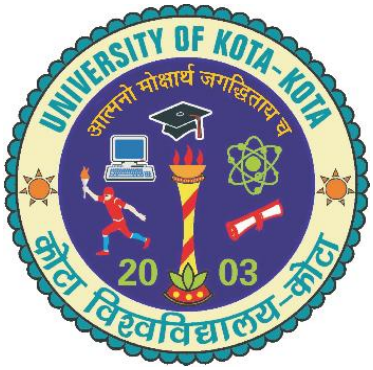
UNIVERSITY OF KOTA

SCHEME OF EXAMINATION

AND

COURSES OF STUDY



Department of Pure & Applied Physics
Faculty of Science

M.Sc. (Physics-Energy)

Third Semester (July-December, 2015)
Fourth 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.
II Year III Semester	3.1	PHY301	Nuclear Physics – I	3 Hrs	4		4	20	80	100	07	29
	3.2	PHY302	Classical Electrodynamics - II	3 Hrs	4		4	20	80	100	07	29
	3.3	PHY303	Solid State Physics-I	3 Hrs	4		4	20	80	100	07	29
	3.4	PHY304	Project-I	3 Hrs	4		4	-	100	100	-	40
	3.5	PHY305	Energy-II	3 Hrs	4		4	20	80	100	07	29
	3.6	PHY306	Physics Laboratory –III	6 Hrs		12	6	30	120	150	12	48
	Total				**20**	**12**	**26**	**110**	**540**	**650**		
IIYear IV Semester	4.1	PHY401	Nuclear Physics-II	3 Hrs	4		4	20	80	100	07	29
	4.2	PHY402	Solid state Physics-II	3 Hrs	4		4	20	80	100	07	29
	4.3	PHY403	Lasers Physics	3 Hrs	4		4	20	80	100	07	29
	4.4	PHY404	Project-II	3 Hrs	4		4	-	100	100	-	40
	4.5	PHY405	Energy-III	3 Hrs	4		4	20	80	100	07	29
	4.6	PHY406	Physics Laboratory-IV	6 Hrs		12	6	30	120	150	12	48
					20	**12**	**22**	**110**	**540**	**650**		

Objectives of the Course:

Innovation and Employability-Physics is fundamental to all physical sciences which explains the nature. Physicists have to be competent enough 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. Most of the conveniences of modern life are based directly on the understanding provided by physics. Many techniques used in medical imaging are derived directly from physics instrumentation. Even the internet is a spin-off from the information processing and communications requirement of high-energy particle physics.

Department of Pure and Applied Physics, University of Kota, Kota has started the M.Sc. (Physics-Energy) course from July, 2007. This course aims to provide a thorough understanding of Physics of both pure and applied nature with extensive theoretical and experimental knowledge in major areas of Physics with specialization in Energy field. The students after completing the course shall find placements in premier research institutes and companies in India and abroad, qualify NET/GATE/JEST examinations and will be eligible for M.Tech., Ph.D. and teaching.

Duration of the Course:

The course M.Sc. (Physics-Energy) shall consist of two academic years divided into four semesters.

Eligibility for Admission:

The basic eligibility for admission to the programme is B.Sc. with Physics, Chemistry and Mathematics with minimum marks for GEN category candidates of Rajasthan-60%; Other state-65%; SC/STOBC/SOBC-55%. The admission in the course is based on the merit of the percentage obtained in their B.Sc. course.

Structure of the Programme:

The M.Sc. (Physics-Energy) 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/Summer 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

