GANDHI INSTITUTE OF TECHNOLOGY AND MANAGEMENT
(GITAM Deemed to be University, Estd. u/s 3 of UGC Act 1956)
VISAKHAPATNAM ∗HYDERABAD ∗BENGALURU
Accredited by NAAC with ‘A+’ Grade

REGULATIONS AND SYLLABUS

Master of Science
in
Physics

(w.e.f 2017-18 admitted batch)

Website: www.gitam.edu

M.Sc. Physics Regulations
(W.e.f. 2017-18 Admitted Batch)

1. ADMISSION

1.1 Admission into M.Sc. in Physics program of GITAM Deemed to be University is governed by GITAM Deemed to be University admission regulations.

2. ELIGIBILITY CRITERIA

2.1 A pass in B.Sc. with Physics, Mathematics and any other Subject and with a minimum aggregate of 50% marks in degree or any other equivalent examination approved by GITAM Deemed to be University .

2.2 Admission into M.Sc. Physics will be based on an All India GITAM Science Admission Test (GSAT) conducted by GITAM Deemed to be University and the rule of reservation, wherever applicable.

3. CHOICE BASED CREDIT SYSTEM

Choice Based Credit System (CBCS) is introduced with effect from the admitted Batch of 2015-16 based on UGC guidelines in order to promote:

- Student Centered Learning
- Cafeteria approach
- Inter-disciplinary learning

Learning goals/ objectives and outcomes are specified leading to what a student should be able to do at the end of the program.

4. STRUCTURE OF THE PROGRAM

4.1 The Program Consists of

i) Foundation Courses (compulsory) which give general exposure to a Student in communication and subject related area.

ii) Core Courses (compulsory)

iii) Discipline centric electives which

a) Are supportive to the discipline

b) Give expanded scope of the subject

c) Give inter disciplinary exposure

d) Nurture the student skills

iv) Open electives are of general nature either related or unrelated to the discipline.

v) Practical Proficiency Courses Laboratory and Project work

4.2 Each course is assigned a certain number of credits depending upon the number of contact hours (lectures/tutorials/practical) per week.

4.3 In general, credits are assigned to the courses based on the following contact hours per week per semester.

- One credit for each Lecture / Tutorial hour per week.
- One credit for two hours of Practicals per week.
- Two credits for three (or more) hours of Practicals per week
- Eight credits for project

4.4 The curriculum of the four semesters M.Sc. program is designed to have a total of 87 credits for the award of M.Sc. degree.

5. MEDIUM OF INSTRUCTION

The medium of instruction (including examinations and project reports) shall be English.

6. REGISTRATION

Every student has to register himself/herself for each semester individually at the time specified by the Institute / University.

7. ATTENDANCE REQUIREMENTS

7.1 Student whose attendance is less than 75% in all the courses put together in any semester will not be permitted to attend the end - semester examination and he/she not be allowed to register for subsequent semester of study. He/she has to repeat the semester along with his / her juniors.

7.2 However, the Vice Chancellor on the recommendation of the Principal / Director of the Institute/School may condone the shortage of attendance to the students whose attendance is between 66% and 74% on genuine grounds and on payment of prescribed fee.

8. EVALUATION

8.1 The assessment of the student"s performance in a Theory course shall be based on two components: Continuous Evaluation (40 marks) and Semester-end examination (60 marks).

8.2 A student has to secure an aggregate of 40% in the course in the two components put together to be declared to have passed the course, subject to the condition that the candidate must have secured a minimum of 24 marks (i.e. 40%) in the theory component at the semester-end examination.

8.3 Practical/Viva voce/Seminar etc. course are completely assessed under Continuous Evaluation for a maximum of 100 marks, and a student has to obtain a minimum of 40% to secure Pass Grade. Details of Assessment Procedure are furnished below in Table 2.

Table 2: Assessment Procedure

S. No.	**Component of assessment**	**Marks allotted**	**Type of Assessment**	**Scheme of Examination**
1	Theory	40	Continuous evaluation	(i) Two mid semester examinations shall be conducted for 15 marks each. (ii) 5 marks are allocated for quiz. (iii) 5marks are allocated for assignments.
		60	Semester-end examination	The semester-end examination Shall be for a maximum of 60 marks.
	Total	100		
2	Practicals	40	Continuous evaluation	Forty (40) marks for continuous evaluation is distributed among the components: regularity, preparation for the practical, performance, submission of records and oral presentations in the laboratory. Weightage for each component shall be announced at the beginning of the Semester.
		60	Continuous evaluation	Sixty (60) marks for two tests of 30 marks each (one at the mid-term and the other towards the end of the Semester) conducted by the concerned lab Teacher and another faculty member of the department who is not connected to the lab, as appointed by the HoD.
	Total	100		
3	Project work (IV semester)	200	Project evaluation	(i) 150 marks for evaluation of the project work dissertation submitted by the candidate. (ii) 50 marks are allocated for the project Viva-Voce. (iii) The project work evaluation and the Viva-Voce shall be conducted by one external examiner outside the University and the internal project work supervisor.

9. REAPPEARANCE

9.1 A student who has secured „F‟ grade in a Theory course shall have to reappear at the subsequent semester end examinations held for that course.

9.1.1 A student who has secured „F‟ grade in a Practical course shall have to attend Special Instruction Classes held during summer.

9.1.2 A student who has secured „F" Grade in Project work / Industrial Training etc shall have to improve his/her report and reappear for Viva – voce at the time of Special Examination to be conducted in the summer vacation.

10. SPECIAL EXAMINATION

A student who has completed his/her period of study and still has "F" grade in a maximum of three Theory courses is eligible to appear for Special Examination normally held during summer vacation.

11. BETTERMENT OF GRADES

A student who has secured only a Pass or Second class and desires to improve his/her Class can appear for Betterment Examinations only in Theory courses of any Semester of his/her choice, conducted in Summer Vacation along with the Special Examinations.

Betterment of Grades is permitted „only once" immediately after completion of the program of study.

12. GRADING SYSTEM

12.1 Based on the student performance during a given semester/trimester, a final letter grade will be awarded at the end of the trimester/semester in each course. The letter grades and the corresponding grade points are as given in Table 3.

Table 3: Grades & Grade Points

S. No.	Grade	Grade Points	Absolute Marks
1	O (outstanding)	10	90 and above
2	A+ (Excellent)	9	80 to 89
3	A (Very Good)	8	70 to 79
4	B+ (Good)	7	60 to 69
5	B (Above Average)	6	50 to 59
6	C (Average)	5	45 to 49
7	P (Pass)	4	40 to 44
8	F (Fail)	0	Less than 40
9	Ab. (Absent)	0	-

12.2 A student who earns a minimum of 4 grade points (P grade) in a course is declared to have successfully completed the course, and is deemed to have earned the credits assigned to that course, subject to securing a GPA of 5 for a Pass in the semester/trimester.

13. GRADE POINT AVERAGE

13.1 A Grade Point Average (GPA) for the semester/trimester will be calculated according to the formula:

$$GPA = \frac{\Sigma [C \times G]}{\Sigma C}$$

Where

C = number of credits for the course,

G = grade points obtained by the student in the course.

13.2 To arrive at Cumulative Grade Point Average (CGPA), a similar formula is used considering the student"s performance in all the courses taken, in all the semesters up to the particular point of time.

13.3 CGPA required for classification of class after the successful completion of the program is shown in Table 4.

Table 4: CGPA required for award of Class

Class	CGPA Required
First Class with Distinction	≥ 8.0*
First Class	≥ 6.5
Second Class	≥ 5.5
Pass Class	≥ 5.0

* In addition to the required CGPA of 8.0 or more the student must have necessarily passed all the courses of every semester in first attempt.

14. ELIGIBILITY FOR AWARD OF THE M.Sc. DEGREE

14.1 Duration of the program: A student is ordinarily expected to complete M.Sc. program in four semesters of two years. However a student may complete the program in not more than four years including study period.

14.2 However the above regulation may be relaxed by the Vice Chancellor in individual cases for cogent and sufficient reasons.

14.3 A student shall be eligible for award of the M.Sc Degree if he / she fulfills all the following conditions.

a) Registered and successfully completed all the courses and projects.

b) Successfully acquired the minimum required credits as specified in the curriculum corresponding to the branch of his/her study within the stipulated time.

c) Has no dues to the Institute, hostels, Libraries, NCC / NSS etc, and

d) No disciplinary action is pending against him / her.

14.4 The degree shall be awarded after approval by the Academic Council

15. Discretionary Power

Notwithstanding anything contained in the above sections, the Vice Chancellor may review all exceptional cases, and give his decision, which will be final and binding.

Department of Electronics and Physics
GITAM Institute of Science
GITAM DEEMED TO BE UNIVERSITY
(Estd u/s 3 of UGC Act 1956)

M.Sc. Physics
Scheme of Instruction and Syllabus

FIRST SEMESTER

Course Code	Name of the Course	Category	Credits	L/W	CIA	SEE	Total Marks
SPH 701	Classical Mechanics	PC	4	4	40	60	100
SPH 703	Quantum Mechanics	PC	4	4	40	60	100
SPH 705	Electromagnetic Theory	PC	4	4	40	60	100
SPH 707	Mathematical Methods of Physics	PC	4	4	40	60	100
LABS							
SPH 721	General Physics Lab	PP	2	6	100	-	100
SPH 723	C-Programming Lab	PP	2	6	100	-	100
Total			**20**	**28**	**360**	**240**	**600**

Note: L/W = Lectures per Week.

SECOND SEMESTER

Course Code	Name of the Course	Category	Credits	L/W	CIA	SEE	Total Marks
SPH 702	Statistical Mechanics	PC	4	4	40	60	100
SPH 704	Contemporary and Low Dimensional Physics	PC	4	4	40	60	100
SPH 706	Advanced Quantum Mechanics	PC	4	4	40	60	100
Programme Elective – 1 (ONE TO BE CHOSEN)							
SPH 742	Advanced Electromagnetic Theory	PE	4	4	40	60	100
SPH 744	Electronic Measurements and Instrumentation(Common with M.Sc Electronic Science)	PE	4	4	40	60	100
SPH 746	Linear and Digital Circuits	PE	4	4	40	60	100
SPH 748	Physics of Semiconductor devices	PE	4	4	40	60	100
***Open Elective**		OE	3	3	40	60	100
LABS							
SPH 722	Solid State Physics Lab	PP	2	6	100	-	100
SPH 724	Analog and Digital Electronics Lab	PP	2	6	100	-	100
Total			**23**	**31**	**400**	**300**	**700**

Note: L/W = Lectures per Week.

