UNIVERSITY OF KOTA

SCHEME OF EXAMINATION

AND

COURSES OF STUDY

Department of Pure & Applied Physics
Faculty of Science

B.Sc. (Hons.) V & VI Semester

Fifth Semester (July-December, 2023)
Sixth Semester (January-June, 2024)

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

Edition: 2023

Course Structure with Distribution of Marks

Year / Sem.	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	Mathematics-I	3 Hrs	3	--	3	15	60	75	06	24
	5.2	Mathematics-II	3 Hrs	3	--	3	15	60	75	06	24
	5.3	Mathematics Practical	6 Hrs	--	4	2	--	50	50	--	25
	5.4	Physics (Hons)-I : Elementary Quantum Mechanics	3 Hrs	3	--	3	15	60	75	06	24
	5.5	Physics (Hons)-II: Mathematical Physics-II	3 Hrs	3	--	3	15	60	75	06	24
	5.6	Physics (Hons)-III: Physics of Materials	3 Hrs	3	--	3	15	60	75	06	24
	5.7	Physics (Hons)-IV: Principles of Power Production	3 Hrs	3	--	3	15	60	75	06	24
	5.8	Physics Practical (Hons)	6 Hrs	--	8	4	--	100	100	--	50
	Total			**18**	**12**	**24**	**--**	**--**	**600**	**--**	
III Year VI Sem	6.1	Mathematics-I	3 Hrs	3	--	3	15	60	75	06	24
	6.2	Mathematics-II	3 Hrs	3	--	3	15	60	75	06	24
	6.3	Mathematics Practical	6 Hrs	--	4	2	--	50	50	--	25
	6.4	Physics (Hons)-I : Solid State Physics	3 Hrs	3	--	3	15	60	75	06	24
	6.5	Physics (Hons)-II: Nuclear & Particle Physics	3 Hrs	3	--	3	15	60	75	06	24
	6.6	Physics (Hons)-III: Elements of Spectroscopy	3 Hrs	3	--	3	15	60	75	06	24
	6.7	Physics (Hons)-IV: Renewable Energy Conversion	3 Hrs	3	--	3	15	60	75	06	24
	6.8	Physics Practical (Hons)	6 Hrs	--	8	4	--	100	100	--	50
				18	**12**	**24**	**--**	**--**	**600**	**--**	

Note: The syllabi of the compulsory / subsidiary papers are same as prescribed for the B.Sc. Pass Course.

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 Hons. course from July, 2013. Our current 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 B.Sc. (Hons.- Phsyics) shall consist of three academic years divided in to six semesters.

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 B.Sc. (Hons.-Physics) 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 50 marks and therefore, eight 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 internal assessment for each theory paper shall be taken by the teacher concerned in the Department during each semester. There will be two components of internal assessment; one by test having 2/3 weightage (10 marks) and another by seminar / assignment / presentation / quiz / group discussion / vivo of 1/3 weightage (05 marks), for theory papers in each semester. Internal assessment test shall be of one hour duration for each paper and shall be taken according to academic calendar notified by the University / Departments. There will be no internal examination in the practical paper.

b) 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.

c) 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.

d) The syllabus for each theory paper is divided into five independent units and each theory question paper will have the format as mentioned below:
There will be ten long answer type questions covering all units with two questions from each unit, descriptive type, answer in about 400 words. *Students have to attempt* 5 questions by taking one question from each unit. *Paper setter shall be instructed to design question paper covering from all five units.*

e) The pattern of question paper of external shall be as follows:

Duration of Examination: 3 Hours **Max. Marks: 60**

There will be ten long answer type questions covering all units with two questions from each unit, descriptive type, answer in about 400 words. *Students have to attempt* 5 questions by taking one question from each unit. *Paper setter shall be instructed to design question paper covering from all five units.*

