a (i) simple pole , (ii) multiple pole.

Unit-5
Integration round the unit circle, Integration of f(z) when it has no pole on the real line, Integration of f(z) when it has poles on real line.

6.3-Nuclear Physics & Particle Physics

Unit 1
Nuclear Properties: Mass, radius, angular momentum, magnetic moment, electric quadrupole moment, parity, estimation of mass, basic concepts of mass spectrographs, Bainbridge Jordan double focussing spectrograph, Coulomb scattering of a charged particle by a nucleus, Electron scattering by a nucleus, variation of nuclear radius with mass number A.

Unit 2
Nuclear Binding : Constituents of the nucleus, properties of nuclear forces, Binding energy, mass defect, variation of binding energy with mass number A. Liquid drop model, Semi-empirical mass formula, origin of various terms, stable nucleus and conditions for stability.

Unit 3
Nuclear Fission: Energy release in nuclear fission (using BE curve) spontaneous fission and potential barrier, liquid drop model, self sustaining chain reaction, neutron balance in a nuclear reactor, classification of reactors, uncontrolled reaction and atomic bomb, Nuclear Fusion: Energy released in nuclear fusion in stars, carbon-nitrogen and proton-proton cycle, problems of controlled fusion.

Unit 4
Particle Accelerator: Linear accelerator, cyclotron, synchrocyclotron, betatron, synchrotron, Electron Synchrotron, proton synchrotron, Nuclear detectors: Ionisation chamber, Proportional counter, GM counter, scintillation counters, solid state detectors, neutron detector.

Unit 5
Subatomic Particles: Properties of particles, classification into leptons, mesons and baryons, matter and antimatter, conservation laws, fundamental interactions, quark model for the structure of matter.

Text/Reference Books:
1. Nuclear physics by Irving Kaplan, Oxford & IBH Pub., 1962.
2. Introduction to experimental Nuclear Physics by R. M. Singru, Wiley Eastern Pvt. Ltd.
3. Nuclear Physics by S. N. Ghoshal, S. Chand, 2006.

6.4- Solid State Physics

Unit 1

Crystal structure : Symmetry elements in crystal, fundamental lattice systems and types, Miller indices and direction indices, crystal structures of simple cubic, FCC, BCC, HCP, diamond and Zinc blend, Crystal Diffraction: Bragg's zaw, X-ray and neutron diffraction, rotating crystal and powder methods, reciprocal lattice, Brilloin zones. Crystal binding and vibrations: Various binding types and repulsive interaction.

Unit 2

Electrical and Thermal Properties of Solids : Free electron model of a solid, Band theory of solids, difference between conductors, insulators, semiconductors, quantum theory of' electrical conductivity, Thermal properties of Solids: Einstein's theory of specific heats, Debye's model of lattice specific heat.

Unit 3

Classical and Quantum theories of diamagnetism and paramagnetism, Paramagnetic susceptibility of conduction electrons, Weiss molecular fields theory of ferromagnetism, Origin of magnetic domain and domain walls, magnetic materials.

Unit 4

Superconductivity: Basic properties of Superconductors, Meissoner effect, isotope effect, type-I and type-II superconductors, Superconducting tunneling, Josephson junction, application of superconductivity. Cooper pairs, Frohlich interaction, BCS theory of superconductivity, High temperature superconductivity in cuprates.

Unit 5

Introduction of band structure, Hall effect, recombination mechanism, Optical transitions, UV-VIS spectrophotometer, Tauc's law, Shockley Read theory, excitons, photoconductivity, photo luminescence.

Text Reference Books:

1. Solid State Physics by S. O. Pillai, New Age International, 2005.
2.Introduction to Solid state Physics by C. Kittel, (John Wiley), VII Ed.,1995.
3. Solid State Physics by A. J. Dekker, (Macmilam), London, 1965.
4. Solid state physics by S. O. Pillai, (New Age International Publishers), 2005.
6. Intermediate Quantum theory of solids- A.D.E.Animalu,(Prentice Hall).

