UNIVERSITY OF KOTA

SCHEME OF EXAMINATION

AND

COURSES OF STUDY

Department of Pure & Applied Physics
Faculty of Science

M.Sc. (Physics) I & II Semester
Under Integrated B.Sc.-M.Sc. (Physics) Programme

First Semester (July-December, 2016)
Second Semester (January-June, 2017)

UNIVERSITY OF KOTA

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

INDIA

Edition: 2016

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.
I Year I Semester	1.1	PHY101	Mathematical Methods in Physics	3 Hrs	4	--	4	30	70	100	12	28
	1.2	PHY102	Classical Mechanics	3 Hrs	4	--	4	30	70	100	12	28
	1.3	PHY103	Quantum Mechanics-I	3 Hrs	4	--	4	30	70	100	12	28
	1.4	PHY104	Solid State Physics	3 Hrs	4	--	4	30	70	100	12	28
	1.5	PHY111	Physics Laboratory-I	6 Hrs	--	16	8	-	100	100	--	50
	Total				**16**	**16**	**24**	**120**	**380**	**500**	**--**	
I Year II Semester	2.1	PHY201	Statistical Mechanics	3 Hrs	4	--	4	30	70	100	12	28
	2.2	PHY202	Classical Electrodynamics -I	3 Hrs	4	--	4	30	70	100	12	28
	2.3	PHY203	Quantum Mechanics-II	3 Hrs	4	--	4	30	70	100	12	28
	2.4	PHY204	Elective-I	3 Hrs	4	--	4	30	70	100	12	28
	2.5	PHY211	Physics Laboratory-II	6 Hrs		16	8	--	100	100	--	50
Total					**16**	**16**	**24**	**120**	**380**	**500**	**--**	

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	3 Hrs	4	--	4	30	70	100	12	28
	3.2	PHY302	Classical Electrodynamics – II	3 Hrs	4	--	4	30	70	100	12	28
	3.3	PHY303	Elective-II	3 Hrs	4	--	4	30	70	100	12	28
	3.4	PHY304	Elective-III	3 Hrs	4	--	4	30	70	100	12	28
	3.5	PHY311	Physics Laboratory –III	6 Hrs	--	16	8	--	100	100	--	50
	Total				**16**	**16**	**24**	**120**	**380**	**500**		
II Year IV Semester	4.1	PHY401	University / Industry Project	--	--	48	24	150	350	500	75	175
Total						**48**	**24**	**150**	**350**	**500**	**--**	

List of Electives

Elective-I
(a): Energy Studies-I
(b): Plasma Physics-I
(c): Material Science-I

Elective-II
(a): Energy Studies-II
(b): Plasma Physics-II
(c): Material Science-II

Elective-III
(a): Energy Studies-III
(b): Plasma Physics-III
(c): Material Science-III

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	60
3.	Viva-voce	25
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

I SEMESTER

PHY 101- Mathematical Methods in Physics

Unit-I

Analytic function and the Cauchy-Riemann equations, Cauchy's integral theorem, Taylor's and Laurent series, Cauchy's residues theorem, singular points, poles, residues, evaluation of definite integrals

Unit-II

Fourier series, Fourier integral, Fourier Transform, Fourier sine and cosine transform, inversion formula for Fourier sine and cosine transforms, change of scale property, shifting theorem, multiple Convolution theorem, Fourier transform of the derivatives of a function

Unit-III

Laplace transforms, first and second shifting theorems, inverse Laplace transform-first and second shifting theorems, Laplace transform and inverse Laplace transform of derivative and integral of function, Convolution theorem

Unit-IV

Error Analysis, Computer Arithmetic, Linear ordinary differential equations, Second-order homogeneous and nonhomogeneous differential equations with constant and variable coefficients, Numerical Integration and Differentiation, Trapezoidal & Simpson's rule, Runga-Kutta method, Simultaneous and Higher order equations.

Unit-V

Bisection method, Newton-Raphson Method, Solution of Linear equations, Curve fitting, Least squares approximation, Linear Vector spaces, Eigen vectors and Eigen Value problems, Caley Hamilton theorem.

