COURSES OF STUDIES

FOR

5yr. Int. M.Sc.

In

Applied Physics

BIJU PATNAIK UNIVERSITY OF TECHNOLOGY, ODISHA

5-YEAR INTEGRATED M.SC IN APPLIED PHYSICS STRUCTURE

First Year

1ST Semester				2nd Semester			
Theory		**Contact Hours**	**Credit**	**Theory**		**Contact Hours**	**Credit**
Code	**Subject**	**L-T-P**		**Code**	**Subject**	**L-T-P**	
FPYC-101	Classical Mechanics & special theory of relativity-I	3-0-0	3	FPYC-201	Electromagnetism	3-0-0	3
FPYC-102	Heat &Thermodynamics	3-0-0	3	FPYC-202	Optics (Geometrical &Physical)	3-0-0	3
FMCE-107	Math –I	3-0-0	3	FMCE-207	Math-II	3-0-0	3
FCYE-108	Chemistry-I	3-0-0	3	FCYE-208	Chemistry –II	3-0-0	3
FHMF-109	Communicative English	2-0-0	2	FHMF-209	Business Communication English	2-0-0	2
FBEF-111	Fundamentals of computers & Programming in C	3-0-0	3	FBEF-211	OOPS Using C++	3-0-0	3
		Total	17			Total	17
Practical / Sessional		**Contact Hours**	**Credit**	**Practical / Sessional**		**Contact Hours**	**Credit**
Code	**Subject**	**L-T-P**		**Code**	**Subject**	**L-T-P**	
FPYC-151	Mechanics and thermal physics -I	0-0-3	2	FPYC-251	Electrical lab	0-0-3	2
FCYE-158	Chemistry lab-I	0-0-3	2	FCYE-258	Chemistry lab-II	0-0-3	2
FHMF-159	Communicative English Lab	0-0-3	2	FHMF-259	Business Communication English Lab	0-0-3	2
FBEF-161	Programming in C lab	0-0-3	2	FBEF-261	OOPS Using C++ lab	0-0-3	2
		Total	8			Total	8
		Total	**25**			**Total**	**25**

Second Year

3rd Semester				4th Semester			
Theory		**Contact Hours**	**Credit**	**Theory**		**Contact Hours**	**Credit**
Code	**Subject**	**L-T-P**		**Code**	**Subject**	**L-T-P**	
FPYC-301	Classical Mechanics & special theory of Relativity- II	3-0-0	3	FPYC-401	Modern Physics	3-0-0	3
FPYC-302	Fluid mechanics & properties of matter	3-0-0	3	FPYC-402	Electronics	3-0-0	3
FMCE-307	Math –III	3-0-0	3	FMCE-407	Math-IV	3-0-0	3
FCYE-308	Chemistry –III	3-0-0	3	FCYE-408	Chemistry-IV	3-0-0	3
FHMF-309	Organizational Behaviour	3-0-0	3	FHMF-409	Economics	3-0-0	3
FBEF-310	Data Structure using C &C++	3-0-0	3	FBEF-411	RDBMS	3-0-0	3
		Total	18			Total	18
Practical/Sessional		**Contact Hours**	**Credit**	**Practical/Sessional**		**Contact Hours**	**Credit**
Code	**Subject**	**L-T-P**		**Code**	**Subject**	**L-T-P**	
FPYC-351	Mechanics and thermal physics-II	0-0-3	2	FPYC-451	Electromagnetism & optics lab - I	0-0-3	2
FCYE-358	Chem. Lab-III	0-0-3	2	FCYE-458	Chem. Lab-IV	0-0-3	2
FBEF-360	Data Structure using C & C++ lab	0-0-3	2	FBEF-461	RDBMS Lab	0-0-3	2
		Total	6			Total	6
		Total	**24**			**Total**	**24**