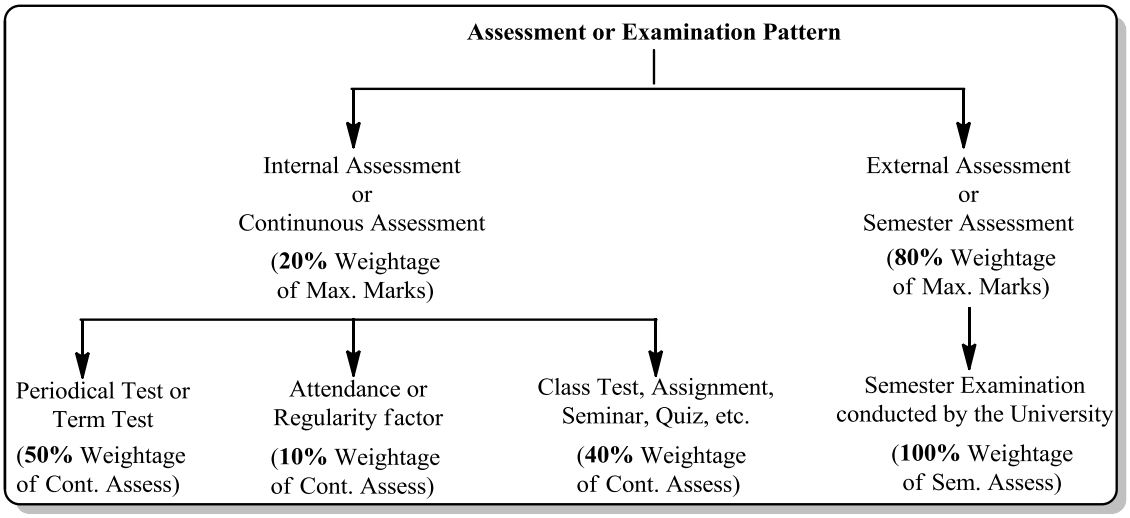
the discussion. Student seminars would be conducted and scientific discussions would be arranged to improve their communicative skills. In the laboratory, instructions would be given for the experiments followed by demonstration and finally the students have to do the experiments individually.

Maximum Marks:

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

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

For internal assessment examinations the scheme shall be followed as:

Section A: One compulsory question will have four parts of 0.5 marks each i.e. total marks 2 with word limit 20 words for each part.

Section-B: Two questions with internal choice with descriptive answer type of 4 marks each. (max. two questions)

Periodical Test / Term Test Format

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

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

Note: The question paper contains two sections as under:

Section A: One compulsory question will have four parts of 0.5 marks each i.e. total marks 2 with word limit 20 words for each part.

Section-B: Two questions with internal choice with descriptive answer type of 4 marks each. (max. two questions)

SECTION A

Q.1(a)		½
(b)		½
(c)		½
(d)		½
	SECTION B	
Q.2		4
	OR	
Q.3		4
Q.4		4
	OR	
Q.5		4

(B) External Assessment

80% weightage of Maximum Marks (80 Marks out of 100 Maximum Marks)

All the question papers of M.Sc. (Physics-Energy) semester scheme shall contain two sections as under:

Section-A : One compulsory question with eight parts of 16 marks in total, having 2 parts from each unit, of short answer in 20 words for each part of 2.0 marks each.

Section-B : There shall be two questions from each unit (total units four) with internal choice with descriptive answer type of 16 marks each. The students will have to attempt one question from each unit.

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

Note: The syllabus is divided into four units and question paper will be divided into two sections. Section-A will carry 16 marks with one compulsory question of equally divided 8(eight) short answer type questions (about 20 words) and examiners are advised to set two short questions from each unit. Section-B shall be of two questions from each unit (total units four) with internal choice with descriptive answer type of 16 marks each. The students will have to attempt one question from each unit

External Examination Format

SECTION-A: 8 x2=16
(Answer all questions)
(Two question from each unit with no internal choice)
Q. No. 1

(i) ……..…… **2 Mark**
(ii) ……..…… **2 Mark**
(iii) ……..…… **2 Mark**
(iv)……..…… **2 Mark**
(v)……..…… **2 Mark**
(vi)……..…… **2 Mark**
(vii)……..…… **2 Mark**
(viii)……..…… **2 Mark**

SECTION-B: 4 x 16=64
(Answer one question from each unit with internal choice)

Q. No. 2. . ……..……
Or
……..…… **16 Marks**

Q. No. 3. ……..……
Or
……..……... **16 Marks**

Q. No. 4. ……..……
Or
……..…… **16 Marks**

Q. No. 5. ……..……
Or
……..……... **16 Marks**

Q. No. 6. ……..
Or
……..... **16 Marks**

Q. No. 7. ……..……
Or
……..……
16 Marks

Q. No. 8. ……..……
Or
……..……..
16 Marks

Q. No. 9. ……..
Or
……..
16 Marks

Distribution of Marks for Practical Examinations:

Duration of Exam: 06 Hours **Maximum Marks: 120**

S. No.	Name of Exercise	Marks
1.	Experiment	70
3.	Viva-voce	25
4.	Practical Record	25
	Total Marks	**120**

The seminar/internal component of 30 marks will be evaluated during the internal assessment process.