Text/Reference books:

1. Introduction to Mathematical Physics by Charlie Harper (PHI), 1972.
2. Applied Mathematics for Engineers and Physicists by Louis A. Pipes and Lawrence R. Harvill, (Third Edition, McGraw-Hill Book Company), 1970.
3. Advanced Engineering Mathematics by E Kreyszig (John-Wiley), 1983.
4. Mathematical Physics by Eygene Butkov (Addison-Wesley Publishing Company), 1968.
5. Mathematical Methods in Physics By Arfken and Weber, (Academic Press, 5^{th} Ed.), 2001.
6. Complex Variables & Functions: Churechill, Brown, Varchy
7. Mathematical Methods: Potter &Goldberg.
8. Computer Based Numerical Algorithms: Krishnamurthy E.V., (East West Press)
9. Elementary Numerical Analysis: Conte de Boor.
10. Statistical Analysis: A Computer Oriented Approach: Affi A.A., Academic Press,
11. Introduction to Data Analysis and Statistical Inference : Morris C., Rolpn J., Prentice Hall, 1981.
12. Introduction to Numerical Analysis: Atkinson E., John Wiley 1978.
13. Elementary Computer Assisted Statistics : Scalzo F., Von Nostrand Reinhod Co. Ltd.1978.
14. Essential Computer Mathematics : Seymour Lipshutz, Schaum's Outline Series, McGraw Hill
15. Introductory Methods of Numerical Analysis : S.S.Sastry.

PHY 102- Classical Mechanics

Unit-I
Holonomic and nonholonomic constraints: Principle of Least Action, Lagrange's equation and its applications, D-Alembert's Principle, Generalized,coordinates, Lagrangian, Symmetry and Conservation laws, Central field problems, Scattering cross-section, Rutherford Formula, Laboratory and CM Frame, two body problem, Kepler problem, Small oscillations, normal coordinates and its applications, Orthgonal transformation, Coupled Oscillators, Free forced and parametric oscillations, Generalized momentum, Legendre transformation.

Unit-II
Hamiltonian, Hamilton's Canonical equations, Canonical transformations, Hamilton's variational principle, Derivation of Lagrange's and Hamiltonian, Extension of Hamilton's Principle for nonconservative and nonholonomic systems, Method of Lagrange's multipliers.

Unit-III
Canonical transformation, integral in variants of poincare: Lagrange's and Poisson brackets as canonical invariants, Equation of motion in Poisson bracket formulation, Infinitesimal contact transformation and generators of symmetry, Liouville's theorem, Hamilton-Jacobi equation and its applications

Unit-IV
Action angle, variable adiabatic invariance of action variable : The Kepler problem in action angle variables, Eulerian angles, Euler theorem, Eigen values of the inertia tensor, Euler equations, Force free motion of a rigid body, Rigid body dynamics- moment of inertia tensor, non-inertial force, Psuedo Force, Coriolis Force.

Unit-V
Special theory of relativity- Lorentz transformations, Four Vector Formulation, Lagrangian and Hamiltonian of a charged particle in presence of EM Fields, Field transformations, relativistic kinematics and mass–energy equivalence, stress tensor, energy momentum tensor, relative motion of charged particle in EM fields.

Text/Reference books:
1. Mechanics by Landau & Lifshitz
2. Classical Mechanics by H Goldstein (Addison Wesley), 1980.
3. Mechanics by A Sommerfeld (Academic Press), 1952.
4. Classical Mechanics by Puranics, Tata Mc Graw Hill.
5. Classical Mechanics: A. Ray Chaudhary.

PHY 103- Quantum Mechanics-I

Unit-I
Basic Formulation of Quantum Mechanics: Superposition of amplitudes, States of a quantum mechanical system, representation of quantum mechanical states, properties of quantum mechanical amplitude, operators and change of state, postulates, essential definitions and commutation relations, quantum conditions and uncertainty relation, Co-ordinate and momentum representation of operators & position, momentum and angular momentum, time dependence of expectation values.