Third Year

5th Semester				6th Semester			
Theory		**Contact Hours**	**Credit**	**Theory**		**Contact Hours**	**Credit**
Code	**Subject**	**L-T-P**		**Code**	**Subject**	**L-T-P**	
FPYC-501	Mathematical method-I	4-0-0	3	FPYC-601	Fiber optics and Holography	3-0-0	3
FPYC-502	Fundamentals of Quantum Mechanics -I	4-0-0	3	FPYC-602	Mathematical Methods -II	4-0-0	3
FPYC-503	Statistical Mechanics-I	4-0-0	3	FPYC-603	Solid State Physics	4-0-0	3
FPYC-504	Fundamentals of Atomic & Molecular Physics	4-0-0	3	FPYC-604	Fundamentals of Nuclear & Particle Physics	4-0-0	3
FPYC-505	Optical electronics	4-0-0	3	FPYC-605	Fundamentals of Quantum Mechanics -II	4-0-0	3
FCYE -508	Environmental science	3-0-0	3	FBEF-610	Computational Methods in physics	3-0-0	3
		Total	18			Total	18
Practical/Sessional		**Contact Hours**	**Credit**	**Practical/Sessional**		**Contact Hours**	**Credit**
Code	**Subject**	**L-T-P**		**Code**	**Subject**	**L-T-P**	
FPYC-551	Electromagnetism & optics lab –II	0-0-3	2	FPYC-651	Modern physics Lab	0-0-3	2
FPYC-552	Electronics-I Lab	0-0-3	2	FBEF-660	Computational Physics lab	0-0-3	2
		Total	4			Total	4
		Total	**22**			**Total**	**22**

Fourth Year

Seventh Semester				**Eighth Semester**			
Theory				***Theory***			
Code	***Subject***	***Contact Hours***	***Credit***	***Code***	***Subject***	***Contact Hours***	***Credit***
FPYC-701	Classical Mechanics	40	4	FPYC-801	Quantum Mechanics-II	40	4
FPYC-702	Mathematical Methods in Physics-I	40	4	FPYC-802	Statistical Mechanics	40	4
FPYC-703	Quantum Mechanics-I	40	4	FPYC-803	Basic Condensed Matter Physics	40	4
FPYC-704	Physics of Semiconductor Devices	40	4	FPYC-804	Mathematical Method in physics-II	40	4
FBEF-705	Research Methodology	40	3	FPYC-805	Electronics	40	4
Practical/Sessional				**Practical/Sessional**			
Code	***Subject***	***Contact Hours***	***Credit***	***Code***	***Subject***	***Contact Hours***	***Credit***
FPYC-751	Electromagnetics and Optics Lab	30	3	FPYC-851	General Physics Lab	30	3
FBEF-755	Advanced Computational Physics Lab	30	3				
		G. Total	**25**			**G. Total**	**23**

Fifth Year

Ninth Semester				Tenth Semester			
Theory				***Theory***			
Code	***Subject***	***Contact Hours***	***Credit***	***Code***	***Subject***	***Contact Hours***	***Credit***
FPYC-901	Adv. Quantum Mechanics & Quantum Field Theory	40	4	FPYC-1001	Atomic and Molecular Physics	40	4
FPYC-902	Nuclear and Particle Physics	40	4	FPYC-1002	Nano Science & Technology	40	4
FPYC-903	Classical Electrodynamics	40	4	Core Elective-II (Theory)			
				FPYE-1004 FPYE-1005	Condensed Matter Physics-II Particle Physics-II	40	4
Core Elective-I (Theory)				Open elective			
FPYE-904 FPYE-905	Condensed Matter Physics-I Particle Physics-I	40	4	FPYE-1006 FPYE-1007 FPYE-1008	Advanced characterization Techniques Vacuum science and Technology Material Science	40	4
Practical/Sessional				**Practical/Sessional**			
Code	***Subject***	***Contact Hours***	***Credit***	***Code***	***Subject***	***Contact Hours***	***Credit***
FPYC-951	Dissertation/Project	40	10	FPYC-1051	Seminar	30	2
FPYC-952	Basic Electronics lab	30	2	FPYC-1052	Modern Phys. Lab.	30	2
Core Elective (Practical)				Core Elective (Practical)			
FPYE-954	Condensed matter physics-I Lab	30	2	FPYE-1054	Condensed matter physics-II Lab	30	2
FPYE-955	Particle Physics-I Lab			FPYE-1055	Particle Physics-II Lab		
		G. Total	**30**			G. Total	**22**

Student can offer one of the core electives from below and any one of the Open Elective

List of Core Electives I and II:

1. Condensed Matter Physics-I &II
2. Particle Physics-I &II

List of Open Elective:

1. Advanced characterization Techniques
2. Vacuum science and Technology
3. Material Science

1st Semester (Theory)

FPYC-101 CLASSICAL MECHANICS & SPECIAL THEORY OF RELATIVITY-I

UNIT -I

Constrained Motion: Constraints, Classification of constraints, Principle of virtual work, D'Alembert's principle and its application.