* **Open Elective -** Student can choose one open elective from the list of open electives offered by GITAM DEEMED TO BE UNIVERSITY

THIRD SEMESTER

Course Code	Name of the Course	Category	Credits	L/W	Continuous Evaluation	Semester End Examination	Total Marks
SPH 801	Solid State Physics	PC	4	4	40	60	100
SPH 803	Nuclear Physics	PC	4	4	40	60	100
SPH 805	Nano-Science and Technology	PC	4	4	40	60	100
Programme Elective- 2 (ONE TO BE CHOSEN**)**							
SPH 841	Analog and Digital Communication	PE	4	4	40	60	100
SPH 843	Introduction to Photonics	PE					
SPH 845	Radiation Physics	PE					
SPH 847	Dynamical Systems	PE					
	***Open Elective**	OE	3	3	40	60	100
LABS							
SPH 821	Analog and Digital Communication Lab	PP	2	6	100	--	100
SPH 823	Nuclear Physics Lab	PP	2	6	100	---	100
SPH 891	Comprehensive viva	PP	2	-	---	50	50
	Total		**25**	**31**	**400**	**350**	**750**

Note: L/W = Lectures per Week.

* **Open Elective** - Student can choose one open elective from the list of open electives offered by GITAM DEEMED TO BE UNIVERSITY

FOURTH SEMESTER

Course Code	Name of the Course	Category	Credits	L/W	Continuous Evaluation	Semester End Examination	Total Marks
SPH 802	Material Characterization Techniques	PC	4	4	40	60	100
Programme Elective (ONE TO BE CHOSEN)							
SPH 850	Nuclear Analytical Techniques	PE	4	4	40	60	100
SPH 852	Materials Science						
SPH 854	Condensed Matter Physics						
SPH 856	Non-linear Optics						
LABS							
SPH 890	Material Science Lab	PP	2	6	100	--	100
SPH 892	Project work	PP	8	12		200	200
Total			**18**	**28**	**180**	**320**	**500**

Note: L/W = Lectures per Week.

Open Electives offered by the Department

(Eligible to all programs other than Electronics and Physics)

Course Code	Name of the Course	Category	Credits	L/W	Continuous Evaluation	Semester End Examination	Total Marks
OPEN ELECTIVE - SECOND SEMESTER							
SOE 754	Environmental Physics	OE	3	3	40	60	100
OPEN ELECTIVE - THIRD SEMESTER							
SOE 763	Biophysics	OE	3	3	40	60	100
SOE 765	Bio Electronics						

M.Sc. PHYSICS I - SEMESTER
SPH 701 CLASSICAL MECHANICS

Hours per week: 4 End Examination: 60 Marks
Credits: 4 Sessionals: 40 Marks

UNIT-I

The Lagrangian Formalism

Constraints, Generalized coordinates, principle of virtual work, D-Alembert's Principle, Lagrangian equation from D-Alembert‟s principle, Lagrange's equation and its applications, Velocity dependant potential in Lagaragian formulation, Lagranges equation in non conservative systems. Generalized potential, Lagranges equation in EM field, Hamiltons principle and Lagranges equation.

UNIT-II

Hamiltonian’s Formalism

Generalized momentum and Cyclic Coordinates, conservation theorems- linear and angular momentum and energy. Hamilton‟s equations, Applications of Hamiltonian dynamics-Harmonic oscillator, particle in central field, Electromagnetic field and compound pendulum. Calculus of variation and Eulers Lagrange‟s equation, Deduction of Hamilton‟s principle from D Alembert‟s principle. Deduction of Lagrange‟s equation from variation principle and principle of least action.

UNIT-III

Rigid body dynamics

Independent coordinates of rigid body, The Euler angles, infinitesimal rotations as vectors, components of angular velocity, angular momentum and inertia tensor, principal moments of inertia, Rotational kinetic energy of rigid body. Euler‟s equation of motion for rigid body, torque free motion of rigid body and force free motion of a symmetrical top.

UNIT-IV

Canonical transformation:

Canonical transformations, Legendre transformation, generating functions, Equations of canonical transformation, conditions and applications of canonical transformations and infinitesimal canonical transformations Poisson brackets Lagrange‟s bracket and relation and invariance of Poisson bracket with canonical transformation and liouvilles theorem.

UNIT-V

Small oscillations

Introduction, potential energy and equilibrium-one dimensional oscillator-stable, unstable and neutral equilibrium. Two coupled oscillators-solution in differential equation, normal coordinates and normal modes. Theory of small oscillations-secular equation and eigen value equation, solution of eigen value equation and small oscillations in normal coordinates**.**

Hamilton-Jacobi theory: (Self Study)

The Hamilton-Jacobi equation for Hamilton‟s principal function, the harmonic oscillator problem, The Hamilton -Jacobi equation for Hamilton‟s characteristic function, Separation of variables in the Hamilton-Jacobi equation, Action-angle variables, Kepler problem in action-angle variables.

Books:

1. Classical Mechanics by H. Goldstein, Narosa Publishing House 2nd Edition 1980
2. Introduction to Classical Mechanics by Takwale Puranik, TMH, 1979
3. Classical Mechanics by J.C.Upadhaya, Himalaya Publisher, 2005

M.Sc. PHYSICS I – SEMESTER
SPH 703 QUANTUM MECHANICS

Hours per week: 4 — End Examination: 60 Marks
Credits: 4 — Sessionals: 40 Marks

UNIT-I

General formalism of wave mechanics

Linear vector space, Postulates of wave mechanics, Operators and their properties, Commutator algebra, Bra-Ket vectors and their properties, Dirac-delta function and Korncker- delta function, Matrix representation, Change of basis, uncertainty relation, momentum representation and equation of motion.

UNIT-II

Schrödinger's wave equation and its applications

Time dependent and time independent Schrödinger‟s wave equation, Admissibility conditions of the wave function, Stationary state solution, continuity equation, Ehrenfest‟s theorem, Particle in a box, step potential, Rectangular potential barrier, Square well potential and harmonic oscillator.

UNIT-III

Angular momentum

Angular momentum operators, Commutation relations, Eigen values and Eigen functions of angular momentum operators, General angular momentum, Spin angular momentum, Pauli‟s spin operators and their properties, Addition of angular momenta: Clebsch- Gordon coefficients and its properties.

UNIT-IV

Approximation methods

Time independent perturbation theory: Non-degenerate and degenerate systems and its applications. Zeeman and Stark effects, Time dependent perturbation theory and its applications, Variation method: ground state and first excited state of the Helium atom.

UNIT-V

Scattering theory

Scattering differential – cross section, the scattering of wave packet, Born approximation and its applications, Partial wave analysis method, Expansion of a plane wave in terms of partial waves, determination of the phase shifts and scattering amplitude, optical theorem and applications.

Books:

1. A text book of Quantum Mechanics by P. Mathews and K.Venkatesan, TMH, 1979
2. Quantum Mechanics by E.Merzbacher, Wiely Publishers, 3rd Edition, 1997
3. Quantum Mechanics by Leonard Schiff TMH 3rd Edition, 1968
4. Modern Quantum Mechanics by J.J.Sakurai, Pearson Edu.,2nd edition, 2010
5. Quantum Mechanics by G. Aruldhas, PHI, 2nd Edition, 2009

M.Sc. PHYSICS I-SEMESTER
SPH 705 ELECTROMAGNETIC THEORY

Hours per week: 4 End Examination: 60 Marks
Credits: 4 Sessionals: 40 Marks

UNIT-I

Electrostatics

Electric field-Introduction, Coulomb‟s law, Electric field, Continuous charge distribution, Divergence and curl of Electrostatic fields, field lines, flux, Gauss law, Divergence of E, Applications of Gauss‟s law, curl of E. Electric Potential-Introduction to potential, Poisson‟s and Laplace equation, Potential of localized charge distribution, Work and Energy in Electrostatics, Work done on moving charge, Energy of point and continuous charge distribution, Conductors: Basic properties, Induced charges, surface charge and force on conductor.

UNIT-II

Magneto statics

Lorentz force law, Magnetic fields, Magnetic forces, currents, Biot -Savarts law-Steady currents, magnetic field of steady current, Divergence and curl of B –Straight line currents, Applications of amperes law, Magnetic vector potential-vector potential

UNIT-III

Electrodynamics

Electromotive force-ohm‟s law, EMF, Motional EMF Electromagnetic induction –Faraday laws, Induced electric field, Inductance, Energy in magnetic fields. Maxwell equations-magnetic charge, Maxwell equations in matter, Charge and Energy equation, Pointing theorem.

UNIT-IV

Electromagnetic waves

Waves in one dimension-wave equation, sinusoidal waves, Boundary conditions polarization Electromagnetic waves in vacuum-wave equation for E and B, Monochromatic plane waves, energy and momentum in EM waves. The Potential formulation-scalar and vector potential, guage transformations, coulomb and Lorentz gauge transformations

UNIT-V

Dielectrics

Electric and Magnetic field in matter, Polarization- Dielectrics, Induced dipoles, alignment of polar molecules, polarization Electric Displacement-Gauss law in dielectrics, Magnetization-Diamagnets, para, ferromagnets, torques and forces in magnetic dipoles Field of magnetized object-bound currents and physical interpretation, Auxiliary field H-Amperes law in magnetized materials.