Unit-II

The time evolution of wave function, Schrodinger equation, 1-D, 2-D and 3-D Potential Box and Simple Harmonic Oscillator, central field problem-hydrogen atom, Energy quantization, WKB method for one dimensional problem, application to bound states (Bohr-Sommerfeld quantization) and the barrier penetration -alpha decay.

Unit-III

Hamiltonian matrix and the time evolution of Quantum mechanical States: Hermiticity of the Hamiltonian matrix, Time independent perturbation of an arbitrary system, simple matrix examples of time independent perturbation, energy states of a two state system, Ammonia molecule as an example of two state system diagonalizing of energy matrix, Pauli matrices.

Unit-IV

Time dependent Perturbation: Transitions in a two state system, The Fermi Golden rule, phase space, emission and absorption of radiation, induced dipole transition and Spontaneous emission of radiation, energy width of a quasi stationary state.

Unit-V

Symmetries and Angular momentum: Compatible observables and constants of motion, symmetry transformation and conservation laws, invariance under space and time translations and space rotation, Angular momentum operators and their eigen values, matrix representations of the angular momentum operators and their eigen states, composition of angular momentum, Clebsch- Gordon coefficients tensor operators and Wigner Eckart theorem.

Text/Reference books:

1. Quantum Mechanics by L I Schiff (Mcgraw-Hill), III ed., 1968
2. Quantum Mechanics Theory and Applications by A. K. Ghatak and S. Lokanathan (Third Edition, 1997, Mcmillan India Limited)
3. Quantum Mechanics: A modern approach by Ashok Das and A.C. Milissionos (Gordan and Breach Science Publishers),1992.
4. Quantum Mechanics An Introduction by Walter Grenier (Third ed., 1994, Springer)
5. Modern Quantum Mechanics by J.J. Sakurai (Addison-Wesley, 1999)
6. Quantum Physics (atoms, molecules…) R. Eisberg and R. Resnick (J. Wiley), 2005.
7. Quantum Mechanics by P. A. M Dirac
8. Quantum Mechanics by Merzbekar
9. Quantum Mechanics: Non relativistic theory: L.D. Landau & E. M. Lifshitz
10. Quantum Mechanics: Thankapann (New Age International publication).

PHY 104- Solid State Physics

Unit-I

Analysis of strain, elastic compliance and stiffness constants, elastic energy density, elastic stiffness constants of cubic crystals and elastic waves in cubic crystals, Vibration of crystals with monatomic basis, two atoms per primitive basis, quantization of elastic waves, phonon momentum, inelastic scattering by phonons.

Unit-II

Larmor diamagnetism, Classical & Quantum theory of Paramagnetism, Curie Langevin and Quantum theories, Susceptibility of rare earth and transition metals, paramagnetic susceptibility of conduction electrons

Unit-III

Ferromagnetism: Weiss molecular field and exchange, Heisenberg's exchange interaction, relation between exchange integral and mean-field constant, spin waves, Magnons, dispersion relation, inelastic neutrons scattering, Antiferromagnetism, dispersion relation, Ferrimagnetism, expression for magnetic susceptibility.

Unit-IV

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

Unit-V

Diffraction techniques: Introduction to x-ray, sealed tube x-ray source, rotating anode x-ray source, synchrotron source, single crystal diffraction, powder diffraction, Low Energy electron diffraction (LEED), dynamic light scattering (DLS).

Text 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. Intermediate Quantum theory of solids- A.D.E.Animalu,(Prentice Hall).

PHY111- Physics Laboratory-I

1. To study the potential energy curve for end on magnetic interaction.
2. To study the Fourier analysis of sinusoidal, square and triangular wave.
3. To study the dispersion curve for a beaded string to calculate the average mass per unit length of the beaded string and to find out cut off frequency.
4. To study a various types of Oscillators (like Hartley etc.).
5. Study of clipping and clamping circuit.
6. Study of Lissajous figure using C. R. O.
7. To study the behavior of V I characteristics of UJT.
8. To study the output and transfer characteristics of a FET.
9. To measure the input and output characteristics of BJT.
10. To draw the V-I characteristics of a DIAC.
11. To draw the V-I characteristics of a TRIAC.
12. To draw the V-I characteristics of a SCR.
13. To draw the V-I characteristics of an Optocoupler.
14. Study the Gaussian distribution of intensity of a laser beam.
15. To study the spatial and temporal coherence of laser.
16. To determination particle size by diode laser.
17. To study the nature of polarization.
18. To determine the speed of light using laser.