Lagrangian formulation : - limitations of Newtonian formulation, degrees of freedom , generalised coordinates and velocities, Derivation of Lagrange's equation, Calculus of variation, Euler – Lagrange equation, derivation of Lagrange's equation from Hamilton's principle , simple application of Lagrange's equation, Cyclic coordinates , Symmetry and conservation theorems. (12)

Unit-II

Phase Space and the motion of the system Hamiltonian Hamilton's Canonical Equation of motion, Physical significance of H, Advantage of Hamiltonian approach, Deduction of canonical equation from variational principle, Hamiltonian canonical equation of motion in different co ordinate system, Application of Hamilton's equation of motion in different co ordinate system, Application of hamiltonian's equation of motion Hamiltonian for charged particle in an electromagnetic field, Principle of least action.

Unit-III

Canonical or Contact transformations, Advantage of Canonical transformation, example of canonical transformation Solution of simple harmonic oscillator problem Condition for transformation to be canonical.

Infinitesimal contact transformation. Hamiltonian Jacobi Method, Solution of harmonic oscillator problem by Hamilton Jacobi Method. Particle Falling Freely, Hamilton Jacobi equation for Hamilton Characteristic function.

Unit-IV

Poisson Bracket-Definition Invariance of poission bracket with respect to canonical transformation Equation of motion in poisson bracket form Jacobi's identity ,Infinitesimal contact transformation interpretation in terms of poision's bracket The angular momentum and poisson bracket Poisson bracket in quantum mechanics Lagrange bracket ,Relation in Lagrange and poisson bracket, Liouvilies Theorem.

Galilean transformation(GT), Invariance of Newton's laws and laws of conservation of linear momentum and kinetic energy under GT. Michelson Morley experiment, postulates of special theory of relativity, Lorentz transformation, length contraction ,time dilation, Velocity transformation, relativistic mass and momentum, mass energy relation.

(8)

Books:

1. Classical Mechanics- H Goldstein (Narosa)
2. Classical Mechanics-Rana And Joag (TMH)
3. Introduction to Classical Mechanics- Takwale & Purnaik(TMH)
4. Mechanics- K R Simon (Addision Wesley)
5. Mechanics-D. S Mathur (S. Chand)
6. Properties of matter- Searle and Neaman (Arnold Publication)
7. Classical Mechanics- M. Das , P.K Jena (Sri krishna Publication)
8. Classical Mechanics- Kibble
9. Introduction to special theory of relativity by Resnick

FPYC-102 HEAT AND THERMODYNAMICS

Unit-I

Thermodynamical system , Principles of thermodynamics , concept of thermodynamic state , Zeroth law of thermodynamics , work done in isothermal and isobaric processes, Heat and work ,Free energy and their application, internal energy function and the first law of thermodynamics , application to various processes , C_P - C_V , Equation of state for adiabatic process, work done in adiabatic process , Equations of state.

Ideal gases and their PVT relations, Gas mixtures.

Unit-II

Maxwell- Boltzmann formula for distribution of molecular speed (statement of formula and discussion), Average RMS and most probable speed, Mean free path, Degrees of freedom, The principle of equipartition of energy, The Vanderwaals equation of state, Evaluation of critical constants,

Unit-III

Zeroeth law of thermodynamics, Heat capacity, Second law of thermodynamics, Carnot's engine, Carnot theorem, The thermodynamic scale of temperature, Entropy, entropy change in reversible and irreversible processes, mathematical formulation of second law, Maxwell's relations, first TdS equation, second TdS equation, Phase change, Clausius-Clapeyron equation

Unit-IV

Thermal conductivity, Conduction along a uniform bar, rectilinear flow of heat, Experimental determination of Thermal conductivity (Ingen-Hausz's method).

Blackbody radiation, Emissive and absorptive power, Kirchoff's law, Stefan-Boltzmann's law, Energy distribution in the blackbody spectrum, Wein's law and Rayleigh-Jean's law (Statement of formula and discussion). Planck's radiation formula, derivation of Rayleigh-Jean's formula, Wein's formula and Stefan-Boltzmann law using Planck's formula.

Books:

1. Heat and thermodynamics- Zemansky And Dittman (Mc Graw Hill)
2. Heat and thermodynamics- A. B Gupta , H. Ray (New Age)
3. Advance textbook of heat- P.K Chakraborty (Hindustan Publication)
4. A treatise on heat – Saha And Srivastava (The Indian Press)
5. Heat and thermodynamics- D. S Mathur.

FMCE107	**Math –I**	**3-0-0**	**3**

Module-I : (14 Hours)

Basic Concepts of Differential Equation: Origin and Classification of Differential equation, Solution of Differential Equation, Kinds of solution, Initial and Boundary value problem, Existence and uniqueness of solution, Formation of Differential equation. **First Order First Degree Equation:** Variable separable, Homogenous Equation, Exact Differential equation, Integrating Factors, Linear equations, Equation reducible to linear form.