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 i.e. IV semester and eligible to re-appear in that paper(s) in next year examination.

(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 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.

III SEMESTER

PHY301- Nuclear Physics-I

Unit-I

Basic nuclear properties: size, shape and charge distribution, spin and parity, Binding energy, semi-empirical mass formula, liquid drop model, Two Nucleon system and Nuclear Forces, General nature of the force between nucleons, saturation of nuclear forces, charge independence and spin dependence, General forms of two nucleon interaction, central, non-central and velocity dependent potentials, Analysis of the ground state ($3S^1$) of deuteron using a square well potential, range-depth relationship, excited states of deuteron, quantitative discussion of the ground state of deuteron under non-central force, calculation of the electric quadrupole and magnetic dipole moments and the D-state admixture

Unit-II

Nucleon-Nucleon Scattering and Potentials: Partial wave analysis of the neutron-proton scattering at low energy assuming central potential with square well shape, concept of the-scattering length, coherent scattering of neutrons by protons in ortho and Para hydrogen molecules, conclusions of these analyses regarding scattering lengths, range and depth of the potential, the effective range theory and the shape independence of nuclear potential, A qualitative discussion of proton proton scattering at low energy, General features of two-body scattering at high energy Effect of exchange forces, Main features of the One boson Exchange Potentials (no derivation).

Unit-III

Interaction of radiation and charged particle with matter: Law of absorption and attenuation coefficient, Photoelectric effect, Compton scattering, pair production, Energy loss of charged particles due to ionization, Bremstrahlung, energy target and projectile dependence of all three processes, Range-energy curves, Straggling.

Unit-IV

Experimental Techniques: Gas filled counters, Scintillation counter, Cerenkov counters, Solid state detectors, Surface barrier detectors, Electronic circuits used with typical nuclear detectors, Multiwire proportion chambers, Nuclear emulsions, Proton synchrotron, Linear accelerators, Acceleration of heavy ions.

Text/Reference Books:

1. Nuclear Physics by Irving Kaplan, (Addison Wesley Pub. Co.), 2nd Ed
2. Nuclear Physics Theory and Experiment by R. R. Roy, B. P. Nigam (New Age Internation Pub.), 1997.
3. Atomic Nucleus by R.D. Evans (McGraw Hill), X ed., 1965
4. Nuclear Physics by S. N. Ghoshal (S. Chand, New Delhi), 2006
5. Introduction to Experimental Nuclear Physics by R. M. Singru (Wiley Eastern pvt. Ltd.)
6. Nuclear Physics: an Introduction by S. B. Patel (Wiley Eastern Ltd.), 1992.
7. Theoretical Nuclear Physics: J.M. Blatt & V.E. WeissKipf.
8. Introductory Nuclear theory: -L.R.B. Elton, ELBS Publs. Londan 1959.
9. Structure of the Nucleus: - M.A. Preston & R.K.Bhaervi, Addision Wesley
10. Nuclear Physics:- Techniques of Nuclear Structure (vol. I) England
11. Introduction to Nuclear Physics:-H.Enge.Addision Wesley
12. Elements of Nuclear Physics:- W.E.Burcham, ELBS Longman.
13. Concepts of Nuclear Physics:- B.L. Cohen, Tata Mc Graw Hill,1988.

14. Nuclei & Particles -E.Segre, Benjamin 1972.
15. Introductory Nuclear Physics:-D.Halliday Willey 1955
16. Introduction of Nuclear Physics & Chemistry :-Harvey.
17. The Physics of Nuclear Reactions :-W.M.Gibson, Pergamon Press.
18. Nuclear Interaction:- S.De Benedetti, Wiley 1955.