Books:

1. Introduction to Electrodynamics by Griffiths, PHI, 3rd Edition , 1999
2. Classical Electrodynamics by J.D. Jackson, John Wiely, 3rd Edition, 1998
3. Foundations of Electromagnetic Theory by John R. Reitz, Frederick J. Milford, Robert W. Christy, Wiely, 4th Edition 2008

M.Sc. PHYSICS I - SEMESTER
SPH 707 MATHEMATICAL METHODS OF PHYSICS

Hours per week: 4 End Examination: 60 Marks
Credits: 4 Sessionals: 40 Marks

UNIT-I

Complex analysis

Analytic function, CR equations, Elementary functions of complex variable, Harmonic functions ,Cauchy Integral theorem, Evaluation of integrals. Cauchy‟s residue theorem and Evaluation of residues and evaluation of Contour integration

UNIT-II

Special functions

Legendre, Hermite, Lagaurre and Bessel differential equations and solution, Recursion formula, Generating function, Recurrence relations and orthogonal properties

Unit III

Fourier series

Determination of Fourier coefficients- Fourier series even and odd functions, Fourier series in arbitrary interval, half range Fourier sine and cosine expansions

Unit-IV

Laplace Transforms

Introduction, Laplace transform, Laplace transform of some standard functions, properties of laplace transform, Evaluation of integral using Laplace transform, Laplace transform of periodic functions, Inverse Laplace transforms, application of Laplace transform to differential equations with constant coefficients and applications to simultaneous differential equations.

Unit-V

Matrices

Introduction, Matrix, Definitions associated with matrices, ad joint of square matrix, reciprocal of matrix, Elementary transformations, rank of matrix, Non homogenous and homogenous linear equations, Linear dependence and independence of vectors, Eigen values and Eigen vectors, Caley-Hamilton theorem, minimal polynomial and equation of matrix, Function of square matrix and similarity of matrices.

Books:

1. Mathematical Physics by B.D.Gupta, Vikas publishing House, 3rd Edition 2004
2. Mathematical Physics by R.V. Church Hill
3. Engineering Mathematics by E.Kreyszig, Wiely Publishers
4. Engineering Mathematics by Ravish R Singh, Mukul Bhatt, TMH

M.Sc. PHYSICS I - SEMESTER
SPH 721 GENERAL PHYSICS LAB

Hours per week: 6 Continuous Evaluation: 100 Marks
Credits: 2

1. Determination of Specific Charge of Electron
2. Determination of Rydberg constant
3. Determination of wavelength of He-Ne Laser by Grating
4. Optical Fibre -Characteristics
5. Franck Hertz Experiment- Existence of discrete states of atom
6. Calibration of Electromagnet
7. Determination of Planck‟s constant
8. Laws of photo electric effect
9. Hall Effect
10. Optical Fibre –Numerical Aperture and Bending Losses

M.Sc. PHYSICS I - SEMESTER
SPH 723 C-PROGRAMMING LAB

Hours per week: 6 Continuous Evaluation: 100 Marks
Credits: 2

1. Arranging words in alphabetical order
2. Finding of largest and smallest from a set of numbers
3. Multiplication of two square matrices
4. Write functions for (i) reverse the string (ii) converting integer into string
5. Write functions for (i) string copy (ii) string compare (iii) Replace a sub-string with another string
6. Program to sort a series of elements.
7. Program to exchange elements of two arrays using pointers.
8. Write a C program to find the number of and sum of all integers greater than 100 and less than 200 that are divisible by a given integer *x*.
9. Given a number, write a C program using *while* loop to reverse the digits of the number. For e.g. the number 12345 should be printed as 54321.
10. Write a C program to read *n* numbers into an array, and compute the mean, variance and standard deviation of these numbers.
11. Write a C program using recursive calls to evaluate f(x) = x – x3/3! + x5/5! - x7/7! + …
12. Write a C program to read in an array of names and to sort them in alphabetical order.
13. Write a C program to sort a sequence of *n* integers using Quick sort technique and then search for a key in the sorted array using Binary search technique.
14. Write an interactive C program to create a linear linked list of customer names and their telephone numbers. The program should be menu-driven and include features for adding a new customer, deleting an existing customer and for displaying the list of all customers.
15. Write a C program to implement a queue in which insertions, deletions and display can be performed.

M.Sc. PHYSICS II - SEMESTER
SPH 702 STATISTICAL MECHANICS

Hours per week: 4 End Examination: 60 Marks
Credits: 4 Sessionals: 40 Marks

UNIT- I

Statistical Description of Systems of Particles and their Thermodynamics

Specification of the state of a system, Statistical ensemble, Phase space Basic postulates, Probability calculations, Behavior of the density of states, Thermal interaction, Mechanical interaction and General interaction. Dependence of the density of states on the external parameters, Statistical calculation of thermodynamic quantities

Unit- II

Interpretation of Ensembles

Isolated system, System in contact with a heat reservoir, simple application of the Canonical distribution and Grand canonical ensemble, Probability distribution functions, mean energies, Fluctuations in energy and density in a canonical ensemble and Grand Canonical ensemble, Connection with thermodynamics.

UNIT- III

Applications of Statistical mechanics

Partition functions and their properties, calculation of thermodynamic quantities, Gibbs paradox, Validity of the classical approximation, specific heats of solids-Dulong and Petits law, Einstein specific heat theory, Debye specific heat theory, Equipartition theorem, Applications as- harmonic oscillator.

Unit- IV

Quantum Statistics of ideal gases

Identical particles and symmetry requirements, Formulation of the statistical problems, The quantum distribution functions, Maxwell-Boltzman statistics, Photon statistics, Bose- Einstein statistics, Fermi Dirac statistics- Calculation of dispersions, Equation of state for Ideal Bose and fermi gas, Bose- Einstien condensation, Theory of white dwarf stars, Quantum statistics in the classical limit.

Unit- V

System of Interacting particles

Lattice vibrations and Normal modes, Non-ideal classical gas, Calculation of partition function-low densities, Equation of state, viral coefficients and its evaluation with integrals, Ferromagnetism-interaction between spins, Weiss molecular field approximation, high and low temperatures. Phase Transitions- Phase diagram, Thermodynamic description, 1st and 2nd order phase transitions, Clausius Clapeyron equation and Landau theory of phase transitions.

Books:

1. Fundamental Statistical and Thermal physics by F.Reif ,Waveland Pr Inc, 4th Edition, 2008
2. Statistical Mechanics by K. Huang Wiely, 2nd Edition,1987

M.Sc. PHYSICS II - SEMESTER
SPH 704: CONTEMPORARY AND LOW DIMENSIONAL PHYSICS

Hours per week: 4 | End Examination: 60 Marks

Credits: 4 | Sessionals: 40 Marks

UNIT – I
Atomic Physics

Hydrogen atom-spectrum, Orbital angular momentum, Larmor precession, Stern and Gerlach experiment, Electron spin, Vector atom model, Spin - orbit interaction and fine structure, Pauli‟s exclusion principle and electronic configuration, Total angular momentum in many electron atoms, Energy levels and transitions in Helium atom, Normal and anomalous Zeeman effect

UNIT - II
Molecular Physics

Electromagnetic Spectrum, Molecular energies, Classification of molecules, Rotational, vibrational and vibrational-rotational spectra of diatomic molecules, Characteristic group absorptions, IR spectrometer, Electronic Spectra, Frank Condon principle, Raman scattering-classical and quantum theories, vibrational and rotational Raman spectra. NMR spectra-principle, spectrometer, chemical shifts and applications. ESR spectra- principle, spectrometer, hyperfine interaction and applications.

.Unit - III
Fiber Optics and Holography

Basic Characteristics of optical fiber, Ray and modal analysis of single and multimode fibers (Step index and graded index), Graded Index fiber, Single and Multimode fibers, material dispersion , Fiber losses. Coupling polarization and Optical communication, Fiber optics sensors and application Holography- Description, types and applications.

Unit - IV
Lasers Physics

Absorption and Emission, Einstein coefficients, Population inversion, Laser system, Pumping methods, Laser cavity configurations, Mode structure, Types of lasers-Ruby,

Nd-Yag, He- Ne, CO_2 laser, Dye laser and semiconductor lasers. Characteristics of Laser radiation. Rate equations: Three – Level System and Four level System

Unit - V
Laser Spectroscopy

Basic Principles Comparison between Conventional Light Sources and Lasers, saturation Excitation Methods, Detection Methods and Laser Wavelength Setting.

Doppler-Limited Techniques- Absorption Measurements, Two-Photon Absorption Measurements and Opto-Acoustic Spectroscopy

Books:

1. Principles of Modern Physics by A.K.Saxena, 2nd Edition, Narosa Publishing, 2010
2. Fundamentals of Molecular Spectroscopy by C.N.Banwell and E.M Cash, TMH 4th Edition, 1994
3. LASERS: Theory and Applications by K.Thyagarajan and A.K.Ghatak, Springer 1st Edition 1981
4. Optical Fibre Communications by G.E.Kieser Mc.Graw Hill, 2010.

.

M.Sc. PHYSICS II - SEMESTER
SPH 706: ADVANCED QUANTUM MECHANICS

Hours per week: 4
Credits: 4

End Examination: 60 Marks
Sessionals: 40 Marks

Unit I

Spherically symmetric Potentials

Particle moving in spherically symmetric potential, system of two interacting particles, rigid rotator, hydrogen atom, hydrogen orbital's, free particle ,three dimensional square well potential and deuteron. Abstract operator method-Ladder operators,eigen value spectrum ,eigen functions and coherent states.

Unit II

Approximate methods

WKB Approximation, its validity, Barrier penetration, Alpha emission and bound states in Potential well and Bohr –sommerfeld quantum condition Perturbation theory for time evolution problems- Scattering of particle by potential ,inelastic scattering-exchange effects, harmonic perturbation, Interaction of atom in electromagnetic field, Absorption and emission of radiation-electromagnetic field, Hamiltonian operator and electric dipole approximation.

Unit III

Identical particles and Many Electron Atoms

Indistinguishibility and state vector space for identical particles, Creation and annihilation operators and its algebra , its symmetries, Pauli,s exclusion principle, spin of two and three electrons, Helium atom ,ortho and para helium and scattering matrix .Many Electro atoms- Central field approximation, Thomas –Fermi model of atom, Hartee equation and Hartee –Fock Equation.

Unit IV

Relativistic Wave Equations

Introduction-Generalization of Schrödinger equation, Klein –Gordan Equation- its interpretation, Plane wave solutions, Charge and current densities,Interaction with electromagnetic field and Non relativistic limit.