Equations of First order but of Higher Degree : Equations solvable for p, Equation solvable for y, Equation solvable for x,

Module-II : (14 Hours)

Linear Equations with Constant coefficient : Linear differential equation of nth order, Homogenous Linear equation with constant coefficient, Non- Homogenous Linear equation with constant coefficient, Operators and its use to solve linear differential equations with constant coefficient, Method of Variation of Parameter, Linear Differential Equation with variable coefficient: Method of reduction of order, method based on the removal of the first derivatives.

Existence and Uniqueness of solution: Picard's method of successive Approximation, Existence and uniqueness Theorem.

Module-III : (12 Hours)

Series Solution and special function: Power series, Radius of convergence of power series, Ordinary point, singular point and regular singular point(only definition), Series solution about an ordinary point, Legendre equation and Legendre polynomial, Orthogonality, Power series method about singular point, Bessel 's equation and Bessel's function, Orthogonality in Bessel function. Boundary value problem for Ordinary Differential Equation; Sturm –Liouville Problems.

Text Books:

1. A Course on Ordinary and Partial Differential Equation by J. Sinha Roy, S Padhy, Kalyani Publisher.

Chapters:1(1.1-1.4),2(2.1-2.7),3(3.1-3.4)4(4.1-4.6),6(6.1,-6.3),7(7.1,7.2,7.3(7.3.1),7.4(7.4.1)),10 (10.1,10.2).

Reference Books:

1. Ordinary Differential Equation by P C Biswal (Pub- PHI)

FCYE108	Chemistry –I	3-0-0	3

Gaseous state: Postulates of Kinetic theory of gases, derivation from ideal behavior, van der walls equation of state. Critical phenomena: PV isotherm of real gases, continuity of states, the isotherms of van der walls equation, relationship between vanderwals constant and critical constants, the law of corresponding states, reduced equation of state **[5hrs]**

Liquid state: Intermolecular forces, structure of liquids (qualitative description), liquid crystals: difference between liquid crystal, solid and liquid. **[2hrs]**

Solid state: space lattice and unit cell. Qualitative description of X-ray diffraction in crystals. Derivation of Braggs eqn., **[2hrs]**

Atomic structure: de-Broglie matter waves, Uncertainty principle, Schrodinger wave equation, quantum numbers and its significance, shape of s, p, d orbitals, electronic configuration of elements. **[3hrs]**

Periodic properties: Screening effect, effective nuclear charge, size of atoms and ions, ionization potential, electron affinity, electronegativity, variable valency and oxidation states, horizontal, vertical and diagonal relationship. **[4hrs]**

Chemical bonding: Ionic bond, polarizability, Fajan's rule , lattice energy and Born- Haber cycle, solvation energy and solubility of ionic compounds, **[3hrs]**

Covalent bond: Lewis theory, dipole moment and its application, percentage ionic character from dipole moment and electronegativity, VBT, hybridization,VSEPR theory, MOT(homo and heteronuclear diatomic molecule), Resonance **[5hrs]**

Metallic bond(free electron and band theories) H-bond, Vanderwaals force. **[3hrs]**

FHMF109	Communicative English	2-0-0	2

Module-I

The elements of communication **[6 hrs]**

1.1 the importance of communication through English at the present time

1.2 the process of communication and factors that influence communication : sender, receiver, channel, code, topic, message, context, feedback, 'noise', filters and barriers

1.3 the importance of audience and purpose

1.4 the information gap principle : given and new information ; information overload

1.5 verbal and non-verbal communication : body language

1.6 comparing general communication and business communication

Module-II The sounds of English **[14 hrs]**

2.1 vowels, diphthongs, consonants, consonant clusters

2.2 the International Phonetic Alphabet (IPA) ; phonemic transcription

2.3 problem sounds

2.4 syllable division and word stress

2.5 sentence rhythm and weak forms

2.6 contrastive stress in sentences to highlight different words

2.7 intonation : falling, rising and falling-rising tunes

2.8 varieties of Spoken English : Standard Indian, American and British (Note : This unit should be taught in a simple, non-technical manner, avoiding technical terms as far as possible.)

Module-III

Review of English grammar **[10 hrs]**

3.1 stative and dynamic verbs

3.2 the auxiliary system ; finite and non-finite verbs

3.3 time, tense and aspect

3.4 voice: active and passive

3.5 modality

3.6 negation

3.7 Interrogation ; reported and tag questions

3.8 conditionals

3.9 concord

3.10 Phrasal verbs (Note The teaching of grammar should be treated as a diagnostic and remedial activity and integrated with communication practice. The areas of grammar in which errors are common should receive special attention when selecting items for review. Teaching need not be confined to the topics listed above.))