II SEMESTER

PHY201- Statistical Mechanics

Unit-I

Basic Principles, Canonical and Grand Canonical ensembles: Concept of statistical distribution, phase space, density of states, Liouville's theorem, systems and ensemble, entropy in statistical mechanics Connection between thermodyanic and statistical quantities, micro canonical ensemble, equation of state, specific heat and entropy of a perfect gas, using micro-canonical ensemble

Unit-II

Canonical ensemble, thermodynamic functions for the canonical ensemble, calculation of mean values, energy fluctuation in a gas, grand Canonical ensemble, thermodynamic functions for the grand canonical ensemble, density fluctuations. Partition functions and Properties, partition function for an ideal gas and calculation of thermodynamic quantities.

Unit-III

Gibbs Paradox, validity of classical approximation, determination of translational, rotational and vibrational contributions to the partition function of an ideal diatomic gas, Specific heat of a diatomic gas, ortho and para hydrogen, Landau theory of phase transition, Random walk and Brownian motion, Langevin theory.

Unit-IV

Identical particles and symmetry requirement, difficulties with Maxwell-Boltzmann statistics, quantum distribution functions, Bose-Einstein and Fermi-Dirac statistics, Boson statistics and Planck's formula, Bose Einstein condensation, liquid He^4 as a Boson system, quantization of harmonic oscillator and creation and annihilation of Phonon operators, quantization of Fermion operators

Unit-V

Theory of Metals: Fermi- Dirac distribution function, density of states, temperature dependence of Fermi energy, specific heat, use of Fermi- Dirac statistics in the calculation of thennal conductivity and electrical conductivity, Widemann -Franz ratio, susceptibility, width of conduction band, Drude theory of light, absorption in metals

Text and Reference books:

1. Fundamentals of Statistical and Thermal Physics by F. Reif (McGraw-Hill Kogakusha), Information Ed., 1985
2. Statistical Physics by Landau and Lifshitz (Butterworth-Heinemann), Oxford, UK, 2005
3. Statistical Physics by K Huang, (John Wiley), 2004
4. Statistical mechanics by R. K. Pathria, (Elsevier), India, 2005

PHY202- Classical Electrodynamics-I

Unit-I

Electrostatics: Electric field, Gauss law, Differential form of Gauss law, curl of electric field, the scalar potential, surface distribution of charges and dipoles and discontinuities in the electric field and potential, Poisson and Laplace equations, Green's Theorem, Uniqueness of the solution with Dirichlet or Neumann Boundary conditions, Formal so1ution of

Electrostatic Boundary value problem with Green's Function, Electrostatic potential energy and energy density, capacitance.

Unit-II

Boundary Value Problems in Electrostatics: Methods of Images, Point charge in the presence of a grounded conducting sphere point charge in the presence of a charge insulated conducting sphere, Point charge near a conducting sphere at fixed potential, conducting sphere in a uniform electric field by method of images

Green function for the sphere, General solution for the potential, Conducting sphere with Hemispheres at different potential, orthogonal functions and expansion**.**

Unit-III

Multipoles, Electrostatics of Macroscopic Media Dielectrics: Multiple expansion, multipole expansion of the energy of a charge distribution in an external field, Elementary treatment of electrostatics with permeable media, Boundary value problems with dielectrics, Molar polarizability, and electric susceptibility, Models for molecular polarizability, Electrostatic energy in dielectric media