Dirac Equation- Relativistic Hamiltonian, Position probability density, Dirac matrices, Plane wave solutions, Spin of dirac particle, Negative energy states, Magnetic Moment of electron, Spin orbit interaction , Radial equation of electron in Central potential and Hydrogen atom.

Unit V

Quantisation of fields

Introduction, Classical approach to field theory,Relativistic Lagrangian and Hamiltonian of charged particle in electromagnetic field .Lagrangian and Hamiltonian formulations Quantum equation ,second quantization,Quantisation of non relativistic schrodinger equation, Klein – Gordan equation and Dirac field.

Books:

1. A text book of Quantum Mechanics- P.Mathews and K.Venkatesan
2. Quantum Mechanics G.Aruldas
3. Quantum Mechanics- V.K.Thankappan
4. Fundamentals of Quantum Mechanics R.D.Ratna Raju

M.Sc. PHYSICS II – SEMESTER
SPH 742 ADVANCED ELECTROMAGNETIC THEORY

Hours per week: 4 End Examination: 60 Marks
Credits: 4 Sessionals: 40 Marks

UNIT- I

Electromagnetic Fields and Waves

Axiomatic classical electrodynamics, Complex notation and physical observables. Physical observables and averages Maxwell equations in Majorana representation, wave equations for E and B The time-independent wave equations for E and B, Electromagnetic Potentials and Gauges- scalar potential, vector potential, electrodynamics potentials, Gauge conditions- Lorenz-Lorentz gauge Coulomb gauge, velocity gauge and Gauge transformations

UNIT –II

Fundamental Properties of the Electromagnetic Field

Discrete symmetries, Charge conjugation, spatial inversion and time reversal, C symmetry P symmetry, T symmetry, Continuous symmetries, General conservation laws- Conservation of electric charge, Conservation of energy. Conservation of linear (translational) momentum-Gauge-invariant operator formalism, Conservation of angular (rotational) momentum- Gauge-invariant operator formalism Electromagnetic duality and Electromagnetic virial theorem.

UNIT- III

Radiation and Radiating Systems

Radiation of linear momentum and energy, Monochromatic signals Finite bandwidth signals and radiation of angular momentum. Radiation from a agnetizi source at rest– electric multipole moments, Hertz potential, Electric dipole radiation, Magnetic dipole radiation. Radiation from an extended source volume at rest- Radiation from a one-dimensional current distribution.

UNIT- IV

Accelerated Radiating Systems

Radiation from a localized charge in arbitrary motion –The Liénard-Wiechert potentials, Radiation from an accelerated point charge –The differential operator method, The direct method,Small velocities, Bremsstrahlung, Cyclotron and synchrotron radiation radiation in general case and virtual photons.

UNIT- V

Electromagnetic Fields and Matter

Maxwell"s macroscopic theory- Polarisation and electric displacement, Magnetisation and the magnetizing field, Macroscopic Maxwell equations. Phase velocity, group velocity and dispersions. Radiation from charges in a material medium –Vavilov-Cerenkov radiation Electromagnetic wave in conductive media, wave equations for E and B and plane waves.

Book:

1. Classical Electrodynamics by J.D Jackson, 3rd Edition, Wiely, 1998.
2. Introduction to Electrodynamics by D.Grifiths, PHI, 3rd Edition, 1999
3. Electromagnetic waves and Radiating systems by K.Jordan and E Balmen Wiely, 2nd Edition.

M.Sc. PHYSICS II - SEMESTER

SPH 744 ELECTRONIC MEASUREMENTS AND INSTRUMENTATION

(Common with M.Sc. Electronic Science)

Hours per week: 4 | End Examination: 60 Marks
Credits: 4 | Sessionals: 40 Marks

UNIT-I

Fundamental Measurements

Accuracy, Precision, Types of errors, Standards of measurements, ***Electronic Instruments:*** RMS, BJT and FET voltmeters, Electronic multimeter, Q meter, LCR meter, vector impedance meter, Power meter, Measurement of Inductance, Capacitance and Effective resistance at high frequency, ***CRO-*** study of various stages in brief, measurement of voltage, current, phase and frequency, Digital and storage oscilloscopes.

UNIT-II

Instruments for Generation and Analysis of waveforms

Signal generators, function generator, wave analyzers- Harmonic distortion analyzer, spectrum analyzer and spectrum analysis. ***Recording Instruments:*** X-Y, Strip chart, Magnetic tape and Digital type recorders, ***Transducers:*** Classification of transducers, Strain gauze, LVDT Thermocouple, Piezo-electric and photoelectric transducers, Flow measurement transducer.

UNIT-III

Data Acquisition Systems

D/A conversion- Linear weighted and ladder type. A/D conversion- Digital ramp ADC, Successive approximation method, Data loggers, Signal Conditioning of the inputs, Computer based data systems, ***Electronic Indicating instruments***: Seven Segment Display, Fourteen Segment Display, Nixie tube, LED and LCD display devices.

UNIT-IV

Bio-Medical Instrumentation

Sources of Biomedical Signals, Basic Medical Instrumentation System, Origin of Bioelectric signals, Recording Electrodes- Elecrode-tissue interface, Skin contact impedance, Biosensors, Measurement of Heart rate, Blood pressure measurement, blood flow meters. ***Bio-Medical Instruments:*** ECG, EEG, EMG, Electronic Pace maker.

UNIT-V

Medical Imaging Systems

Radiography, X-Ray machine, CT scanner, **Nuclear Medical Imaging systems**: Physics of Radio Activity, Radiation Detectors, Gamma Camera, NMR imaging. Ultrasonic Imaging Systems, Ultrasonic Therapy Unit, Angiography and Flour scopy

Books

1. Electrical and Electronic Measurements and Instrumentation by Sawhney, Dhanpat Rai Publications, 3rd Edition , 2005
2. Hand Book of Biomedical Instrumentation- Khandpur by Tata Mcgraw Hill- 2nd Edition
3. Medical Instrumentation by Application & Design - John G. Webster, Houghton Miffin & Co., Boston
4. Biomedical Instrumentation by Marvin D. Wirs, Chilton Book Co., London

M.Sc. PHYSICS II – SEMESTER
SPH 746 LINEAR AND DIGITAL CIRCUITS

Hours per week: 4 End Examination: 60 Marks
Credits: 4 Sessionals: 40 Marks

UNIT-I

BJT and FET amplifiers

Bipolar Junction Transistor**:** configurations, Biasing, BJT as an amplifier, BJT characteristics, Frequency response of BJT, Applications of Transistor. ***Field Effect Transistor*****:** Construction and characteristics, Biasing, FET as an amplifier, Applications of FET. ***MOSFET:*** Introduction, Depletion and Enhancement type MOSFETs. ***Feedback concepts:*** Practical feedback circuits, Feedback amplifiers, Oscillator operation, types of oscillators

UNIT-II

Operational amplifiers

Op-amp basics, parameters, Differential and common mode operation, virtual ground, practical op-amp circuits – Integrator, Differentiator and Summing amplifier. ***Op-amp Applications***-Constant gain multiplier, Voltage to Current Converter, Current to Voltage Converter, Instrumentation Amplifier, Active filters, Oscillators, Logarithmic and Anti Logarithmic Amplifiers, Schmitt trigger, Compactors.

UNIT-III

Power Supplies

Rectifiers- Half wave, Full wave and Bridge rectifiers, Filter considerations, Zener diode voltage regulator, discrete transistor voltage regulation (series and shunt), IC voltage regulators-78XX and 79XX, Variable Power supply Design. ***Linear Ics:*** About IC 555 (Timer) and its applications: Astable, Monostable and Bistable multivibrators. VCO (IC 566), PLL (IC 565).

UNIT-IV

Combinatorial logic circuits

Simplification of Boolean expressions**:** Algebraic method, Karnaugh map method, EX-OR, EX-NOR gates, Encoders and Decoders, Multiplexers and Demultiplexers. ***Digital arithmetic operations and circuits:*** Binary addition, subtraction, multiplication and division. Design of adders, subtractors and Parallel binary adder. ***Applications of Boolean Algebra:*** Magnitude comparator, Parity generator and checker, Code converters, Seven segment decoder /Driver display, ALU design.

UNIT-V

Sequential Logic Circuits

Flip-Flops: NAND latch, NOR latch, R-S, J-K, T-flip-flops, D-Latch ***Counters:*** Asynchronous (ripple) counters, Counters with MOD number $<2^n$, Down counter, Synchronous counters, Up-down counter, Ring counter, Johnson counter. Applications of counters ***Registers:*** Shift registers, PIPO, SISO, SIPO, PISO, State diagrams.

Books:

1. Electronic Devices and Circuit Theory by R. Boylestad and L. Nashelsky- 10th Edition – Pearson
2. Digital Systems principals and applications by Ronald J Tocci- 10th Edition –Pearson
3. Digital Design by Morris Mano- 4th Edition Pearson
4. Op-Amp Applications by Ramakanth Gaykward – 4th Edition- PHI
5. Linear IC Applications by D. Roy Chowdhary – New Age International- 4th Edition

M.Sc. PHYSICS II – SEMESTER
SPH 748 PHYSICS OF SEMICONDUCTOR DEVICES

Hours per week: 4 | End Examination: 60 Marks
Credits: 4 | Sessionals: 40 Marks

UNIT- I
Transport phenomena in solids

Energy bands: insulator, metal semiconductor, intrinsic and extrinsic semiconductor, direct and indirect semiconductor, Fermi level variation in semiconductor, temperature dependence of carrier concentration, carrier dynamics in semiconductors, carrier transport by drift and diffusion scattering low field response, high field transport, impact ionization, band to band tunneling charge injection and quasi Fermi levels.

UNIT- II
Bipolar Transistors

BJT static performance parameters: Emitter injection efficiency, base transport factor, collector efficiency and current gain, Transient response: Cutoff saturation, the switching cycle, frequency limitations of transistors, secondary effects in real devices: Early effect and punch through thermal effects, current crowding effect, high injection and Krik effect.