Essential readings:

1. An Introduction to Professional English and Soft Skills by B.K.Das et al., Cambridge University Press.

FBEF111	Fundamentals of computers & Programming in C	3-0-0	3

Module-I :(10 Hours)

Digital Logic Fundamentals: Logic Gates, Introduction to Multiplexer, De-multiplexer, Encoder, Decoder & Flip-Flops.

Introduction to Computer Fundamentals: Basic architecture of computer, Functional units, Operational concepts, Bus structures, Von Neumann Concept. Instruction code, Instruction set, Instruction sequencing, Instruction cycle, Instruction format, Addressing modes, Micro instruction, Data path, Hardwired controlled unit, Micro programmed controlled unit.

Generation of Programming languages, Compiler, Linker, Loader

Module-II :(10 Hours)

C language fundamentals: Character set, Key words, Identifiers, data types, Constants and variables, Statements, Expressions, Operators, Precedence and associativity of operators, Side effects, Type conversion, Managing input and output

Control structures: Decision making, branching and looping.

Arrays: one dimensional, multidimensional array and their applications, Declaration, storage and manipulation of arrays

Strings: String variable, String handling functions, Array of strings

Functions: Designing structured programs, Functions in C, Formal vs. actual arguments, Function category, Function prototype, Parameter passing, Recursive functions.

Storage classes: Auto, Extern, register and static variables

Module-II :(10 Hours)

Pointers: Pointer variable and its importance, pointer arithmetic and scale factor, Compatibility, Dereferencing, L-value and R-value, Pointers and arrays, Pointer and character strings, Pointers and functions, Array of pointers, pointers to pointers, Dynamic memory allocation

Structure and union: declaration and initialization of structures, Structure as function parameters, Structure pointers, Unions.

File Management: Defining and opening a file, Closing a file, Input/output Operations in files, Random Access to files, Error handling

Text Books:

1. William Stalling , " Computer Organization and Architecture "Pearson Education

Balagurusamy : "C Programming" Tata McGraw-Hill

Reference Books:

J. P. Hayes "Computer Architecture and Organization" McGraw Hill Education India.

H. Schildt – "C the complete Reference" McGraw-Hill

K.R. Venugopal, S.R. Prasad, " Mastering C, McGraw-Hill Education India

CORE PRACTICAL

FPYC-151MECHANICS & THERMAL PHYSICS

1. Determination of accurate weight of a body using balance by Gauss method.
2. Determination of specific heat of liquid by the method of cooling.
3. Determination of velocity of sound by resonance column method.
4. Acceleration due to gravity by bar pendulum and study of the effect of Amplitude on timeperiod.
5. Acceleration due to gravity by Kater's pendulum.
6. Specific heat of a conducting solid by method of mixture (using radiation Correction.)
7. Verification of laws of vibration of string using sonometer.
8. Determination of Young's modulus of wire by Searle's method.
9. Determination of rigidity modulus of rod by static method.
10. Refractive index of water using travelling microscope.
11. Determination of surface tenson of water by using capillary rise method.
12. Refractive index of glass using travelling microscope.

FCYE158	Chemistry Lab -I	0-0-3	2

1. Qualitative analysis of mixture of inorganic substances containing four ions (including anions like phosphate, fluoride and mixture of anions like carbonate, sulfite, sulfide, nitrate, chloride, bromide, phosphate, arsenate, nitrate, iodate and sulfate and cations of qualitative groups I, II, III, IV, V and VI)
2. To determine the specific reaction rates of the hydrolysis of the esters by H+ ion at room temp.
3. To study the effect of acid strength on hydrolysis of the esters
4. To study kinetically the reaction rate of iodide-H_2O_2 reaction
5. To study the distribution of iodine between water and CCl_4
6. To study the distribution of benzoic acid between water and benzene.