Unit-IV

Magnetostatics: Introduction and definition, Biot & Savart’s law, the differential equation of magnetostatics and Ampere's law, Vector potential and Magnetic induction for a circular current loop, Magnetic fields of a localized current distribution, Magnetic moment, Force and torque on and energy of a localized current distribution in an external magnetic induction, Macroscopic equations, Boundary conditions on B and H, Methods of solving Boundary-value problems in magnetostatics, Uniformly magnetized sphere, Magnetized sphere in an external field, Permanent magnets, Magnetic shielding, spherical shell of permeable material in an uniform field

Unit-V

Time varying fields, Maxwell's equations and Conservation Laws: Energy in a magnetic field, Vector and Scalar potentials, Gauge transformations, Lorentz gauge, Coulomb gauge, Green functions for the wave equation, Derivation of the equations of Macroscopic Electromagnetism, Poynting’s theorem and conservations of energy and momentum for a system of charged particles and EM fields, Conservation laws for macroscopic media, Electromagnetic field tensor, Transformation of four potentials and four currents, Tensor description of Maxwell's equation

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.

PHY203- Quantum Mechanics-II

Unit-I

Scattering (non-relativistic): Differential and total scattering cross section, transformation from CM frame to Lab frame, solution of scattering problem by the method of partial wave analysis, expansion of a plane wave into a spherical wave and scattering amplitude, the optical theorem, applications: scattering from a delta potential, square well potential and the hard sphere, scattering of identical particles.

Unit-II

Energy dependence and resonance scattering, Breit-Wigner formula, quasi stationary states, The Lippman-Schwinger equation and the Green's function approach for scattering problem, Born approximation and its validity for scattering problem, Coulomb scattering problem under first Born approximation in elastic scattering.

Unit-III

Relativistic Formulation and Dirac Equation: Attempt for relativistic formulation of quantum theory, The Klein-Gordon (KG) equation, Probability density and probability current density, solution of free particle KG equation in momentum representation, interpretation of negative probability density and negative energy solutions, Dirac equation for a free particle, properties of Dirac matrices and algebra of gamma matrices, non-relativistic correspondence of the Pauli equation (inclusive of electromagnetic interaction), Solution of the free particle, Dirac equation, orthogonality and completeness relations for Dirac spinors, interpretation of negative energy solution and hole theory.

Unit-IV

Symmetries of Dirac Equation: Lorentz covariance of Dirac equation, proof of covariance and derivation of Lorentz boost and rotation matrices for Dirac spinors, Projection operators involving four momentum and spin, Parity (P), Charge, Conjugation(C), time reversal (T) and CPT operators for Dirac spinors, Bilinear covariant, and their transformations behaviour under Lorentz transformation, P,C,T and CPT, expectation values of coordinate and velocity, involving only positive energy solutions and the associated problems, inclusion of negative energy solution, Zitterbewegung, Klein paradox.

Unit-V

The Quantum Theory of Radiation: Classical radiation field, transversality condition, Fourier decomposition and radiation oscillators, Quantization of radiation oscillator, creation, annihilation and number operators, photon states, photon as a quantum mechanical excitations of the radiation field, fluctuations and the Uncertainty relation, validity of the classical description, quantization of Dirac field, invariant scattering cross section, S-matrix expansion, Feynman Rules of QED and Feynman diagrams of Compton Scattering, Pair Production Thomson scattering.

Text/Reference books:

1. Quantum Mechanics by L I Schiff (Mcgraw-Hill), III ed., 1968
2. Quantum Mechanics Theory and Applications by A. K. Ghatak and S. Lokanathan (Mcmillan India Limited), Third Edition, 1997,
3. Quantum Mechanics: A modern approach by Ashok Das and A.C. Milissionos (Gordan and Breach Science Publishers),1992.
4. Quantum Mechanics An Introduction by Walter Grenier (Springer),Third ed., 1994.
5. Modern Quantum Mechanics by J.J. Sakurai (Addison-Wesley), 1999.
6. Quantum Physics (atoms, molecules…) R. Eisberg and R. Resnick (J. Wiley),2005.
7. Quantum Field Theory by F. Mandal & G. Shaw (John –Willey),1992.