UNIT- III
Field effect transistors

MOS device: MOS as capacitor, V-I characteristics, Depletion and Enhancement MOSFET, Complementary MOSFET, important issues in real devices: short channel effects, substrate bias, effects, latch-up, sub-threshold characteristics, leakage currents, charge transfer device, basic principle applications.

Unit- IV
Microwave and Photonic devices

Tunnel diode, IMPATT and Gunn diode, varactor diode, characteristics of microwave transistor, tunnel transistor, LED, photo detectors, solar cells, semiconductor lasers

UNIT -V
Integrated circuits

Evolution of ICs: Small Scale Integration, Meduim Scale Integration, Low Scale Integration, Very Large Scale Integration, Monolithic and Hybrid circuits, Monolithic IC process: Crystal growth, Wafer preparation, Metallization, Testing, Bonding and Packaging.

Books:

1. Solid state electronic devices by Ben. G. Streetman and S. Banerjee, PHI, 6th Edition, 2005
2. Semiconductor devices - Basic principles by Jasprit Singh (John Wiely), 1st Edition, 2000

M.Sc. PHYSICS II - SEMESTER
SPH 722: SOLID STATE PHYSICS LAB

Hours per week: 6 Continuous Evaluation: 100 Marks
Credits: 2

1. Determination of Boltzmann constant
2. Study of Atomic spectrum of Sodium
3. Forbidden energy Gap of LED/ Ge/ Si.
4. Electron Spin Resonance
5. Study of depletion capacitance
6. Forbidden energy Gap of semiconductor
7. Study of band gap and potential of P-N Junction
8. Lattice dynamics- I Dispersive relations of mono atomic lattice
9. Lattice dynamics –II Dispersive relations of Di atomic lattice
10. Resistivity of semiconductor- Four Probe method

M.Sc. PHYSICS II - SEMESTER
SPH 724 ANALOG AND DIGITAL ELECTRONICS LAB

Hours per week: 6 Continuous Evaluation: 100 Marks
Credits: 2

Analog Experiments

Any 6 from the Following List

1. Active Band pass filter (IC 741)
2. Monostable multi vibrator (IC 555)
3. Astable multivibrator (IC 555)
4. Voltage controlled oscillator (IC 555)
5. Wein bridge oscillator (IC 741)
6. Voltage regulator (IC 723)
7. Op-amp characteristics (IC 741)
8. Op-amp as Differentiator (IC 741)
9. Op-amp as Integrator (IC 741)
10. Saw tooth wave generator (IC 555)
11. Colpitt"s oscillator (BF 194/ IC 741)
12. Twin T filter (IC 741)
13. Phase shift oscillator (IC 741)
14. Logarithmic amplifier (IC 741)
15. Triangular wave generator (IC 741)
16. Crystal oscillator (BC 548)
17. Tuned amplifier (BF 194)
18. SCR characteristics
19. Hartley oscillator (IC 741)
20. Clipping and Clamping circuits

Digital Experiments

Any 6 from the Following List

1. Implementation of logic gates
2. Study of Adder and Subtractor (IC 7483)
3. Binary to Gray code converter (IC 7486)
4. BCD to Excess-3 code converter (7486)
5. Design of Flip-Flops with basic gates (IC 7486)
6. Encoder and Decoder (IC 74138, 74148)
7. Multiplexer and Demultiplexer (IC 74151, 74154)
8. UP- Down counter (IC 74192,74193)
9. D to A converter (IC 7490, 741)
10. 4-bit counter using Flip-Flpos (IC 7490)
11. 4-bit shift register (IC 7476, 7400)
12. 4-bit magnitude comparator (IC 7485)
13. Parity generator (IC 7486, 7404)
14. Study of ALU (IC 74181)
15. Appliance Timer
16. Frequency counter

M.Sc. PHYSICS III - SEMESTER
SPH 801 SOLID STATE PHYSICS

Hours per week: 4 | End Examination: 60 Marks
Credits: 4 | Sessionals: 40 Marks

UNIT- I

Introduction to Crystals

Crystal structure, Unit cell, Symmetry operations-translation and point, crystal types, Indices of lattice direction and plane, interplanar spacing, density of atoms in crystal plane, Crystal structures- simplest, CsCl, NaCl, Alkali metals, Diamond and HCP. Reciprocal lattice, Braggs law, laue interpretation of crystals, Imperfections in Crystal- Point, line, Burger vector, dislocation and Surface imperfections.

UNIT- II

Energy Bands in Solids

Free electron gas, electrical conductivity, Fermi surface and its effects on electrical conductivity, failure of free electron model, Energy bands in solids-Bloch theorem, periodicity of bloch functions and eigen values, Kronig penney model, nearly free electron model, zone schemes for energy bands, tight binding approximation, estimation of cohesive energy. Concept of holes effective mass, Fermi surfaces construction and de hass-van alphen effect.

UNIT- III

Lattice Vibrations

Introduction, Dynamics of chain of identical atoms, diatomic linear chain, Reststrahlen band, theory of harmonic approximation, Normal modes of real crystals, quantization of lattice vibration. Classical Lattice heat capacity, quantum theory of lattice heat capacity-average thermal energy of harmonic oscillator, Einstein and Debye model and Anharmonic effects-thermal expansion, phonon collision and thermal conductivity

UNIT-IV

Dielectric Properties of materials

Polaraisation, dielectric constant, local electric field, dielectric constant and its measurement, dielectric polarisability, sources of polarisability- theory of electronic, ionic and orientation. Dielectric loses, piezo, pyro and ferroelectric properties of crystals, ferroelectricity, ferroelectric domains, anti ferroelectricity and ferrielectricity.

UNIT -V

Magnetic properties of Materials

Classification of magnetic materials, Atomic theory of magnetism-Hunds rules, orign of permanent magnetic moments, langevins theory of dia and paramagnetism. Quantum theory and formulation of magnetic susceptibility for dia and paramagnetism. Pauli paramagnetism, cooling by adiabatic demagnetization. Ferro magnetism- wiess molecular field, ferromagnetic domains, domain theory, anti ferromagnetism and ferrimagnetism.

Books:

1. Solid State physics by M.A.Wahab Narosa Publishing House, 2005
2. Elements of Solid State physics by J.P. Srivastava PHI 2nd Edition
3. Elementary of Solid State physics by M.Ali Omar -Pearson Education, 1999

M.Sc. PHYSICS III - SEMESTER
SPH 803 NUCLEAR PHYSICS

Hours per week: 4 End Examination: 60 Marks
Credits: 4 Sessionals: 40 Marks

UNIT-I
General Properties, Nuclear Forces and models

Introduction to nuclear properties, semi empirical mass formula, nuclear magnetic dipole moment, electric quadrupole moment. Deuteron bound state problem-excited states of the deuteron, Nucleon-nucleon scattering, Proton-proton and neutron-neutron interactions, Nuclear shell model: magic numbers, spin orbit interaction, prediction of angular momenta and parities for ground states.

UNIT-II
Radioactivity and Nuclear Decay

The radioactive decay law, production and decay of radioactivity, natural radioactivity, α-decay process, Geiger Nuttal Law, Gamow's theory of α decay, Fermi's theory of β-decay, selection rules, parity violation in β-decay, properties of neutrino, energetics of gamma decay, selection rules, angular correlation, Internal conversion.

UNIT-III
Nuclear Reactions

Introduction, kinds of nuclear reactions, conservation laws, nuclear reaction kinematics, charged particle reaction spectroscopy, neutron spectroscopy, nuclear cross section, compound nucleus, nuclear transmutations by α, protons, neutrons, deuterons, nuclear reactions with heavy ions, nuclear reaction cross section, different stages of nuclear reactions.

UNIT IV
Nuclear Energy

Nuclear Fission, types of fission, distribution of fission products, neutron emission inFission, fissile and fertile materials, spontaneous fission, Bohr-Wheeler theory of nuclear fission, Nuclear Fusion, plasma fusion reactions, energy balance, Solar fusion, types of nuclear reactors.

UNIT-V
Elementary particle Physics

Introduction, Classification of elementary particles, Particle interactions and families, symmetries and conservation laws of energy and momentum, angular momentum, parity, Baryon number, Lepton number, isospin, strangeness quantum number, Gellmann and Nishijima formula, K-mesons and hyperons, Elementary ideas of CP and CPT invariance, Quark model and Grand Unified Theories.

Books:

1. Introductory Nuclear Physics-Kenneth S. Krane
2. Nuclear Physics by D.C.Tayal, Himalaya publishing Co.,
3. Introduction to Nuclear Physics by Harald A.Enge
4. Atomic Nucleus by RD Evans
5. Introduction to Elementary Particles by D. Griffiths

M.Sc. PHYSICS III – SEMESTER
SPH 805 NANOSCIENCE AND TECHNOLOGY

Hours per week: 4 | End Examination: 60 Marks
Credits: 4 | Sessionals: 40 Marks

UNIT- I

Physics of Solids

Energy bands n solids, crystal momentum, concept of effective mass, concept of holes, Sommerfeld‟s Electron theory of metals, density of states, Fermi surfaces, fermisurface and brillouin zones, phonons, zero, one and two phonon scattering, x-ray measurements of phonon spectra, imperfections in crystals, point defect, polarons, excitons, dislocations and surface defects.

UNIT -II

Fundamentals of Nanoscience

Historical background, Nanotechnology and Nanoscience, Significance of Nanoscale quantum confinement, size dependent properties, length scales, Quantum size effect in Nanoparticles, Nano clusters types of nanomaterials, fullerenes, nanowires, nanotubes, thinfilm and applications of nanotechnology.

UNIT -III

Synthesis of Nanomaterials

Physical methods, mechanical – ball milling, melt mixing, evaporation, ion sputtering, laser ablation, laser pyrolysis, Physical Layer Deposition chemical vapour deposition, molecular beam epitaxy. Chemical methods: sol-gel technique, precipitation method and combustion synthesis, colloidal synthesis & capping of nanomaterials and hydrothermal synthesis and reverse micelles.

UNIT- IV

Properties of Nanoparticles

Metal nanoclusters- magic numbers theoretical modeling, geometric structure, electronic structure, reactivivity, fluctuations, magnetic clusters, transition from bulk to nanomaterials. Semiconducting Nano particles- optical properties, photofragmentation and coulombic explosion. Electrical, mechanical, chemical, thermal and elastic properties of carbon nanotubes.