Unit – I

Q. No. 1 12 Marks

or

Q. No. 2 12 Marks

Unit – II

Q. No. 3 12 Marks

or

Q. No. 4 12 Marks

Unit – III

Q. No. 5 12 Marks

or

Q. No. 6 12 Marks

Unit – IV

Q. No. 7 12 Marks

or

Q. No. 8 12 Marks

Unit – V

Q. No. 9 12 Marks

or

Q. No. 10 12 Marks

Distribution of Marks for Practical Examinations (For Hons. subject):
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/project/dissertation with 40% 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. 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 for three years under-graduate 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**
• 75% 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
• A candidate who has secured aggregate 40% and above but less than 50% marks	Pass

V SEMESTER

5.4- Elementary Quantum Mechanics

Unit 1

Failures of the classical mechanics, black body radiation and spectral distribution of energy, Planck's quantum hypothesis and average energy of Plank oscillator, Plank's radiation law and discussion to obtain Wein's, Rayleigh-Jeans and Stefan-Boltzmann laws using it, photo electric effect, Einstein's explanation, Compton effect, Wave-particle duality, de Broglie waves, Davisson-Germer experiment, group and phase velocities.

Unit 2

Uncertainty principle, formulation and its applications, finite size of atom, non existence of electrons in nucleus, Concept of wave packet, Phase velocity and group velocity, Construction of one dimensional wave packet, Momentum space representation of wave packet (Fourier transform), Bohr's principle of complementarity, wave function, boundary and continuity conditions of wave function, physical significance of wave function (Schrodinger's and Born's interpretation).

Unit 3

Schrodinger's equation, Its need and justification, time dependent and time independent forms, probability current density, Postulates of Quantum mechanics, operators in quantum mechanics, Definition of an operator, linear and Hermition Operator, Properties of Hermitian operators, Expectation values of dynamical variables -position, momentum, energy, Eigen functions & eigen values, degeneracy, orthogonality of eigen function, ehrenfest theorem, Commutation relations, parity-symmetric and antisymmetric wave functions.

Unit 4

Particle in a one-dimensional box, 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,

Unit 5

Square well potential problem, calculation of transmission and reflection coefficients, Particle in one dimensional infinite potential well, Particle in a one-dimensional finite depth potential well, Energy eigen values and eigen functions, simple harmonic oscillator (One dimensional case), Zero point energy.

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

5.5. Mathematical Physics-II

Unit 1
Orthogonal Curvilinear coordinate system, scale factors, expression for gradient, divergence and curl and their applications to Cartesian, cylindrical and spherical polar coordinate systems, Coordinate transformation and Jacobian.

Unit 2
Matrices**:** Addition and Multiplication of Matrices, Types of Matrices (Null, Diagonal, Scalar and Unit, Upper-Triangular and Lower-Triangular), Transpose of a Matrix, Symmetric and Skew-Symmetric Matrices, Hermitian and Skew-Hermitian Matrices, Singular and Non-Singular matrices, Conjugate of a Matrix.

Unit 3
Matrices**:** Adjoint of a Matrix, Inverse of a Matrix by Adjoint Method, Trace of a Matrix, Eigen-values and Eigenvectors, Cayley- Hamiliton Theorem, Diagonalization of Matrices, Solutions of Coupled Linear Ordinary Differential Equations.

Unit 4
The second order linear differential equation with variable coefficient and singular points, series solution method and its application in the Bessel's, Hermite's, Legendre's and Laguerre's differential equations, Basic properties like orthogonality, recurrence relations, graphical representation and generating function of Bessel, Hermite, Legendre Laguerre and Associated Legendre functions.

Unit 5
Technique of separation of variables and its application to following boundary value problems: Laplace equation in three dimension Cartesian, Coordinate system-line charge between two earthed parallel plates, Wave equation in spherical polar coordinates the vibration of circular membrane, Diffusion equation in two dimensional Cartesian coordinate system-heat conduction in thin rectangular plate, Laplace equation in spherical coordinate system-Electric Potential about a spherical surface.

Text/Reference Books:
1. Matrices and Tensors in Physics by A.W.Joshi.(New Age Int.Pub., 1995).
2. Vector Spaces and Matrices in Physics by M. C. Jain (Alpha Science International Ltd, 2007).
3. Mathematical Physics by B.S. Rajput, Pragati Prakashan (2011).