8. Relativistics Quantum Mechanics -Bjorken &Drell (Mc Graw hill)
9. Quantum mechanics-Thankpapn V.K.(Wiley Eastern ltd. New Delhi)
10. Elements of Advance Quantum Theory- J.M. Ziman (Cambridge University Press)

PHY204- Elective-I

(a): Energy Studies-I

Unit-I

Introduction to energy resources, Classification of energy sources, Introduction to technology related to harnessing of energy sources (coal, oil, natural gas, geothermal, tidal, nuclear energy, solar, wind, hydropower, biomass), impacts on environment due to conventional and non-conventional sources of energy.

Unit-II

Concepts of Bio-energy: Photosynthesis process, biomass, biofuel, importance, production and applications of bio-fuels. Anaerobic digestion. Themochemical conversion: Liquification, gasification, pyrolysis and combustion.

Unit-III

Fundamentals of Engineering Thermodynamics: Energy, heat and work, mechanical equivalent of heat, first law of thermodynamics, second law of thermodynamics (control mass, control volume systems and steady state steady flow processes).Thermodynamic power cycles, Carnot vapor cycle, Rankine vapor cycle, refinement of Rankine cycle, Otto cycle, Internal Combustion engines-classification, engine parts and functions, Vapor absorption and vapor compression refrigeration cycles.

Unit-IV

Electrical Energy: Electrical loads (resistive, capacitive and inductive), phasor diagrams, single and three phase AC, star and delta connections. Basic principles of Transformers, DC and AC generators, alternators, DC motor, single and three phase motors.

Unit-V

Hydrogen Fuel: Fundamentals and use of hydrogen as a fuel, hydrogen fuel cells, production of hydrogen from hydrocarbons (Steam Methane reforming), use of solar energy to produce hydrogen (active and passive methods), hydrogen separation and purification. Hydrogen transmission in pipelines and storage in pressurized and cryogenic tanks, hydrogen storage in metal hydrides and carbon materials, hydrogen safety.

Text/References Books:

1. Renewable Energy: Power for a sustainable future edited by Godfrey Boyle.
2. Problems and solutions: Energy Studies – W. Shepherd, D. W. Shepherd (Imperial College Press)
3. D. D. Hall & R. P. Grover, Biomass Renewable Energy John Wiley, New York, 1987.
4. Dictionary of Energy – Cleveland and Morris (Elsevier)
5. J. M. Fowler, Energy & Environment, 2nd Edn. McGraw Hill New York, 1984.
6. Energising our future – Rational choices for the 21st Century – John R. Wilson, Griffin Burgh (Wiley).
7. Renewable Energy: M. Kaltschmit, W. Streicher, A. Wiese, Springer 2007.
8. Energy Management Handbook, W.C. Turner, S. Doty, CRC Press, 2006.
9. Hydrogen Production Storage, Ram B. Gupta, CRC Press.
10. Fundamentals of electric circuit: Alexander & Sadiku, Tata McGraw Hill.

11. Thermodynamic: An Engineering Approach: T.A. Cengel & Boles (McGraw Hill).
12. Energy for a sustainable world: Jose Goldenberg, Thomas Johansson, A.K.N.Reddy, Robert Williams (Wiley Eastern).

(b): Plasma Physics-I

Unit-I
Basic properties and occurrence- Definition of plasma, Criteria for plasma behaviour, Plasma oscillation, Quasineutrality and Debye shielding, The plasma parameter, natural occurrence of plasmas, Astrophysical plasmas, Plasma in Magnetosphere and ionosphere.
Unit-II
Plasma production and diagnostics, Thermal ionization, Saha equation, Brief discussion of methods of laboratory, plasma production, Steady state flow discharge, microwave breakdown and induction discharge.
Unit-III
Double Plasma Machine, Elementary ideas about plasma diagnostics, electrostatic and magnetic probes.
Unit-IV
Charged particle motion and drifts, Guiding center motion of a charges particle, Motion in (i) uniform electric and magnetic fields (i) gravitational and magnetic fields, Motion in non-uniform magnetic field (i) grade B perpendicular to B, grad B drift and curvature drift 01) grade B parallel to B and principle of magnetic mirror,
Unit-V
Motion in non-uniform electric field for small larmour radius, Time varying electric field and polarization drift, Time varying magnetic leld adiabatic invariance of magentic moment.