UNIT -V

Methods and Measuring Properties

Introduction, structure-atomic structure, crystallography, particle size determination and surface structures. Microscopy-Transmission Electron Microscopy, Field ion microscopy and scanning microscopy. Scanning Transmission Electron Microscopy, Atomic Force Microscopy. Diffraction techniques–X-ray diffraction, Intensities in x-ray scattering and particle size effects.

Books:

1. Principles of Modern Physics 2nd Edition by Narosa publishing House
2. Introduction to nanotechnology by Charles P. Poole and Frank.J.Owens Wiely Publishers
3. Nano –The Essentials by T.Pradeep Mc.Graw Hill Education, 2008
4. Nanotechnology: Principles & Practices by S.K. Kulkarni, Capital Publ. Co.New Delhi
5. Nanomaterials: Synthesis, Properties, and Applications by Alan S. Edelstein, Robert C. Cammarata Institute of Physics Publication

M.Sc. PHYSICS III – SEMESTER
SPH 841 ANALOG AND DIGITAL COMMUNICATION

Hours per week: 4 End Examination: 60 Marks
Credits: 4 Sessionals: 40 Marks

Unit-I

Amplitude Modulation

Introduction, Amplitude Modulation, Amplitude Modulation index, MI for Sinusoidal Modulation Index, Frequency spectrum, Average Power for sinusoidal amplitude modulation. Effective voltage and current for Sinusoidal Amplitude Modulation. Amplitude Modulator circuits and Amplitude demodulator circuits and superhetrodyne receiver

Unit II

Single Side Band Modulation

Non sinusoidal modulation, double side band suppressed carrier modulation. Introduction to single side band, principles of SSB, balanced Modulators, SSB generation and SSB reception, modified SSB systems , signal to noise ratio for SSB systems and companded single side band.

Unit-III

Angle Modulation

Introduction, frequency modulation, Sinusoidal F.M, frequency spectrum of sinusoidal FM, Average Power of sinusoidal FM. Non Sinusoidal Modulation, Deviation ratio.

Measurement of modulation index for sinusoidal FM. Phase Modulation- equivalence between PM and FM. FM Transmission -Direct and Indirect methods.FM detectors- Slope detector, balanced double tuned detector and PLL detector

Unit-III

Pulse Modulation

Introduction to pulse modulation-Digital line wave forms: symbols, bits ans bauds, functional notation for pulses, line codes and wave forms, unipolar -NRZ – RZ, Polar line codes. Pulse Modulation- Pulse amplitude modulation,Pulse code modulation, pulse frequency modulation ,pulse position modulation and pulse width modulation.

Unit-V

Digital Modulation And Transmission

Sampling Theorem, Signal reconstruction, Pulse Code Modulation (PCM) Quantization, Digital carrier systems-Amplitude shift keying,Phase shift keying and Frequency shift keying and Differential phase shift keying ,Differential PCM and Delta modulation.

Books:

1. Electronic Communications- Dennis Roddy and John Collins
2. Modern Digital and Analog Communication System - B.P.Lathi
3. Principles of Communication System – H.Taub and D.Schilling

M.Sc. PHYSICS III – SEMESTER
SPH 843 INTRODUCTION TO PHOTONICS

Hours per week: 4 End Examination: 60 Marks
Credits: 4 Sessionals: 40 Marks

Unit I

Laser Cavity Modes

Line shape function and Full Width at half maximum (FWHM) for Natural broadening, Collision broadening, Doppler broadening, Longitudinal and Transverse modes. ABCD matrices and cavity Stability criteria for confocal resonators. Quality factor, Q-Switching, Mode Locking in lasers. Expression for Intensity for modes oscillating at random and modes locked in phase. Methods of Q-Switching and Mode locking.

Unit II

Gaussian Beam

Complex amplitude of Gaussian beam, Properties of Gaussian beam-Intensity, power, beam radius, beam divergence, depth of focus, and phase. q –parameter and its properties-beam waist , location of the waist, and Radius of curvature of the wave front, Gaussian beam reflection from a spherical mirror, Gaussian beam transmission through an arbitrary optical system, Hermite - Gaussian beams, Laguerre Gaussian and Bessel beams

Unit III

Transformation of A Gaussian Beam By Lens

Transformation of the q-parameters by a lens system, size of the waist of the emergent beam from a lens, location of the waist of the emergent beam, Rayleigh range of the emergent beam, Angle of the far field divergence of the emergent beam, Beam propagation factor m^2, The Gaussian beam in spherical mirror cavity, Resonance frequencies of the cavity.

Unit IV

Nonlinear Optics

Nonlinear optical media**,** Second order nonlinear optics- Second harmonic generation and rectification, Phase matching condition, Difference frequency generation, sum frequency generation, Electro-optic effect- Pockels electro-optic effect**,** Kerr electro-optic effect, three wave mixing, Third order nonlinear effects-Third harmonic generation (THG) Optical Kerr effect, Self phase modulation, self focusing, Four wavemixing, optical phase conjugation, Degenerate four wavemixing,

Unit V

Semiconductor Photon Detectors

Photodetectors- the p-n photodiode, the p-i-n photodiode, hetero structure photodiodes, array detectors, Properties of semiconductor photo detectors-quantum efficiency, responsivity, and response time, Avalanche photodiodes-principles of operation, Gain and responsivity, Response time, Noise in photodetectors-photoelectron noise, Gain noise, Circuit noise, signal to noise ratio and receiver sensitivity

Books:

1. Lasers -Theory and Applications – K.Thyagarajan and A.K. Ghatak (MacMillan)
2. Fundamentals of Photonics- Bahaa E Saleh.
3. Elements of Photonics, Volume 1-Keigo Izuka
4. Laser fundamentals – William T. Silfvast (Cambridge)
5. Optical Electronics – Ajoy Ghatak and K.Thyagarajan (Cambridge)

M.Sc. PHYSICS III - SEMESTER
SPH 845 RADIATION PHYSICS

Hours per week: 4 | End Examination: 60 Marks
Credits: 4 | Sessionals: 40 Marks

UNIT - I

Introduction radiations – types of radiation – electromagnetic spectrum – atomic and nuclear structure – nuclear forces – x-rays- Radioactivity– nuclear transformation – nuclear reactions– production of radioactive materials – radioactive decay – half- life, mean life – transient sector equilibrium - Radioisotopes in medicine and health care.

UNIT - II

Interactive of radiation with matter – photo electric effect, Compton effect and pair production – attenuation and absorption of radiation – exponential law– half value layer – interaction of charged particles – neutron interactions– optical interactions – ultrasound interactions

Radiation detectors –principles of radiation detection– ionization chamber, proportion counter, GM tubes, semiconductor detector, gamma ray spectrometer.

UNIT - III

Radiation dosimetry – Radiological units and their measurement – Curie, Roentgen Gray, RAD and Sievert –applications of units in radiological safety – Exposure rate, Dose rate, air kerma, tissue air ratio (TAR) – percentage depth dose (POD), tissue maximum ratio (TMR) – dose limits Measurement of exposure and dose – internal dosimetry and external dosimetry – doses from various sources of radiation - Film badges - TLDs

UNIT - IV

Environmental impact of radioactivity and radioisotopes - biological effects of radiation, cosmic radiation and cosmogenic radionuclides- naturally occurring long-lived radionuclides – Radon and its decay products – Environmental impact of uranium industry – Nuclear Energy and the environment – Other man made radiation sources in the environment – radioactive wastes

UNIT - V

X-rays and x-ray machines –cobalt therapy units - quality assurance and calibration of therapy units

Basics of NMR and MRI, nuclear medicine x-ray machines – cobalt therapy units - quality assurance and calibration of therapy units

Nuclear medicine –Invitro and Invivo - SPECT, PET

Radiation protection – ICRP frame work of radiological protection –measures of radiation protection –special facilities for handling radioisotopes

Books:

1. Physics of Radiation Therapy by F.M.Khan, 3rd Edition, Lippincott Williams & Wilkins
2. Basic medical radiation physics by Stanton, Appleton-Century-Crofts
3. Fundamentals of Radiochemistry by D.D.Sood, A.V.R.Reddy and N.Ramamoorthy, IANCAS Publication, 3rd edition, BARC, Mumbai.
4. Source book on Atomic energy by Samuel Glasstone, Affiliated East-West Press Pvt.Ltd

M.Sc. PHYSICS III - SEMESTER
SPH 847 DYNAMICAL SYSTEMS

Hours per week: 4 — End Examination: 60 Marks
Credits: 4 — Sessionals: 40 Marks

UNIT- I

Dynamics of Differential equations

Introduction to systems, Integrations of linear second order equations, Integration of non linear second order equations, Dynamics of phase plane, linear stability analysis, time dependent integrals and non autonomous systems.

UNIT- II

Hamiltonian Dynamics

Lagrangian formulation of mechanics, Hamiltonian formulation of mechanics, canonical transformations, Hamilton Jacobi equations and action angle variables, and integrable Hamiltonians.

UNIT- III

Classical Perturbation Theory

Elementary perturbation theory, canonical perturbation theory, many degrees of freedom and problem of small divisors, Kolmogorov –Arnold-Moser theorem and its invariants.

UNIT- IV

Chaos in Hamiltonian Systems and Mappings

Surface of section, Area preserving mapping, fixed points and the Poincare-Birkhoff -Fixed point theorem, Homoclinic and Hetroclinic points, criteria for local chos, criteria for onset and wide spread chaos, statistical concepts in chaotic systems and Hamiltonian chaos in fluids.

UNIT -V

Nonlinear Evolutions

Dynamics of dissipative systems and turbulence, experimental observations and theories on onset of turbulence. Basic properties of KdV equation, inverse scattering transform-basic principles, Inverse scattering transform KdV equation, Hamiltonian structure of integrable systems, soliton systems and Dynamics of non integrable evolution equations.