5.6-Physics of Materials

Unit 1
Elementary Lattice Dynamics - Lattice vibrations and phonons, vibrations of crystals with monoatomic basis, two atoms per primitive basis, quantization of elastic waves, Inelastic neutron scattering by phonons, phonon momentum, Thermal Conductivity of insulators.

Unit 2
Drude-Lorentz Theory of Electrical Conductivity, Boltzman Transport Equation, Sommerfield Theory of Electrical Conductivity, Mathiessen's Rule, Thermal Conductivity,

Boltzmann equation and mean free path, relaxation time and scattering processes, Hall Effect.

Unit 3
Dielectric Properties of Materials - Polarization. Local Electric Field at an Atom. Depolarization Field. Dielectric Constant. Electric Susceptibility. Polarizability. Classical Theory of Electric Polarizability. Clausius- Mosotti Equation. Normal and Anomalous Dispersion. Complex Dielectric Constant.

Unit 4
Magnetic properties of solids: Magnetic susceptibility, Classification of magnetic materials, Origin of atomic Magnetism, Classical theories of diamagnetism and paramagnetism, Quantum theory of paramagnetism, Weiss molecular fields theory of ferromagnetism, Origin of magnetic domain and domain walls, Heisenberg exchange interaction.

Unit 5
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.

Text/Reference Books:
1. Charles Kittel, Introduction to Solid State Physics, 7th Edition, John Wiley and Sons, Inc.
2. A J Dekkar, Solid State Physics, Macmillan India Limited, 2000.
3. J. S. Blackmore, Solid State Physics, Cambridge University Press, Cambridge.
4. N. W. Ascroft and N. D. Mermin, Solid State Physics, (Harcourt Asia, Singapore, 2003).
5. M. Ali Omar, Elementary solid state physics: principles and applications, (Pearson Education, 1999)

5.7-Principles of Power Production

Unit 1
Introduction to energy resources, classification of energy sources-renewable, non-renewable, commercial, non-commercial, conventional, non-conventional, primary and secondary sources, impacts on environment due to use of conventional and nonconventional sources of energy, climate change, global warming, CO_2 emissions, green house gases. Power scenario – India and World, installed capacity of power plants in India, power generation status, power losses, electrification status, effect of availability of power on development of country and quality of life.

Unit 2
Coal based thermal power plants-Types of coal, properties of coal, coal production and processing, principle, working and components of coal based thermal power plant, introduction to basics of combustion, boiler, steam generation, turbine, generator, cooling tower, demineralization of water, transmission system. Advantages and disadvantages of coal based power plants.

Unit 3
Nuclear Fission based thermal Power Plants- Introduction to fission and fusion based on binding energy and nuclear stability, nuclear fission reaction, thermal neutrons, fissile material, critical energy of fission, energy released in fission, types of nuclear fission reactors- pressurised water

reactor, light water reactor, boiling water reactor, gas cooled reactor, pressurized heavy water reactor, control rods, moderator, neutron poisons, control of chain reaction and reactor safety.

Unit 4

Hydroelectric power plants-Principles of conversion of hydel energy to electricity, classification and types of hydroelectric power plants, construction and system components - dam, barrage, reservoir, screens, penstock, turbine and generator, head and flow of water, impulse and reaction turbine, energy conversion chain, efficiency and losses.

Unit 5

Concepts of Bio-energy: Photosynthesis process, biomass, biofuel, importance, production and applications of bio-fuels, biomass combustors, gasifiers, anaerobic digestion, organic waste to energy conversion process, production of biogas, composition of biogas and its applications.