PHY302- Classical Electrodynamics-II

Unit-I

Plane Electromagnetic Waves and Wave Equation: Plane waves in a non-conducting medium, Frequency dispersion characteristics of dielectrics, conductors and plasmas, waves in a conducting or dissipative medium, superposition of waves in one dimension, group velocity, casualty connection between D and E, Kramers-Kroning relation

Unit-II

Magneto-hydrodynamics of conducting fluids and Plasma Physics: Plasma Physics, Introduction of Lab and Space plasma, Plasma Parameters, Debye Length, Electron and Ion Temperature, Electron and Ion Number Density, Characteristic Frequencies, Plasma Frequencies, Cyclotron Frequencies, Plasma Waves and Oscillations, Modes of a Cold, Warm and Hot Plasmas, Effect of Magnetic Field on Plasma Dispersion Characteristics, Pinch effect, Instabilities, Hydrodynamic and Velocity Space, Linear and non-linear phenomena, MHD equations, magnetic field lines, magnetic hysteresis, hydro-magnetic waves.

Unit-II

Radiation by moving charges : Lienard-Wiechert Potentials for a point charge, Total power radiated by an accelerated charge, Larmour's formula and its relativistic generalization, Angular distribution of radiation emitted by an accelerated charge, Radiation emitted by a charge in an arbitrary ultra relativistic motion, Distribution in frequency and angle of energy radiated by accelerated charges, Thomson scattering and radiation, Scattering by quasi free charges, coherent and incoherent scattering, Cherenkov radiation.

Unit-IV

Radiation damping, self fields, of a particle, scattering and absorption of radiation by a bound system: Introductory considerations, Radiative reaction force from conservation of energy, Abraham Lorentz evaluation of the self force, difficulties with Abraham Lorentz model, Integro-differential equation of motion including radiation damping,, Line Breadth and level shift of an oscillator, Scattering and absorption of radiation by an oscillator, Energy transfer to a harmonically bound charge

Text/Reference books:

1. Classical clectrodynamics by J.D. Jackson, (John Wiley & Sons), II Ed., 1975.
2. Classical Electricity and Magnetism by Panofsky & Philips, (Indian Book, New Delhi), 1962.
3. Introduction to Electrodynamics by Griffiths, (Pearson Education), 2005.
4. Classical theory of Electrodynomics by Landau &Lifshitz, (Pergaman Press, New York), 1960.
5. Electrodynamics of Continuous Media by Landau & Lifshitz, (Pergaman Press New York), 1960.
6. Elements of Electromagnetics by Mathew N.O. Sadiku, (Oxford Univ. Press), II ed., 1999.

PHY303-Solid State Physics-I

Unit-I

Bravais lattices, Reciprocal lattice, Diffraction and the structure factor, Bonding of solids, Ionic, Covalent and Metallic bonding, Vaan-der Wall forces, Lattice dynamics of ionic & covalent crystals, metals, Analysis of strain, elastic compliance and stiffness constants, elastic energy density, elastic stiffness constants of cubic crystals and elastic waves in cubic crystals.

Unit-II

Vibration of crystals with monatomic basis, two atoms per primitive basis, quantization of elastic waves, phonon momentum, inelastic scattering by phonons, phonon heat capacity, Plank distribution, density of states in one and three dimensions, Debye model for density of states, Debye T^3 law, Einstein model, thermal conductivity, phonon-phonon interaction-umklapp process, thermal expansion, Phonon dispersion by inelastic scattering of neutrons

Unit-III

Nearly free electron model, origin and magnitude of energy gap, Bloch function, Kronig-Penney model, wave equation of electron in periodic potential, number of orbitals in a band, band gap in semiconductors, equation of motion, Law of mass action, effective mass in semiconductors, intrinsic carrier concentration, impurity conductivity, Fermi surfaces, tight bonding method for energy gap, De Hass-van Alfen affect.

Unit-IV

Ellipsoidal energy surfaces in Si and Ge, Hall effect, recombination mechanism, optical transitions and Schockely-Read theory excitons, Defects and dislocations, Ordered phases of matter: translational and orientational order, kinds of liquid crystalline order, Quasi crystals

Text and Reference Books:

1. Introduction to Solid state Physics by C. Kittel, (John Wiley), VII Ed.,1995.
2. Solid State Physics by A. J. Dekker, (Macmilam), London, 1965.
3. Solid state physics by S. O. Pillai, (New Age International Publishers), 2005.
4. Solid State Physics by Ashkroft and Mermin.
5. Intermediate Quantum theory of solids- A.D.E.Animalu,(Prentice Hall).
6. Quantum theory of Soilds- Kittel,(John Wiley).
7. Soild State Physics Source books- S.P.Parker,(Mc.Graw Hill).
8. Soild State Physics- Harrison, (Banjamin Press)
9. Quantum Solid State Physics-S.V.Vonsovsky & M.I.katsnelson,(Springer Verlag).