Text/Reference Books:
1. An Introduction to Plasma Physics by F.F. Chen, (Plenum Press),1974.
2. Methods in Non-linear Plasma theory by R.C. Davidson, (Academic Press), 1972.
3. Plasma Physics in Theory and Application by W.B.Kunkel, (McGraw Hill), 1966,
4. Fundamentals of Plasma Physics by J.A. Bitten Court, Third Edition, Springer Publications.
5. Statistical Plasma Physics by S. Ichimaru, Addition Wesley Publishing Co.
6. STIX, T.H., Theory of Plasma Waves, McGraw-Hill, New York (1962).
7. Plasma Physics (Midway Reprint Series) by S K Trehan (Edited), S. Chandrasekhar, Chicago press.

(c): Material Science-I

Unit-I
Need of material science, single crystal, polycrystals, amorphous structure, Introduction to XRD for the determination of crystal structure; Crystal imperfections: point defects, linear defects, surface defects, bulk and volume defects.
Unit-II
Polymers: Introduction, classification, polymer structure, copolymers, tacticity, geometric isomerism, molecular weight, molecular weight distribution, molecular weight averages, polydispersity index; Ceramics: Introduction to ceramic structure and applications of ceramics.

Unit-III

Introduction to Phase diagrams: Phase rule, Unary phase diagram, binary phase diagram (Al_2O_3, PbSn, Ag-Pt), Hume-Routhery rules for solid solutions, the lever rule. The tie line rule, Diffusion: Diffusion mechanism, Fick's law of diffusion, steady state and non-steady state, applications based on Fick's second law, kirendall effect.

Unit-IV

Phase Transformations: Nucleation, homogeneous, heterogeneous growth, Transformation kinetics, Time-temperature-transformation (TTT) curves, applications of nucleations & growth, glass transition.

Unit-V

Mechanical behavior: Elastic, anelastic, viscoelastic behavior of materials, modulus as a parameter in design, Plastic deformation, plastic deformation by slip, shear strength, motion of dislocation: effect of stress, temperature, grain size, solute atoms, precipitate particles, multiplication of dislocations, basic concepts of creep and fracture.

Text/Reference Books:

1. W. Jr. Callister, Material science and Engineering: An Introduction." John Willey and sons, 2007.
2. M. F. Ashby and D.R. H. Jones, "Engineering materials1 and 2", BH publication, 2002.

PHY211- Physics Laboratory-II

1. To determine the Rydberg's constant with the help of Spectrometer.
2. To study the variation of refractive index of the material of the prism with wavelength and to verify Cauchy's dispersion formula.
3. To verify Hartmann's Formula using constant deviation spectrograph.
4. To determine wavelength of Monochromatic light using Fabry-Perot interferometer.
5. To verify Fresnel's law of reflection and refraction from a plane refracting surface.
6. Determine the dielectric constant of turpentine oil with the help of Leacher wire system.
7. To study the torque speed characteristics and determine the transfer function of a D.C. motor.
8. To study the V-I characteristic of solar cell and to calculate the fill factor of the solar cell.
9. To determination the absorption coefficient of a liquid or solution (water, $KMnO_4$) with the help of a photo voltaic cell.
10. To study the functional groups & structure of the material using FTIR.
11. To determine the optical band gap of a given materials either in bulk or in film form by UV- VIS.
12. Synthesis and characterization of various nanoparticles.
13. To study the dielectric constant of different materials.
14. Study the dia, para and ferro magnetism in an inhomogeneous magnetic field.
15. Study of solar flat plate collector.
16. Study of solar / electrical hot water system. To study the Electro-Optic effect and AC modulation.
17. To study of thermal expansion of quartz crystal using Newton's Ring method.
18. To study the Acoustic-Optic effect.
19. To study the Brewster angle and refractive index of a given materials.
20. To determine the attenuation and bending losses of an optical fiber.