Books:

1. Chaos and Integrability in Non-linear Dynamics by M. Tabor (Wiley), 1989
2. Chaos: An Introduction to Dynamical Systems (Textbooks in Mathematical Sciences) by Kathleen T. Alligood , Tim D. Sauer and James A. Yorke Springer, 2nd Edition
3. Regular and stochastic motion by Lichtenber & Lieberman, Springer, 2nd Edition, 1992
4. Chaos in Guage Theories by Biro Muller (World Scientific), 1995

M.Sc. PHYSICS III – SEMESTER
SPH 821 ANALOG AND DIGITAL COMMUNICATION ELECTRONICS LAB

Hours per week: 6 Continuous Evaluation: 100 Marks
Credits: 2

1 Generation of Amplitude Modulation

2. Detection of Amplitude Modulation

3. Frequency Modulation

4. Pulse Width Modulation

5. Pulse position Modulation

6. Amplitude Shift Keying

7. Phase shift Keying

8. Frequency shift keying

9. Phase locked loop

10. Mixer

M.Sc. PHYSICS III - SEMESTER

SPH 823: NUCLEAR PHYSICS LAB

Hours per week: 6 Continuous Evaluation: 100 Marks

Credits: 2

1. Plateau Characteristics
2. Intensity variation of radiation
3. Plateau Characteristics Same source different distance
4. Inverse square law for gamma radiation
5. Absorption Coefficient of material
6. Statistical Aspects of Radiation
7. Beta back scattering factor
8. Gamma ray Spectrometer Energy resolution characteristics
9. Resolving time of a G.M. Tube by two source method
10. Determination of Dead time

M.Sc. PHYSICS IV-SEMESTER
SPH 802: MATERIAL CHARACTERIZATION TECHNIQUES

Hours per week: 4 | End Examination: 60 Marks
Credits: 4 | Sessionals: 40 Marks

UNIT- I

Nuclear Techniques

Unusual advantages in nuclear experimentation, Detectors for Energetic Charged particles. Energy measurements and identifications. Scintillation Detectors-mechanism in organic and inorganic crystal scintillations, Scintillation Response, time characteristics of scintillation output and energy resolution, Inorganic and organic scintillators. Photo and Electron multipliers, Measurement with Scintillation detectors –Gamma ray spectroscopy with Nal(Tl), fast time coincidence measurements.

UNIT - II

Spectroscopic Techniques

UV, Visible molecular absorption spectrometer – Beer Lamberts law and interpretation. Infrared spectroscopy- instrumentation and interpretation of vibrational spectra sample handling techniques. Raman scattering – spectrometer and sample handling techniques. Nuclear Magnetic Resonance – Instrumentation, chemical shift, spectra of solids, and interpretation. Electron Microscopes- SEM, TEM and AFM with principle and instrumentation.

UNIT - III

Semiconductor growth Techniques

Charge carrier density, doping, carrier densities, conductivity with hetero structures and super lattice. Binary compounds, Oxides, Layered, organic and magnetic semiconductors. Growth techniques- Czochralski, Bridgeman methods, Chemical vapor decomposition method, Molecular beam epitaxy, Fabrication of self organized quantum dots by stranski-krastanow growth method and liquid phase epitaxy.

UNIT - IV

Astronomical Techniques

Different optical configuration for astronomical telescope plate scale and diffraction Limits-telescopes for ã-ray, X-ray, UV, IR, mm and radio astronomy- photometry with Photometers and CCD- spectrometry and polarimetry with various instruments.

UNIT - V

Optical Techniques

Optical properties-refractive index, (linear and Non linear), absorption coefficient Special properties-Accidental anisotropy, birefringence, electro optic effect, acousto optic effect. Colored glasses-absorption, color centers. Colour due to dispersed particles, Luminescent glasses.

Books:

1. Nuclear radiation Detectors by V.S.Ramamoorthy and S.S.Kapur
2. Fundamentals of Molecular Spectroscopy by Colin Banwell, Elaine McCash 4th Ed.TMH
3. Fundamentals of semiconductor by Physics and Materials properties by Peter Y.Yu and Manuel Cardona 3rd Edition Springer
4. Astrophysics by Baidyanath Basu, Prentical Hall
5. Introduction to Nano technology by Charles P. Poole Jr. and Frank J. Owens Wiely

M.Sc. PHYSICS IV-SEMESTER
SPH 850 NUCLEAR ANALYTICAL TECHNIQUES

Hours per week: 4 End Examination: 60 Marks
Credits: 4 Sessionals: 40 Marks

UNIT – I

Radiation and Detectors: Interaction of gamma rays, electronics, heavy charged particles and neutrons with matter, production of radio nuclides and measurement of strength of radioactive sources, radiation exposure, absorbed does, biological effects, radiation protection, shielding, safety aspects; study of detectors and counting systems i) ionization chamber ii) proportional counter iii) GM counter iv) scintillation detector v) semiconductor detector- energy transfer mechanism, mode of detection, energy resolution.

UNIT -II

Important features of radiation detectors- counting curves and plateaus- energy resolution – Fano factor – Detection efficiency – dead time

Nuclear electronics: pre-amplifier and its characteristics–amplifier and its characteristics –charge sensitive and voltage sensitive pre-amplifiers –pulse shaping techniques – base line restoration, pulse height discriminators, analog to digital converters (ADC) – Single channel and multichannel analyzers.

Measurement of life times of nuclear excited states covering ranges from a few Pico seconds to thousands of years using techniques like delayed coincidence, recoil distance, line shifts, Doppler shift attenuation, activity measurement.

UNIT - III

Nuclear activation analysis – prompt gamma neutron activation analysis (PGNAA) – Neutron Activation Analysis (NAA) – Sensitivity and detection limit – different methodology of NAA- chemical separations of NAA – Standardization of NAA – Relative method – single comparator or K_o –NAA method advantages and limitations of NAA- Experimental methodology in NAA.

UNIT – IV

Coincidence measurements: Slow fast coincidence arrangements for measurement of coincidence between radiation, prompt and chance coincidences. Energy and time coincidence measurements. Double coincidence methods: ROSSI, Bothe coincidence circuits, Sum coincidence technique, Anti-Compton gamma ray spectrometry- Principles of life time measurements.

UNIT - V

XRF and PIXE: Principles of XRF, X – Ray production, instrumentation and techniques. Fluorescence yield, Types of sources for XRF studies Applications of XRF, Fundamentals of PIXE and PIGE and their applications.

Books:

1. Nuclear radiation detectors by SS Kapoor and VS Ramamurthy
2. Radiation detection and measurement by G F Knoll
3. Techniques for nuclear and particle physics experiments by W R Leo
4. Source book on Atomic energy by Samuel Glasstone, Affiliated East-West Press pvt.Ltd
5. Introduction to Experimental Nuclear Physics by R.M.Singru, Wiley eastern private ltd.
6. Fundamentals of Radiochemistry by D.D. Sood, A.V.R. Reddy and N. Ramamoorthy, 2nd Ed. IANCAS publication, BARC.

M.Sc. PHYSICS IV-SEMESTER
SPH 852: MATERIALS SCIENCE

Hours per week: 4 End Examination: 60 Marks
Credits: 4 Sessionals: 40 Marks

UNIT- I

Applied Crystallography in Materials Science

Noncrystalline and semicrystalline states, Lattice, Crystal systems, unit cells. Indices of lattice directions and planes. Coordinates of position in the unit cell, Zones and zone axes. Crystal geometry. Symmetry classes and point groups, space groups. Glide planes and screw axes, space group notations, Equivalent points. Systematic absences, Determination of crystal symmetry from systematicabsences. Stereographic projections. Standard projection of crystals. (12 lectures)

UNIT- II

Introduction to Materials Classification of Materials

Crystalline & amorphous materials, high Tc superconductors, alloys & composites, semiconductors, solar energy materials, luminescent and optoelectronic materials, Polymer, Liquid crystals and quasi crystals, Ceramics. (12 lectures)

UNIT- III

Preparation Techniques of Materials

Preparation of materials by different techniques: Single crystal growth, zone refining, epitaxial growth. Melt-spinning and quenching methods, sol-gel, polymer processing. Preparation of ceramic materials; Fabrication, control and growth modes of organic and inorganic thin films: different technique of thin film preparations: Basic principles. (12 lectures)

UNIT-IV

Synthesis of Nanomaterials

Top down and bottom up approaches of synthesis of nano-structured materials, nanorods, nanotubes/wire and quantum dots. Fullereness and tubules, Single wall and multiwall nanotubes. (12 lectures)

UNIT- V

Phase Transition in Materials

Solid solutions, Phases, Thermodynamics of solutions, Phase rule, Binary phase diagrams, Binary isomorphous systems, Binary eutectic systems, ternary phase diagrams, kinetics of solid reactions. Order disorder phenomenon in binary alloys, long range order, super lattice, short range order. (12 lectures)

Reference Books

1. Materials science and Engineering by V. Raghavan, Prentice-Hall Pvt. Ltd.
2. Thin Solid Films by K. L Chopra
3. Elements of X-ray diffraction by B. D. Cullity, Addison-Wesley Publishing Co.
4. Elements of crystallography by M. A. Azaroff 5. Engineering Materials by Kenneth G. Budinski, Prentice-Hall of India Pvt. Ltd.

M.Sc. PHYSICS IV-SEMESTER
SPH 854: CONDENSED MATTER PHYSICS

Hours per week: 4 End Examination: 60 Marks
Credits: 4 Sessionals: 40 Marks

UNIT- I

Concepts of Condensed matter

Gaseous and liquid states, liquid gas phase transition, spatial correlation, ice-crystalized water, broken symmetry and rigidity, Dislocations- topological defects. Universality of water, Energies and potentials-Energy scales, vanderwaal attraction, Molecular Hydrogen-Heitler London approach and hard sphere repulsion.

UNIT -II

Structure and Scattering

Elementary scattering theory, photons, neutrons and electrons, density operator and correlation functions, hard sphere liquids. Crystalline solids-unit cells and direct lattice, reciprocal lattice, periodic functions and Bragg scattering. Symmetry and crystal structure- two and three dimensional bravice lattice and close packed structures.