PHY304- Project-I

The project shall be implemented in III semester but the final submission shall be in IV semester. However, a mid-term detailed presentation shall be made by the student with semester end examinations and he/she shall present the work plan and the work done till date.

PHY305- Energy II

Unit I

Solar Thermal Energy Conversion: Solar radiation, liquid flat plate collectors -performance analysis, collector efficiency factor, collector heat removal factor, parametric analysis, testing procedures, applications, evacuated tube collector. Concentrating collectors: Flat plate collectors with reflectors, cylindrical parabolic collector, compound parabolic collector, parabolic dish collector, central receiver collector, Solar thermal power generation.

Unit II

Solar Photovoltaics (SPV)**:** Silicon material, ribbon silicon, production of junctions, oxidation process, high efficiency solar cells, bifacial solar cells, basic components of thin film solar cell, thin film materials- amorphous silicon, copper indium diselenide, tandem cells, organic solar cells, Characteristic curves of solar cell, module technology, electrical output properties of solar cells, SPV water pumping.

Unit III

Wind Power Generation: Physical principles, Betz limit, horizontal and vertical axis wind turbines, technical description of generation system, energy conversion, losses and characteristic power curve, power control- stall and pitch, introduction to hybrid systems.

Unit IV

Hydroelectric Power Generation: Principles, construction types and classification, system components, reaction and impulse turbines, energy conversion chain, losses and power curve, Energy Storage: Thermal, Chemical, Mechanical and Electrical Energy storage.

Text and Reference Books:

1. Physics of solar cells : Peter Wurfel (Wiley- VCH)
2. Stand Alone Solar Electric Systems : Mark Hankins (Eartnscan Expert Series)
3. Solar Domestic Water Heating : Chris Laughton (Earthscan Expert Series).
4. Principles of Energy Conversion: A.W. Culp.
5. Direct Energy Conversion: M.A.kettani.
6. Energy Conversion systems: Begamudre, Rakoshdas.
7. Renewable Energy Sources and Conversion Techonology: N.K. Bansal, M.K. Kaleemann.
8. Solar Engineering of Thermal Process: Duffie and Beckman (J. Wiley).
9. Power Generation Through Renewable Sources of Energy: B.R.Pai,M.S.Ramprasad (Tata Mcgraw Hill).
10. Solar Power Engineering: B.S. Mangal (Tata-Mcgraw Hill).
11. Wind Energy Explained: Theory, Design and Application, Manwell, McGowan, Rogers (Wiley).
12. Efficient Use of Energy: I.G.C.Dryden (Butterworth Scientific).
13. Photovoltaic Solar Energy Conversion: A. Goetzberger, Springer.
14. Energy Science: Principles, technologies and impacts: John Andrews and Nick Jelly (Oxford).
15. K.Sukhatme, Suhas P.Sukhatme., "Solar energy: Principles of thermal collection and storage", Tata McGraw Hill publishing Co. Ltd, 8th edition, 2008.

PHY306- Physics Laboratory-III

1. To determine the ultrasonic velocity and obtain the compressibility of a given liquid.
2. To study dynamics of a lattice using electrical analogue.
3. To study variation of rigidity of a given specimen as a function of the temperature.
4. To determine the modulus of rigidity of matter by using torsional oscillator (simple brass and iron rod).
5. To determine half-life of a radio Isotope using G.M. Counter.
6. To study absorption of particles and determine range using at least two Sources.
7. To study characteristics of G.M. Counter and to study statistical nature of radio-active decay.
8. To study spectrum of β-particles Using Gamma ray spectrometer.

9. To calculate the solar azimuthal angle for solar radiation with solar time (8:00 a.m. to 4:00 p.m.) for 21 March, 21 June and 21 December.
10. To calculate the angle of incidence of solar radiation in degree at solar noon for different days (at an interval of 20 days) of a year at surface inclined at 0°, 45° and 90° facing towards south (surface azimuth angle = 0°) & to plot the results.
11. Determine the operating frequency of Reflex Klystron.
12. Draw the V-I characteristics of Reflex Klystron.
13. Draw the characteristics of Attenuator.
14. To verify the Waveguide Law.
15. To study the directivity and coupling coefficient of Directional Coupler.
16. To study the properties of Magic Tee and also determine isolation and coupling coefficient.
17. To measure the VSWR of (i) short circuit (ii) open circuit (iii) matched load (iv) unmatched load.
18. To study the properties and E-plane and H-plane Tees. Determine Isolation and coupling coefficient.
19. To study the functional groups & structure of the material using FTIR.
20. To determine the optical band gap of a given materials either in bulk or in film form by UV-VIS-NIR spectrometer.