Text/Reference Books:

1. Nuclear Energy 6th Edition: An introduction to the Concepts, Systems and Applications of Nuclear Processes- Raymond LeRoy Murray (Elsevier).
2. Nuclear Energy in the 21st Century: World Nuclear University Press- Ian Hore-Lacy.
3. Energy Science: Principles, technologies and impacts – John Andrews & Nick Jelly (Oxford).
4. Energy Management Handbook, W.C. Turner, S. Doty, CRC Press, 2006.
5. Power Plant Engineering, P. K. Nag, Tata McGraw Hill.
6. The Physics of Nuclear Reactions :W.M.Gibson,Pergamon Press.
7. Non-conventional Energy Resources, B. H. Khan, Tata McGraw Hill, 2006
8. Non-Conventional Energy Sources, G D Rai, Khanna Publishers.
9. Electrical Power Generation: Conventional and Renewable, Tanmay Deb, Khanna Publishers, 2018.
10. Reports of Ministry of Power and Central Electricity Authority, India.

5.8- Laboratory Practices

1. Determine the electric charge (e/m) using Millikan's oil drop method.
2. Determine the specific charge (e/m) using Thomson method.
3. Determine the specific charge (e/m) using helical method.
4. Determine ballistic constant using constant deflection method.
5. Determine ballistic constant using condenser method.
6. Determine high resistance by leakage method.
7. Determine the magnetic field using ballistic galvanometer and search coil.
8. Determine the mechanical equivalent of heat (J) by using calendar and barn's constant flow calorimeter
9. Determine the thermal conductivity of a bad conductor using lee's disc method.
10. Determine the melting point of given material using platinum resistance thermometer.
11. Plot thermo emf vs temperature graph and find the inversion and neutral temperature.
12. Determine the thermodynamic constant (Cp/Cv) using Clement and Desorme's method.
13. Study of variation of total thermal radiation with temperature and verify the Stefan's law.
14. Determine the value of Stefan's constant.
15. Design a Zener regulated power supply and studies the regulation with various loads.
16. Study the characteristic of field effect transistor (FET) and design and study amplifier of finite gain.

17. Applications of operational amplifier as(minimum two of the following exercises) : (i) Inverter (ii) Non-Inverter (iii) Differentiator (iv) Integrator.
18. Study of polarization by reflection from a glass plate with the help of Nicol prism and photo cell and verification of Brewster's law of Malus.
19. Any other experiments of the equivalent standard can be set.

VI SEMESTER

6.4- Solid State Physics

Unit 1

Crystal structure : Symmetry elements in crystal, fundamental lattice systems and types, Miller indices and direction indices, Spacing of planes in Crystal Lattice, crystal structures of simple cubic, Face centered cubic structure, Body concerted cubic structure, Hexagonal closed packed structure, diamond and Zinc blend structure, Pervoskite structure, reciprocal lattice, Brilloin zones.

Unit 2

Crystal bonding, ionic bond, binding energy of ionic crystal, determination of the repulsive exponent, covalent bonding, metallic bonding, molecular or Vander Waal's bonding, hydrogen bonding, Crystal Diffraction: Bragg's law, X-ray and neutron diffraction, rotating crystal and powder methods, Lave equation.

Unit 3

Electrical and Thermal Properties of Solids: Phonon, Lattice Specific heat, Various theories of specific heat – Classical theory, Einstein's theory and theory, Quantum theory of electrical and Thermal conductivity, Weidmann-Franz law, light propagation in conducting media, Fermi Dirac distribution function, density of states.

Unit 4

Semiconductor, Law of mass action, Calculation of impurity conductivity, Introduction of band structure, Ellipsoidal energy surfaces in Si and Ge, Hall effect, recombination mechanism, Shockley Read theory, excitons, photoconductivity, photo luminescence.

Unit 5

Band theory of solids: Formation of bands, Wave Function in a periodic lattice and Bloch theorem, Kronig Penny Model, Effective mass of an electron moving in a crystal, Physical origin of effective mass, difference between conductors, insulators, semiconductors.

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- 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.

6.6-Elements of Spectroscopy

Unit 1
Hydrogen Atom : 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.

Unit 2
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 3
Systems with Identical Particles: Indistinguishability and exchange symmetry, many particle wave functions and Pauli's exclusion principle, spectroscopic terms for atoms, Vector representation and Coupling of angular momenta, interaction energies, LS- Russel Saunders coupling, jj coupling, their interaction energies.

