UNIVERSITY OF KOTA

SCHEME OF EXAMINATION

AND

COURSES OF STUDY

Department of Pure & Applied Physics
Faculty of Science

M.Sc. (Physics-Energy)

First Semester Examination, December 2016
Second Semester Examination, 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	Advanced Electronics	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	Atomic & Molecular Physics	3 Hrs	4	--	4	30	70	100	12	28
	2.5	PHY211	Physics Laboratory-II	6 Hrs	--	16	8	--	100	100	--	50
					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. Asses.
II Year III Semester	3.1	PHY301	Nuclear Physics – I	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	Solid State Physics-I	3 Hrs	4	--	4	30	70	100	12	28
	3.4	PHY305	Energy-I	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	Nuclear Physics-II	3 Hrs	4	--	4	30	70	100	12	28
	4.2	PHY402	Solid state Physics-II	3 Hrs	4	--	4	30	70	100	12	28
	4.3	PHY403	Lasers Physics	3 Hrs	4	--	4	30	70	100	12	28
	4.5	PHY405	Energy-II	3 Hrs	4	--	4	30	70	100	12	28
	4.6	PHY411	Physics Laboratory-IV	6 Hrs	--	16	8	--	100	100	--	50
Total					**16**	**16**	**24**	**120**	**380**	**500**	**--**	

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-55%; Other state-60%; SC/STOBC/SOBC-Minimum Pass Marks. 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 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: M.Sc. (Physics-Energy)	**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
2.	Viva-voce	25
3.	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, 5th 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- Advanced Electronics

Unit-I

Intrinsic and Extrinsic Semiconductors, mobility and conductivity, Direct and Indirect semiconductors, diffusion, the continuity equation, four probe method of resistivity measurement, homo- and hetero-junction, junction breakdown, types of diodes, load line concept, Biasing of BJT, Junction field effect transistor (FET) and MOSFET.

Unit-II

Opto-electronic devices: Solar cells, photo-detectors, Surface Emitter LEDs, Edge Emitter LEDs, Semiconductor LASER, Heterostructure LASERs, Operational amplifiers and their applications like adder, subtractor, comparators and waveform generator, A/D and D/A converters.

Unit-III

Digital Electronics: The transistor as a switch, circuit realization of OR,AND,NOT, NOR and NAND gates, Exclusive OR gate, Boolean algebra - Demorgan's theorems Adder, Subtractor, Comparator, Decoder / Demultiplexer Data selector/ multiplexer –Encoder

Unit-IV

Sequential Logic: Flip -Flops: one-bit memory, The RS Flipflop, JK Flip- Flop, JK master slave Flip -Flops, T Flip -Flop, D Flip- Flop.

Unit-V

Shift resisters - synchronous and asynchronous counters- cascade counters, Binary counter, Decade counter, Basic concepts about fabrication and characteristics of integrated circuits

Text/Reference Books:

1. Integrated Electronics by J. Millaman and C. Halkias, (McGraw Hill, New York), 1972
2. Electronic Devices and circuits by Malvino
3. Solid State Electronic Devices and Integrated Circuits by Ben. G. Sterectman, (Prentice Hall Inc.), 1995.
4. Physics of Semiconductors Devices by S.M. Sze (John Wiley & Sons), 1999.
5. Digital Principles and Applications by C. P. Malvino and D. P. Leach, Mc-Graw Hill, 1985.
6. Digital logic and computer design by M. M. Mano, Tata Mc-Graw Hill.
7. Digital Integrated Circuits by Taub and Shilling, Tata Mc-Graw Hill
8. Digital Fundamentals by Floyd, Mc-Graw Hill.

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:
   (a) the excitations of normal modes and frequency splitting measurements using coupled oscillator.
   (b) the frequency of energy transfer as a function of coupling strength using coupled oscillator.
4. 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 cutoff frequency.
5. Study of Double stage R.C. Coupled amplifier for: (i). Frequency response (ii) the amplitude characteristics.
6. To study the waveform characteristics of multivibrators (Astable, Mono-stable and Bi-stable) and determine its frequency by varying R.
7. To study a various types of Oscillators (like Hartley etc.).
8. To study frequency response of Low pass filter, Band pass filter, High pass filter and Band elimination.
9. Study of clipping and clamping circuit.
10. Study of operational amplifier circuits.
11. Study of Lissajous figure using C. R. O.
12. Verify the various theorems of Boolean algebra.
13. Verify the D'morgans theorem.
14. Implement the Boolean expression and verify the truth table.
15. Study the various combinational circuits-Half Adder, Half subtractor, Full Adder, Full subtractor, Parity Generator, Parity Checker.
16. Study the advanced combination circuits-Multiplexer, Demultiplexer, Encoder, Decoder.
17. Study the various code converters & verify the truth table-Binary to BCD converter, Binary to Gray codes and Binary to EX-3.

18. Study the weighted code converter.
19. Study the flip flops and verify the truth table-R-S,D,J-K, T and Master slave.
20. Study the various registers using flip-flop-Serial in Serial out, Serial in Parallel out, Parallel in Parallel out, Parallel in Serial out
21. Study the various synchronous counters using flip-flop-Binary up, Binary down, Mod-10
22. Study the various asynchronous counters using flip flop- Binary up, Binary down.
23. Study the special counters-Ring counter and Twisted ring counter (Johnson counter).
24. To study the A/D & D/A converters also calculate resolution & error percentage in observation.
25. To study the behavior of V I characteristics of UJT.
26. To study the output and transfer characteristics of a FET.
27. To measure the input and output characteristics of BJT.
28. To draw the V-I characteristics of a DIAC.
29. To draw the V-I characteristics of a TRIAC.
30. To draw the V-I characteristics of a SCR.
31. To draw the V-I characteristics of an Optocoupler.
32. To study and plot the characteristics of Photo-Diode.

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- Atomic & Molecular Physics

Unit-I

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

Unit-II

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

Unit-III

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

Unit-IV

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

Unit-V

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

Text/Reference books:

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

PHY211- Physics Laboratory-II

1. To study the hyperfine structure of spectral lines and Zeeman effect by C.D.S.
2. To study the absorption spectrum of Iodine vapour.
3. To determine the Rydberg's constant with the help of Spectrometer.
4. To study the variation of refractive index of the material of the prism with wavelength and to verify Cauchy's dispersion formula.
5. To determine the wavelength of Sodium light by Michleson Interferometer.
6. To determine the difference between two lines of Sodium light by Michleson Interferometer.
7. To determine the refractive index of glass by Michleson Interferometer.
8. To verify Hartmann's Formula using constat deviation spectrograph.
9. To determine wavelength of Monochromatic light using Fabry-Perot interferometer.
10 To determine g-factor by ESR setup.
11 To study Frank Hertz experiment i.e. variation of accelerating voltage with electron beam current.
12 To verify Fresnel's law of reflection and refraction from a plane refracting surface.
13 Determine the dielectric constant of turpentine oil with the help of Leacher wire system.
14 Determination of wavelength of He-Ne Laser light by diffraction grating.
15 Study of diffraction of laser beam by a slit.
16 To study the torque speed characteristics and determine the transfer function of a D.C. motor.
17 To study the V-I characteristic of solar cell and to calculate the fill factor of the solar cell.
18 Study of LC transmission line.
19 To determination the absorption coefficient of a liquid or solution (water, $KMnO_4$) with the help of a photo voltaic cell.