UNIVERSITY OF KOTA

SCHEME OF EXAMINATION

AND

COURSES OF STUDY

Department of Pure & Applied Physics
Faculty of Science

B.Sc. (Hons.) V & VI Semester
Under Integrated B.Sc.-M.Sc. (Physics) Programme

Fifth Semester (July-December, 2017 / 2018)
Sixth Semester (January-June, 2018 / 2019)

UNIVERSITY OF KOTA

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

INDIA

Edition: 2017

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	Nomenclature		L	P	C	Conti. Assess.	Sem. Assess.	Total Marks	Conti. Assess.	Sem. Assess.
III Year V Sem	5.1	Linear Programming & Its Applications	3 Hrs	4	--	4	30	70	100	12	28
	5.2	Real Analysis	3 Hrs	4	--	4	30	70	100	12	28
	5.3	Elementary Quantum Mechanics	3 Hrs	4	--	4	30	70	100	12	28
	5.4	Nuclear & Particle Physics	3 Hrs	4	--	4	30	70	100	12	28
	5.5	Laboratory Practices	6 Hrs	--	16	8	--	100	100	--	50
	Total			**16**	**16**	**24**	**120**	**--**	**500**	**--**	
III Year VI Sem	6.1	Discrete Mathematics	3 Hrs	4	--	4	30	70	100	12	28
	6.2	Complex Analysis	3 Hrs	4	--	4	30	70	100	12	28
	6.3	Solid State Physics	3 Hrs	4	--	4	30	70	100	12	28
	6.4	Atomic & Molecular Physics	3 Hrs	4	--	4	30	70	100	12	28
	6.5	Laboratory Practices	6 Hrs	--	16	8	--	100	100	--	50
				16	**16**	**24**	**120**	**--**	**500**	**--**	

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-55%; Other state-60%; 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

will 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/credit per week. One teaching hour per week shall equal to one credit and carry 25 maximum marks and therefore, four teaching hours/credit 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 credits per week and carry 25 maximum marks and therefore, sixteen teaching hours per week shall carry 100 maximum marks for laboratory or practical work.

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 schemes for the internal and external examinations shall be as under:

a) The assessment of the student for theory paper shall be divided into two parts in which first part is continuous assessment or internal assessment (30% of maximum marks) and second part is semester assessment or external assessment (70% of maximum marks). For practical papers there will be only one external assessment (100% of maximum marks).

b) The internal assessment for each theory paper shall be taken by the teacher concerned in the Department during each semester. There will be two internal assessment tests each of 15% weightage, for theory papers in each semester. Each internal assessment test shall be of one hour duration for each paper and shall be taken according to academic calendar notified by the University. There will be no internal examination in the practical paper.

c) A student who remains absent (defaulter) or fails or wants to improve the marks in the internal assessment may be permitted to appear in the desired paper(s) (only one time) in the same semester with the permission of the concerned Head of the Department. A defaulter / improvement fee of Rupees 250/- per paper shall be charged from such candidates. Duly forwarded application of such candidates by the teacher concerned shall be submitted to HOD who may permit the candidate to appear in the internal assessment after depositing the defaulter/ improvement fee. A record of such candidates shall be kept in the Department.

d) The external assessment shall be of three hours duration for each theory paper and six hours duration for practical paper. The practical examination shall be taken by the panel of at least one external and one internal examiner at the end of each semester.

e) The syllabus for each theory paper is divided into five independent units and each theory question paper will be divided into three sections as mentioned below:
   - ***Section-A*** *shall have 01 compulsory question comprising 10 questions (maximum 20 words answer) taking two questions from each unit. Each question shall be of one mark and total marks of this section will be 10. This section will be compulsory in the paper.*
   - ***Section-B*** *will carry 25 marks with equally divided into five long answer type questions (answer about in 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.*
   - ***Section-C*** *will contain five long answer type questions. One compulsory question of 15 marks and four questions of 10 marks each. Students are instructed to attempt total three questions with one compulsory question (answer about in 500 words) of and any two more questions (answer about in 400 words) out of remaining four questions. Paper setter shall be instructed to design question paper covering from all five units.*

f) The pattern of question paper of internal and external shall be as follows:

(A) Continuous or Internal Assessment:

30% weightage of Maximum Marks (30 Marks out of 100 Maximum Marks)

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

Duration of Exam: 1.00 Hr	**Max. Marks: 15**
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 04 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)		1
(b)		1
(c)		1
(d)		1
	SECTION B	
Q.2		3
Q.3		3
Q.4		3
Q.5		3
	SECTION C	
Q.6		5
Q.7		5

(B) Semester or External Assessment:

70% weightage of Max. Marks (70 Marks out of 100 Max. Marks)

Duration of Examination: 3 Hours **Max. Marks: 70**

SECTION-A: 10x1=10

(Answer all questions)

(Two question from each unit with no internal choice)

Q. No. 1

(i) ……..…… **1 Mark**

(ii) ……..…… **1 Mark**

(iii) ……..…… **1 Mark**

(iv)……..…… **1 Mark**

(v)……..…… **1 Mark**

(vi)……..…… **1 Mark**

(vii)……..…… **1 Mark**

(viii)……..…… **1 Mark**

(ix)……..…… **1 Mark**

(x)……..…… **1 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: 1x15 + 2x10=35

(Answer any three questions including compulsory Q.No. 7)

(Maximum four sub-divisions only)

Q. No. 7. …… **15 Marks**

Q. No. 8. …… **10 Marks**

Q. No. 9. …… 10 **Marks**

Q. No. 10. …… **10 Marks**

Q. No. 11. …… **10 Marks**

Distribution of Marks for Practical Examinations:

Duration of Exam: 06 Hours **Maximum Marks: 100**

S. No.	Name of Exercise	Marks
1.	Exercise No. 1	35
2.	Exercise No. 2	35
3.	Viva-voce	15
4.	Practical Record	15
	Total Marks	**100**

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 as pass in a semester examination, if he/she secures at least 40% marks in each theory paper separately in external & internal examination and 50% marks in each practical paper and at least 50 % marks in project/dissertation with 50% aggregate marks in that semester.

b) A candidate declared as fail/absent in one or more papers at any odd semester examination shall be permitted to take admission in the next higher semester (even semester) of the same academic session.

c) A candidate may be promoted in the next academic session (odd semester) if he/she has cleared collectively at least 50% of the papers of both semesters of previous academic session with 50% of the aggregate marks. The candidate who does not fulfill the above condition will remain as an ex-student and will reappear in the due papers along with next odd/even semester exams.

d) If any student who is provisionally admitted in higher odd semester but could not secure prescribed minimum marks in previous semesters will be treated as ex-student and his/her admission fee will be carry forwarded to the next odd semester of forthcoming academic session.

e) If a candidate, who is declared as pass, wishes to improve his/her performance in the theory papers of previous semester, he/she may re-appear only one time in these papers in next odd/even semester examinations.

f) Candidate shall not be permitted to re-appear or improve the marks obtained in the external examination of practical / dissertation in any condition.

g) If the number of papers prescribed in a semester examination is an odd number, it shall be increased by one for the purpose of reckoning 50% of the papers for considering the student pass/fail.

h) A candidate may be given only two additional chances for passing the semester thus maximum tenure for completing the two years' postgraduate course will be limited to four years, for three years postgraduate programme up to five years and so on.

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 additional 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:

The classification of successful candidates after last semester examination shall be as under:

Description of Marks Obtained	Division / Result
• 80% and above marks in a paper.	Distinction in that paper.
• A candidate who has secured aggregate 60% and above marks	First Division
• A candidate who has secured aggregate 50% and above but less than 60% marks	Second Division

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- Nuclear & 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.

5.5- 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.
20. Any other experiments of the equivalent standard can be set.

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-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).

6.4- 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

6.5- 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. Any other experiments of the equivalent standard can be set.