IV SEMESTER

PHY 401- Nuclear Physics-II

Unit-I

Nuclear shell model: Single particle and collective motions in nuclei, assumptions and justification of the shell model, average shell potential, spin orbit coupling, single particle wave functions and level sequence, magic numbers, shell model predictions for ground state parity, angular momentum, magnetic dipole and electric quadrupole moments and their comparison with experimental data, configuration mixing, single particle transition probability according to the shell model, selection rules, approximate estimates for the transition probability, nuclear isomerism,

Unit-II

Collective nuclear models: Collective variable to describe the cooperative modes of nuclear motion, Parameterization of nuclear surface, A brief description of the collective model Hamiltonian (in the quadratic approximation), Vibrational modes of a spherical nucleus, Collective modes of a deformed even-even nucleus and moments of inertia, Collective spectra and electromagnetic transition in even nuclei and comparison with experimental data, Nilsson model for the single particle states in deformed nuclei

Unit-III

Nuclear gamma and beta decay: Electric and magnetic multipole moments and gamma decay probabilities in nuclear system (no derivations), Reduced transition probability, Selection rules, futernal conversion and zero, Zero transition, General characteristics of weak interaction, nuclear beta decay and lepton capture, electron energy spectrum and Fermi- Curie plot, Fermi theory of beta decay (parity conserved selection rules Fermi and Gammaw-Teller) for allowed transitions, ft-values, Forbidden transitions, Experimental verification of parity violation, The V-A interaction and experimental evidence,

Unit-IV

Nuclear Reactions: Theories of Nuclear Reactions, Partial wave analysis of reaction Cross section, Compound nucleus formation and breakup, Resonance scattering and reaction, Breit-Wigner dispersion formula for S-waves (l= 0), continuum cross section, statistical theory of nuclear reactions, the optical model, Stripping and pick-up reactions and their simple theoretical description, nuclear structure studies with deuteron stripping (d,p) reactions.

Text/Reference books:

1. Nuclear Physics by Irving Kaplan, (Addison Wesley Pub. Co.), 2nd Ed.
2. Nuclear Physics Theory and Experiment by R. R. Roy, B. P. Nigam (New Age Internation Pub.), 1997.
3. Atomic Nucleus by R.D. Evans (McGraw Hill), X ed., 1965.
4. Nuclear Physics by S. N. Ghoshal (S. Chand, New Delhi), 2006.
5. Introduction to Experimental Nuclear Physics by R. M. Singru (Wiley Eastern pvt. Ltd.)
6. Nuclear Physics: an Introduction by S. B. Patel (Wiley Eastern Ltd.), 1992.
7. Theoretical Nuclear Physics: J.M. Blatt & V.E. WeissKipf.
8. Introductory Nuclear theory: -L.R.B. Elton, ELBS Publs. Londan 1959.
9. Structure of the Nucleus: - M.A. Preston & R.K.Bhaervi, Addision Wesley
10. Nuclear Physics:- Techniques of Nuclear Structure (vol. I) England
11. Introduction to Nuclear Physics:-H.Enge.Addision Wesley
12. Elements of Nuclear Physics:- W.E.Burcham, ELBS Longman.

13. Concepts of Nuclear Physics:- B.L. Cohen, Tata Mc Graw Hill,1988.
14. Nuclei & Particles -E.segre, Benjamin 1972.
15. Introductory Nuclear Physics:-D.Halliday Willey 1955
16. Introduction of Nuclear Physics & Chemistry :-Harvey.
17. The Physics of Nuclear Reactions :-W.M.Gibson,Pergamon Press.
18. Nuclear Interaction:- S.De Benedetti, Wiley 1955.