6.5-Atomic & Molecular Physics

Unit 1

Hydrogen Atom : Gross structure energy spectrum, probability distribution of radial and angular (l =1,2) wave functions (no derivation), Magnetic dipole in external magnetic field, Space quantization, effect of spin, relativistic and spin orbit corrections to energy levels of hydrogen, Hamiltonian including all corrections and term shifts, fine structure, the Lamb shift (only an qualitative description)

Unit 2

Systems with Identical Particles: Indistinguishability and exchange symmetry, many particle wave functions and Pauli's exclusion principle, spectroscopic terms for atoms, The Helium atom, Variational method and its use in the calculation of ground state and excited state energy, Helium atom, The Hydrogen molecule, Heitler-London method for molecule. Vector representation and Coupling of angular momenta, interaction energies, LS- Russel Saunders coupling, jj coupling, their interaction energies, Term derivation of one and two electron system, singlet, doublet and triplet characters of emission spectra.

Unit 3

Interaction with External Fields: Atom in a weak uniform external electric field and first and second order Stark effect, calculation of the polarizability of the ground state of H-atom and of an isotropic harmonic oscillator, Linear Stark effect for H-atom levels, spin-orbit interaction, Normal and anomalous Zeeman Effect, Splitting of levels, Paschen Back effect, Difference between Zeeman and Paschen Back effect.

Unit 4

Spectroscopy (qualitative) : General features of Alkali spectra, Rotational spectra of a molecule, The rigid rotator model, The non-rigid rotator, Isotope effect, Vibrational spectra of a molecule, The molecule as a simple harmonic oscillator, Anharmonic oscillator, Isotope effect, Molecule as vibrating Rotator, P, Q and R branches.

Unit 5

Born-Oppenheimer approximation, General features of electronic spectra, Fine structure of electronic bands, P, Q and R Branches, Franck-Condon's principle, Electronic, rotational and vibrational spectra of diatomic molecules, Classical and Quantum theory of Raman Effect, Raman spectra for rotational and vibrational transitions, Vibrational-Rotational Raman spectra, comparison with infra red spectra, Selection rules.

Text/Reference books:

1. Introduction to Atomic Spectra by H. E. White
2. Spectra of diatomic molecules by G. Herdetzberg
3. Spectroscopy Vol. I, II, & III by Walker & Straughen
4. Atomic Spectra by Kuhn.
5. Molecular Spectroscopy By C. N. Bennwell, Tata McGraw Hill Publication.
6. Elementary Atomic Structure: G.R.Woodgate
7. Quantum Physics (atoms, molecules…) R. Eisberg and R. Resnick (J. Wiley),2005

6.6- Laboratory Practices

1. Determine hall voltage, mobility, carrier concentration and hall coefficient in a given semiconductor.
2. Determine the band gap in a semiconductor using four-probe method.
3. Determine the magnetic susceptibility of a paramagnetic salt by Quinck's method.
4. Determine the power factor of a coil using CRO.
5. Determine hysterisis loss using CRO.
6. Study the dynamics of a lattice using electrical analogue.
7. Study the characteristics of a G.M counter and verify the inverse square law.
8. Study of β- absorption in aluminium foil using G.M counter.
9. Determine the g- factor by ESR- step up.

10. Study of variation of modulus of rigidity of a given specimen as a function of temperature.
11. Implementation of simple problems with the Objects and class. Understanding of private, public and protected access using problem, Implementation of static variable & static member function. Constructors & destructors. Problems using friend function.
12. Implementation of polymorphism.
13. Implementation of inheritance.
14. Implementation of operator overloading to overload various operators: unary operators (+,-, *, % etc) and binary operators: +, *, [ ], >> and << operators on vectors.
15. Problem related with dynamic binding. Problems using this pointer.
16. Problems related with the templates function and template classes.