Unit 4
Atom in a weak uniform external electric field, Linear Stark effect for H-atom levels, calculation of the polarizability of the H-atom, spin-orbit interaction, Normal and anomalous Zeeman Effect, Splitting of levels, Paschen Back effect.

Unit 5
Spectroscopy (qualitative) : Born-Oppenheimer approximation, rotational and vibrational spectra of a molecule, anharmonic oscillator, isotope effect, molecule as vibrating rotator, general features of electronic spectra, fine structure of electronic bands, Franck-Condon's principle, classical and quantum theory of Raman effect, Raman spectra for rotational and vibrational transitions, comparison with infra red spectra.

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

6.7-Renewable Energy Conversion

Unit 1
Solar spectrum – Electromagnetic spectrum, Physics of the Sun, solar constant, spectral distribution and variation of extraterrestrial radiation, beam, diffuse and global solar radiation, basics of conversion of solar radiation to thermal energy, property of glass and green house effect, applications of solar thermal energy in solar devices- solar cookers, solar dryers, solar distillation stills, solar water heaters and power generation.

Unit 2
Introduction to Solar Photovoltaics- solar radiation to electrical energy conversion, semiconductors, p-n junction, photovoltaic effect, photovoltaic cell, current-voltage characteristics, equivalent circuit, fill factor, efficiency, power curve, maximum power point, effect of irradiation and temperature on efficiency of solar cells.

Unit 3
Wind Power Generation: Physical principles for conversion of kinetic energy of wind to electricity, lift and drag forces, maximum theoretical efficiency of horizontal wind turbine, Betz limit, wind turbine components, horizontal and vertical axis wind turbines, description of generation system, energy conversion, losses and characteristic power curve, cut in speed, cut out speed, rated power.

Unit 4
Geothermal Energy conversion: Geothermal energy resources, geothermal energy for power production- dry steam, single flash steam, double flash steam and binary cycle power plants, production well and injection well, potential, advantages and disadvantages.

Unit 5

Ocean, tidal and wave energy: Wave power, Wells turbine for conversion of wave energy, principle of operation of oscillating water column wave energy converter, concept of ocean thermal energy conversion, closed cycle OTEC, open cycle OTEC, occurrence of tides and principle of tidal power.

Text/Reference books:

1. Renewable Energy Engineering and Technology: Principles and Practice, Edited by V V N Kishore, The Energy and Resources Institute, New Delhi.
2. Energy Science: Principles, technologies and impacts – John Andrews & Nick Jelly (Oxford).
3. Non-conventional Energy Resources, B. H. Khan, Tata McGraw Hill, 2006
4. Non-Conventional Energy Sources, G D Rai, Khanna Publishers.
5. Solar Energy: Principles of Thermal Collection and Storage, Sukhatme S.P. Tata McGraw Hill Pub., New Delhi
6. Solar Energy Fundamentals and Applications, Garg H.P., Prakash J., Tata McGraw-Hill, 2005.
7. Solar Photovoltaic: Fundamentals,Technologies and Application, Chetan Singh Solanki PHI Learning Pvt Ltd., 2009.
8. Wind Energy: Theory and Practice, Siraj Ahmed, PHI, 2013
9. Renewable Energy: Power for sustainable future, Godfrey Boyle, Oxford University Press, 2004.

6.8- 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 hall voltage, mobility, carrier concentration and hall coefficient in a given semiconductor.
8. Determine the band gap in a semiconductor using four-probe method.
9. Determine the magnetic susceptibility of a paramagnetic salt by Quinck's method.
10. Determine the power factor of a coil using CRO.
11. Determine hysterisis loss using CRO.
12. Study the dynamics of a lattice using electrical analogue.
13. Study the characteristics of a G.M counter and verify the inverse square law.
14. Study of β- absorption in aluminium foil using G.M counter.
15. Determine the g- factor by ESR- step up.
16. Study of variation of modulus of rigidity of a given specimen as a function of temperature.
17. Any other experiments of the equivalent standard can be set.