PHY402- Solid State Physics-II

Unit-I

Larmor diamagnetism, Classical & Quantum theory of Paramagnetism, Curie Langevin and Quantum theories, Susceptibility of rare earth and transition metals, paramagnetic susceptibility of conduction electrons, Ferromagnetism: Domain theory, Weiss molecular field and exchange, spin waves, Magnons, dispersion relation and its experimental determination by inelastic neutrons scattering, heat capacity.

Unit-II

Nuclear magnetic resonance, Line width, hyperfine splitting, Nuclear quadrupole resonance, ferromagnetic resonance, Antiferromagnetic resonance, Electron paramagnetic resonance, Principle of MASER action.

Unit-III

Meissner effect, heat capacity, London's equation, microwave and infrared properties, isotope effect, flux quantization, density of states, nuclear spin relaxation, Types of Superconductors, AC and DC Josephson tunneling, Cooper pairs and derivation of BCS Hamiltonian, results of BCS theory (no derivation), coherence length field quantization in a superconducting ring, duration of persistent current, high temperature superconductors, super fluidity, Landon's theory of super fluidity.

Unit-IV

Basic theory of X-ray diffraction, Indexing of Debye-Scherer patterns from powder samples, Electron microscopes (SEM & TEM), Scanning probe microscopes (SPM), Scanning Tunneling microscope, atomic force microscope, Basic principles of X-ray, X-ray absorption fine structure, X-ray photo-emission and positron annihilation techniques.

Text and Reference Books:

1. Introduction to Solid state Physics by C. Kittel, (John Wiley), VII Ed.,1995.
2. Solid State Physics by A. J. Dekker, (Macmilam), London, 1965.
3. Solid state physics by S. O. Pillai, (New Age International Publishers), 2005.
4. Solid State Physics by Ashkroft and Mermin.
5. Intermediate Quantum theory of solids- A.D.E.Animalu,(Prentice Hall).
6. Quantum theory of Soilds- Kittel,(John Wiley).
7. Soild State Physics Source books- S.P.Parker,(Mc.Graw Hill).
8. Soild State Physics- Harrison, (Banjamin Press)
9. Quantum Solid State Physics-S.V.Vonsovsky & M.I.katsnelson,(Springer Verlag).

PHY403- Laser Physics

Unit-I

Spontaneous and Stimulated emission, Population inversion, Idea of laser. Gaussian beam and its properties, Stable and Unstable Optical Resonators, Longitudinal and Transverse

modes of laser cavity, Gain in a regenerative laser cavity, Threshold for 3 and 4 level laser systems, Q-switching and mode locking – Pulse shorting – nano, pico and femtosecond operation

Unit-II

Ruby laser, He-Ne laser, carbon oxide laser, Excimer laser, X-ray laser, Dye laser, Neodymium : YAG and Neodymium : glass laser, Fiber laser, Semiconductor laser, Quantum-well laser, Diode – Pumped solid state laser

Unit-III

Laser fluorescence and Raman scattering, Laser induced multiphoton process, Ultrahigh resolution spectroscopy with lasers and its applications, Holography: Construction of hologram and reconstruction of the image, Types of Hologram, Medical and Engineering applications of lasers, Potential of lasers in defense applications.

Unit-IV

Optical Fibers, Light wave communication, Light propagation- total internal reflection, Acceptance angle and Numerical aperture. Fiber materials and Fabrication, Fiber cables, comparison of Fiber cables with conventional metallic cables, Optical Fibers- step index, single and multimode, graded index. Fiber losses and dispersions.

Text/Reference books:

1. Laser Fundamentals by William T. Silfvast (Cambridge University Press), 1998.
2. Optical Electronics by Ajoy Ghatak and K. Thyagarajan (Cambridge University Press), VII Reprint, 2006.
3. Lasers by Ajoy Ghatak and K. Thyagarajan, (Cambridge University Press)
4. Lasers by Orazio Svelto, (Springer Science Inc., USA), IV Ed, 1998.
5. Laser Spectroscopy by W. Demtroder, (Springer-Verlag), Berlin, III Ed., 2003
6. Optoelectronics: An Introduction, J. Wilson and J.F.B. Hawkes, (Prentice Hall International (UK) Limited), II Ed., 1989.
7. Optoelectronic Devices and Systems by S.C. Gupta, (Prentice Hall India), 2005
8. Laser Electronics by Joseph T. Verdeyen, (Prentice Hall of India Private Limited), II Ed., 1993.
9. Lasers: Principal and Applications by J. Wilson and J.F.B. Hawkes, (Prentice Hall International (UK) Limited).
10. Laser by P.W. Milonni, J.H. Eberly, John-Wiley & Sons.
11. Lasers and Optical Engineering by P.Das, Narosa Publishers.