FHMF159	Communicative English Lab	0-0-3	2

Lab sessions will be devoted to practice activities based on all three modules of theory.

a. phonemic transcription

Students will be trained to find out the correct pronunciation of words with the help of a dictionary, to enable them to monitor and correct their own pronunciation. i transcription of words and short sentences in normal English orthography (writing) into their IPA equivalents ; ii transcription of words presented orally ; iii conversion of words presented through IPA symbols into normal orthography iv syllable division and stress marking (in words presented in IPA form)

b. Listening

i listening with a focus on pronunciation (ear-training) : segmental sounds, stress, weak forms, intonation Students should be exposed, if possible, to the following varieties of English during listening practice : Standard Indian, British and American.

c. Speaking

i pronunciation practice (for accent neutralization), particularly of problem sounds, in isolated words as well as sentences ii practising word stress, rhythm in sentences, weak forms, intonation ii reading aloud of dialogues, poems, excerpts from plays, speeches etc. for practice in pronunciation

d. Grammar and usage

The focus will be on the elimination of common errors. Some writing activities (e.g. writing of short paragraphs on assigned topics) can be used to identify these errors. Project Work Students will be required to produce and submit by the end of Semester 1 a 350-500 word project report on a topic of their choice. The project should involve data collection, analysis and reporting.

FBEF161	Programming in C lab	0-0-3	2

Experiment No. 1

a) Write a C program to find the sum of individual digits of a positive integer.

b) A Fibonacci sequence is defined as follows: the first and second terms in the sequence are 0 and 1. Subsequent terms are found by adding the preceding two terms in the sequence. Write a C program to generate the first n terms of the sequence.

c) Write a C program to generate all the prime numbers between 1 and n, where n is a value supplied by the user.

Experiment No. 2

a) Write a C program to calculate the following Sum:

Sum=1-x2
/2! +x4
/4!-x6
/6!+x8
/8!-x10/10!

b) Write a C program to find the roots of a quadratic equation.

Experiment No. 3

a) Write C programs that use both recursive and non-recursive functions

i) To find the factorial of a given integer.
ii) To find the GCD (greatest common divisor) of two given integers.
iii) To solve Towers of Hanoi problem.

Experiment No. 4

a) Write a C program to find both the larges and smallest number in a list of integers.

b) Write a C program that uses functions to perform the following:

i) Addition of Two Matrices
ii) Multiplication of Two Matrices

Experiment No. 5

a) Write a C program that uses functions to perform the following operations:

i) To insert a sub-string in to given main string from a given position.
ii) To delete n Characters from a given position in a given string.

b) Write a C program to determine if the given string is a palindrome or not

Experiment No. 6

a) Write a C program to construct a pyramid of numbers.

b) Write a C program to count the lines, words and characters in a given text.

Experiment No.7

a) Write a C program that uses functions to perform the following operations:

i) Reading a complex number
ii) Writing a complex number
iii) Addition of two complex numbers
iv) Multiplication of two complex numbers

(Note: represent complex number using a structure.) 21

Experiment No. 8

a) Write a C program which copies one file to another.

b) Write a C program to reverse the first n characters in a file.

(Note: The file name and n are specified on the command line.)

Book:- PVN. Varalakshmi, Project Using C Scitech Publish

1st Semester (Pass course)

FPYE-106 MECHANICS AND WAVES (Pass)

Unit-I

Motion of a system of particles: centre of mass, velocity, acceleration, momentum, Equation of motion, Kinetic energy and angular momentum of centre of mass. Conservation of linear momentum and angular momentum for system of particles, moment of inertia, parallel axis theorem perpendicular axis theorem. Moment of inertia of cylinder and sphere. Rotational kinetic energy and power, g by compound pendulum (bar pendulum).Gravitational force, field potential energy and potential, gravitational potential and field at a point due to a thin spherical shell and a solid sphere. (10)

Unit-II

Central force motion, reduction of two body problems into an equivalent one body problem, general characteristics of central force motion. Derivation of Kepler's laws of planetary motion from gravitational force.

UNIT-III

Relation between elastic constants. Torsion of a cylinder, bending of beams, expression for bending moment, equation for bending, depression occurring at nth e free ends of a light, heavy cantilever. Viscosity of liquids, laminar flow through a narrow tube and poisseuille's formula surface tension-pressure difference across curved membrane. (12)

Unit-IV

OSCILLATION AND WAVES

Simple harmonic oscillator,damped harmonic oscillator,power loss,Q-factor,overdamped motion,critical damping,forced vibration,resonance,sharpness of resonance.Mathematical description of travelling waves,wave equation.Tansverse waves in a stretched string longitudinal waves in a gaseous medium,composition of simple harmonic waves.Lissajous figures. (8)

Books:

1. Classical Mechanics- H Goldstein (Narosa)
2. Classical Mechanics-Rana And Joag (TMH)
3. Introduction to Classical Mechanics- Takwale & Purnaik(TMH)
4. Mechanics- K R Simon (Addision Wesley)
5. Mechanics-D. S Mathur (S. Chand)
6. Properties of matter- Searle and Neaman (Arnold Publication)
7. Classical Mechanics- M. Das , P.K Jena (Sri krishna Publication)
8. Classical Mechanics- Kibble