UNIT- III

Thermodynamics of Homogenous fluids

Laws of thermodynamics, thermodynamic potentials, stability criteria, homogenous function and equation of state, Ideal gas, spatial correlation in classical systems, ordered systems, Symmetry, order parameter and models- discrete symmetries and continuous symmetries and models

UNIT- IV

Mean Field Theory

Bragg William theory, landau theory, Ising and n vector models-non local susceptibility and correlation length. Liquid gas transition-critical point and critical isochore, coexistence curve. Liquid–Solid transition- Are all crystals BCC, Criterion for freezing, changes in density and density fluctuation theory.

UNIT- V

Critical Phenomena

Variational mean field theory-two inequalities, mean field approximation, Break down of mean field theory - mean field transition revisited. self consistent field approximation. Critical exponents, Universality and scaling-exponents and scaling relations, scaled equation of state, multi critical points, amplitude ratios, calculation of critical exponents and amplitude ratios.

Books:

1. Principles of Condensed Matter Physics by P.M.Chaikin and T.C Lubensky Cambridge Univ. Press ,2000
2. Advanced Condensed matter Physics by Leonard .M. Sander Cambridge Univ. PressEdition, 2009

M.Sc. PHYSICS IV - SEMESTER
SPH 856 NON - LINEAR OPTICS

Hours per week: 4 End Examination: 60 Marks
Credits: 4 Sessionals: 40 Marks

UNIT- I

Non Linear Optical Susceptibility

Introduction to non linear optics, Description of non linear optical processes, formal definition of non linear susceptibility and nonlinear susceptibility of a classical anharmonic oscillator. Properties of non linear susceptibility, time domain optical nonlinearties, Kramers –Kroing relations in linear and non liner optics

UNIT- II

Wave Equation Description of Non Linear Optical Interactions

Wave equation for nonlinear optical media, coupled wave equations for sum frequency generation, phase matching, Quasi phase matching, Manley Rowe relation, sum frequency generation, second harmonic generation. Difference frequency generation and parametric amplication. Optical parametric oscillators, Non linear optical interactions with focused Gaussian beams.

UNIT- III

Quantum Mechanical Theory of Non Linear Optical Susceptibility

Introduction, Schrodinger calculations of Nonlinear Optical Susceptibility, density Matrix Formulation of Quantum Mechanics, Perturbation solution of density matrix equation of motion, density matrix calculation of linear susceptibility, density matrix calculation of second order susceptibility. Electromagnetically induced transparency and local field corrections.

UNIT- IV

Intensity Dependent Refractive Index

Description of intensity dependent refractive index, tensor nature of third order susceptibility, non resonant electronic nonlinearities, non linearities due to molecular orientation, thermal non linear optical effects and semi conductor non linearities.

UNIT -V

Non Linear Optics in Two Level Approximation

Introduction, density matrix equation for two level atoms, steady state response of two level atom due to monochromatic field, optical Bloch equations, Rabi oscillations and dressed atomic states, optical wave mixing in two level systems.

Books:

1. Non Linear Optics by Robert W.Boyd 3rd Edition Academic Press, 2008
2. Lasers and Non Linear Optics by B.B laud 3rd Edition New Age Intl, 1985

M.Sc. PHYSICS IV - SEMESTER
SPH 890 MATERIAL SCIENCE LAB

Hours per week: 6 Continuous Evaluation: 100 Marks
Credits: 2

1. Ultrasonic Interofemeter
2. Rigidity modulus-Internal friction
3. B-H Curve- Determination of Curie temperature
4. Thermo EMF
5. Constant Deviation Spectrograph - Absorption spectrum
6. Divergence of Laser beam Diode Laser
7. Measurement of Susceptibility of liquid/solution – Quick‟s tube
8. Dielectric Constant
9. Study Zinc /Aluminum /Raman spectra

OPEN ELECTIVE II – SEMESTER
SOE 754 ENVIRONMENTAL PHYSICS

Hours per week: 3 | End Examination: 60 Marks
Credits: 3 | Sessionals: 40 Marks

UNIT-I

Introduction to Environmental Physics

The human environment: First, Second and Third law of Thermodynamics, Energy and metabolism **-** Laws of thermodynamics and the human body

Energy transfers: Conduction, Convection, Newton‟s law of cooling, Radiation, Evaporation, Survival in cold climates, Survival in hot climates

Noise pollution: Domestic noise and the design of partitions

UNIT-II

Water

Hydrosphere, Hydrologic cycle, Water in the atmosphere, Clouds, Physics of cloud formation, growing droplets in cloud, Thunderstorms

Wind: Measuring the wind, Physics of wind creation, Principal forces acting on air masses, Gravitational force, Pressure gradient, Cyclones and anticyclones, Global convection, Global wind patterns.

UNIT-III

Physics of Ground

Soils, Soil and hydrologic cycle, Surface tension and soils, Water flow, Water evaporation, Soil temperature.

Environmental Biophysics -Energy budget concept, radiation energy fluxes, energy equilibrium between biotic and abiotic environmental components

Ozone layer depletion – Greenhouse effect

UNIT-IV

Fossil Fuels

Nuclear power, Renewable resources – Hydroelectric power, Tidal power, Wind power ,Wave power Biomass, Solar power – Solar collector, Solar photovoltaic Energy demand and conservation – Heat transfer and thermal insulation – Heat loss in buildings

UNIT-V

Environmental Impact of Radioactivity and Radioisotopes

Biological effects of radiation, cosmic radiation and cosmogenic radionuclide‟s- naturally occurring long-lived radionuclide‟s – Radon and its decay products – Environmental impact of uranium industry – Nuclear Energy and the environment – Other man made radiation sources in the environment – radioactive waste.

Books:

1. Environmental Physics by E. Boeker & R. Van Grondelle, John Wiley & sons,1994
2. Concepts of Modern Physics by Beiser McGraw Hill, 5th Edition
3. The nature and properties of Soils by Brady, N.C. Tenth Edition. Mac Millan Publishing Co., New York,1990
4. Environmental Studies: The earth as a living planet by Botkin, D.B and Kodler E.A., John Wiley and Sons Inc.,2000
5. Environmental Physics by M. Dželalija

OPEN ELECTIVE III - SEMESTER
SOE 763 BIOPHYSICS

Hours per week: 3 | End Examination: 60 Marks
Credits: 3 | Sessionals: 40 Marks

UNIT- I

Energy Around Us

Forms of energy, ambient energy, molecular energy, molecular energy absorbance, molecular transduction, ionizing radiation, magnetic resonance and sound, Molecular contacts- Dissociation constants, methods of measuring dissociation constants, metal molecular coordination bond and hydrogen bonding.

UNIT- II

Diffusion and Direct Transport

Forces and flows, Ficks law of diffusion, Brownian motion, physical diffusion of ions and molecules, molecular motors and intracellular cargo transport. Energy production of ATP and ADP, phospocreatine and glycosis

UNIT- III

Force and Movement

Skeletal length and tensionrelation, muscle contraction, cardiac and smooth muscle length-tension relation, Hill formalism of cross bridge cycle, muscle shortening, lengthening and power, calcium dependence of muscle velocity, smooth muscle latch, muscle tension transients and law of Laplace for hollow organs.

UNIT -IV

Load Bearing and Fluid Flow

Stress and strain, teeth and bone, blood vessels, tendons, ligaments and cartilage. Fluid flow properties, synovial fluid flow, arterial blood flow, artirole blood flow, viscosity and hematocrit, arterial stenosis, arterial asymmetry and lung air flow

UNIT -V

Biophysical Interfaces

Surface tension, action of surfactant on lung surface tension, membrane lipids, membrane curvature, membrane protein and carbohydrate environment, membrane protein transporters, membrane organization, ultrasonic pore formation, membrane diffusion and viscoeleasticity and membrane ethanol effects.

Books:

1. Biophysics(A Physiological approach) by Patrick.F.Dillon, Cambridge University Press,2012
2. Biophysics by An introduction, Rodney Cotterill ,Wiely,2002
3. Biophysics by Daniel Goldfarb, Mc Graw Hill,2011

OPEN ELECTIVE III - SEMESTER
SOE 765 BIOELECTRONICS

Hours per week: 3 End Examination: 60 Marks
Credits: 3 Sessionals: 40 Marks

UNIT - I

Introduction to Sensors

Sensors, Nose as sensor, sensors and biosensors, components of biosensors, Aspects of sensors-Recognition elements-transducers, methods of immobilization, performance factors. Biocatalysis and bioaffinity based sensors, Advantages and limitations of biosensors and areas of application.

UNIT -II

Transduction Elements

Electrochemical Transducers, Potentiometery and ion selective electrodes-Nernst equation, cells and electrodes, reference electrodes and quantitative relationships (with N.E).Voltametry -Linear sweep and cyclic, Amperometry- kinetic and catalytic effects, Conductivity, Photometric sensors-optical techniques, optical transducers-device construction, solid phase absorption label sensors and applications.

UNIT - III

Sensing Elements

Ionic recognition-ion selective electrodes, interferences, conductive devices, Modified electrodes and screen printed electrodes. Molecular recognition-chemical Recognition agents-thermodynamic complex formation, kinetic catalytic effects. Biological recognition agents-Enzymes, tissues, antibodies and nucleic acids Immobilization- adsorption and microencapsulation.

UNIT - IV

Performance Factors

Introduction, Selectivity-ion selective electrodes, enzymes and antibodies. Sensitivity-linear range and detection. Time factors-response factors, recovery and life times.

Precesion and accuracy. Different transducers-urea, amino acid and glucose biosensors, factors affecting performance of sensors-amount of enzyme, immobilization method and pH.

UNIT - V

Electrochemical Sensors and Biosensors

Potentiometric sensors-ionic selective electrodes-concentration and activities, calibration graph. Potentiometric Biosensors-pH linked, ammonia linked, carbon dioxide linked and iodine selective. Amperometric sensors-Direct electrolytic methods. Conductometric and biosensors-chemiresistors, biosensors based on chemiresistors and semi conductive oxide sensors.

Books:

1. Chemical Sensors and Biosensors by Brain R.Eggins Wiely Publishers, 1st Edition
2. Biosensors: fundamentals and applications by Anthony P. F. Turner, Isao Karube, George S. Wilson Oxford University Press, 1987
3. Molecular Bioelectronics by C.Nicolini World Scientific,1996