PHY404-Project-II

Final report shall be submitted and sent to the external examiner for evaluation. The student shall defend his/her project by presentation in-front of a panel of examiners consisting of one external examiner.

PHY405- Energy III

Unit I

Nuclear reactions : Introduction to fission and fusion nuclear energy, typical reactions. Basic Concepts: Binding Energy of a nuclear reaction, mass energy equivalence and conservation laws, nuclear stability and radioactive decay, radioactivity calculations. Interaction of Neutrons with Matter: Compound nucleus formation, elastic and inelastic scattering, cross

sections, energy loss in scattering collisions, critical energy of fission, fission cross sections, fission products, fission neutrons, energy released in fission, γ -ray interaction with matter, fission fragments.

Unit II

The Fission Reactor: The fission chain reaction, reactor fuels, conversion and breeding, the nuclear power resources, nuclear power plant & its components, power reactors and current status. Reactor Theory: Neutron flux, continuity equation, diffusion equation, boundary conditions, solutions of the DE, Neutron moderation. Health Hazards: radiation protection & shielding. Nuclear Fusion: Fusion reactions, reaction cross-sections, reaction rates, Lawson criterion, magnetic and inertial confinement, introduction to ITER, ASDEX.

Unit III

Energy Conservation and Management: Thermodynamic basis of energy conservation, Irreversible processes, Reversibility and Availability, Exergy and available energy, Energy conservation in HVAC systems and thermal power plants, Energy conservation in buildings, UValue of walls / roof, Lighting Systems - Different light sources and luminous efficacy, Insulation use – Materials properties, Optimum thickness, Energy audit and Instrumentation.

Unit IV

Green Buildings: Thermal comfort, classification of climate zones, Heat flow calculations in buildings,. Direct heat gains through windows. Convective gains/losses, Gains from people, appliances etc. Passive and low energy concepts and applications. Passive cooling/heating concepts, building form and orientation, internal and external shading devices, ventilation, passive concepts for composite climates, evaporative and nocturnal cooling, earth–air tunnel, solar chimney-based hybrid system.

Text and 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 and Nick Jelly (Oxford).
4. Energy Management Handbook, W.C. Turner, S. Doty, CRC Press, 2006.
5. Nuclear Physics: L.Kaplan, Addi Wesley 1963.
6. The Physics of Nuclear Reactions :W.M.Gibson,Pergamon Press.
7. Sustainable Construction: Green Building Design & Delivery – Charles J. Kibert, John Wiley & Sons (Third Edition).
8. Energy Conservation Building Code, India.

PHY406- Physics Laboratory-IV

1. To study the Electro-Optic effect and AC modulation.
2. To study of thermal expansion of quartz crystal using Newton's Ring method.
3. To study the Acoustic-Optic effect.
4. To study the Brewster angle and refractive index of a given materials.
5. To determine the attenuation and bending losses of an optical fiber.
6. Study the Gaussian distribution of intensity of a laser beam.
7. To study the spatial and temporal coherence of laser.
8. To determination particle size by diode laser.
9. To study the nature of polarization.
10. To determine the speed of light using laser.

11. To calibrate a scintillation spectrometer and determine energy of gamma-rays from an unknown Source.
12. To study Compton scattering of gamma-rays and verify the energy Shift formula.
13. To study the alpha particles using Spark chamber.
14. To study the Bremstralung effect Using Scintillation spectrometer.
15. To determine the end point energy of β-particles using β--ray Spectrometer.
16. To study the Hall effect in Semiconductor and determination of Allied parameters.
17. To find the Band gap of given Semiconductor Material with the help of Four Probe method.
18. Measurement of Magnetic susceptibility of paramagnetic Solution by Quinck Method.
19. To set up a fiber optics analog and digital link.
20. To study the losses in Optical fiber.
21. To study numerical aperture of optical fiber.
22. To study the characteristics of a fiber optics LED and Photo detect