FPYE-156MECHANICS,THERMAL PHYSICS(PASS PRACTICAL)

1. Determination of accurate weight of a body using balance by Gauss method.
2. Determination of specific heat of liquid by the method of cooling.
3. Determination of velocity of sound by resonance column method.
4. Acceleration due to gravity by bar pendulum and study of the effect of Amplitude on timeperiod.
5. Acceleration due to gravity by Kater's pendulum.
6. Specific heat of a conducting solid by method of mixture (using radiation Correction.)
7. Verification of laws of vibration of string using sonometer.
8. Determination of Young's modulus of wire by Searle's method.
9. Determination of rigidity modulus of rod by static method.
10. Determination of surface tenson of water by using capillary rise method.

2nd Semester (theory)
FPYC-201 ELECTROMAGNETISM

Unit-I

Electromagnetic induction and transient current: Motional emf and flux rule, Faraday's law of electromagnetism induction, Faraday's law in integral and differential forms, Calculation of induced electric field due to an infinite long wire carrying a slowly varying current, Self inductance and mutual inductance, Self inductance of a solenoid and of a straight conductor, energy stored in an inductor in the electromagnetism field, Transient currents, Growth and Decay of current in series R-L, R-C and RLC circuits.

Unit-II

Coulomb's law, electric field, field at a point due to (electric dipole), discrete charge distribution and continuous charge distribution, flux of electric field, Gauss' law of electrostatics, field due to linear, spherical and cylindrical charge distribution curl of electrostatic field, Electrostatic potential, Gauss law in magnetism, Ampere's circuital law and its modification.

Unit-III

Alternating currents, Power in ac circuits, Wattless current, Series and Parallel resonant circuits, Sharpness of resonance, Q-factor.

Maxwell's equations, Displacement current and their physical significance, Maxwell's equations inside matter, Boundary conditions, Scalar and Vector potentials, Gauge transformation, Coulomb gauge and Lorentz Gauge, Lorentz force law in potential form, Electromagnetic waves, Poynting's theorem.

Unit-IV

Electromagnetic waves:Electromagnetic waves in non conducting media, the wave equation, Monochromatic waves in vacuum, Energy and momentum of electromagnetic waves, Propagation through linear media, Reflection and transmission at normal incidence, and at oblique incidence, Plane electromagnetic waves in conductors, The modified wave equation, Monochromatic plane waves in conducting media, Reflection and transmission at conducting surface (normal incidence).

Books:

1. Introduction to Electrodynamics- D. J Griffiths (PHI)
2. Foundation of electromagnetic theory- Ritz and Milford (Narosa)
3. Electricity and magnetism- E. Purcell (Berkely Physics Course) TMH
4. Electronics- Chattopadhyay& Rakshit (New Age)
5. Electronics- B. B Swain
6. Electricity and magnetism- D. C Tayal
7. Electricity and magnetism- Satyaprakash

FPYC-202Optics(Geometrical & physical)

Unit-I

Geometrical Optics: Introduction,Cardinals points, Cardinals points of two thin lenses separated by a distance, Nodal points and Nodal planes, Ramsdens and Huygens eyepiece.

Unit-II

Interference: Coherent sources, division of wave front, Biprism,Interference in thin film due to reflected and transmitted light, Newton's ring by reflected light, determination of wavelength of light by Newton's rings experiment, Michelson interferometer – construction, measurement of wavelength**.** Febry-perot interferometer experiment and determination of wavelength (10)

Unit-III

Diffraction: Introduction, Fresnel's half period zones and rectilinear propagation of light, zone plates, diffraction due to straight edge. Fraunhoffer diffraction, single slit and transmission grating. (5)

Resolving power-Rayleigh's power,limit of resolution of eye,resolving power of optical instruments, resolving power of telescope,resolving power of microscope, resolving power of a plane transmission grating. (5)

Unit-IV

Polarisation : Polarized and non polarized light.Polarization by reflection refraction and scattering, Brewster's law, Malus law, double refraction, ordinary and extra-ordinary rays,Nicol prism.,Production of elliptically polarised light,Production of circularly polarised light, Babinet compensator, half wave and quarter wave plate, Laurent polarimeter,optical rotation,specific rotation,Freshnel's explanation,Biquartz,PhotoelasticityElectro-optic effect,magneto-optic effect. (10)

Books:

1. Fundamental of optics- Jenkins ,White (Mc Graw Internationl series)
2. Optics- Ghatak (TMH)
3. Principles of Optics- B. K Mathur
4. Geometrical and Physical Optics- R.S Longhurst
5. Optics- Brij Lal Subramaniam
6. Geometrical and Physical Optics- P. K Chakrabarty
7. Optics- Eugene Hecht (Addision Wesley)
8. Optical Physics- Stephen G. Lipson, Henry Lipson& D.S Tannhauser (Cambridge University Press)

FMCE207	**Math-II**	**3-0-0**	**3**

Module I : (12 Hours)

Bounded and unbounded sets, Infimum and Supremum of a set and their properties, Order completeness property of R, Archimedian property of R, Density of rational and irrational numbers in R.

Neighbourhood, Open set, Interior of a set, Limit point of a set, Closed set, Countable and uncountable sets, Derived set, closure of a set, Bolzano- Weierstrass theorem for sets.

Sequence of real numbers, Bounded sequence, limit points of a sequence, limit interior and limit superior convergent and non-convergent sequences, Cauchy's sequence, Cauchy's general principle of convergence

Module II : (12 Hours)

.Infinite series and its convergence, Test for convergence of positive term series, Comparison test, Ratio test, Cauchy's root test**.**

Preliminary Notations, Group Theory **:** Algebraic structures, Groups, Some Examples of Groups, Subgroups, A Counting Principle, Cosets, Normal Subgroups and Quotient Groups,

Module III: (12 Hours)

Group Homomorphisms, Isomorphisms, Automorphisms, Permutation Groups.

RingTheory : Definition & Example of Rings,Some Special Classes of Rings.

TEXT BOOKS:

1.G. Das & S. Pattnaik : Fundamentals of Mathematical Analysis, TMH

2.Topics In Algebra, by I. N. Herstein, Wiley Eastern.

Ch. 1, Ch. 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.10, Ch. 3.1, 3.2, 3.3, 3.4

REFERENCE BOOKS:

1.. R. G. Bartle and D.R. Sherbert, Introduction to Real Analysis (4^{th} Edition), Wiley. 2.. K. A. Ross, Elementary Analysis: The Theory of Calculus, Under graduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004.

3. Sudhir R Ghorpade and Balmohan V. Limaye, A course in Calculus and Real Analysis, Undergraduate Text in Math., Springer (SIE). Indian reprint, 2004.

4. Modern Algebra by A. R. Vasishtha,Krishna PrakashanMandir, Meerut.

5.Topics in Algebra by P.N.Arora, Sultan Chand & Sons.

FCYE208	Chemistry -II	3-0-0	3

NomenclatureofOrganicmolecules: Briefrevision, Nomenclatureofpolycycliccompounds includingbridged, spiroand other special structures.**[2hrs]**

StructureandBonding: Nature of bonding in aliphatic, aromatic compounds; Aromaticity in benzenoid and non-benzenoid compounds. InductiveandFieldeffects,Resonance;hyperconjugation,structuraleffectson acidityand basicity.**[3hrs]**

Types of reagents-Electrophiles , nucleophiles,ReactiveIntermediates-Carbocations;carbanions; freeradicals,radicalanionsandcations;(Introduction tostructure, stability, and reactions).**[3hrs]**

Stereochemistry: Conformational analysisofacyclicsystemsandcyclohexanesystems, axial and equatorial bonds,conformation of monosubstituted cyclohexane, Introductionofterminologiessuchaserythro,threo,exo, endo, epimers,etc.Optical isomerism(in compounds containing more than onechiralcentre,in biphenyls,allenesandspirocompounds.),resolution of enantiomers, inversion, racemisation and retention

Relative and absolute configuration, sequence rule,D,L and R,S systems of nomenclature

Geometric isomerism: determination of configuration (cis, trans and E,Z),oximes and alicyclic compounds. **[5hrs]**

Reaction mechanism: Substitution reaction: Aliphaticsubstitutions: SN1, SN2, reactions;Free radicalsubstitutions ,electrophilicaromatic substitution(idea only); addition reaction (addition of H2, X2,HX type), markownikoff and anti-markownikoff addition,Eliminations:E1,E2, **[6hrs]**

Chemical Kinetics and catalysis: Rates of reactions, factors influencing rates of reaction-conc., temp, press, solvent, light, catalyst. (Arrehenius eqn. concept of activation energy), collision theory of reaction rates, Order and molecularity, mathematical characteristics of simple chemical reactions-zero order, first order, second order, pseudo order, half and mean life. Determination of the order of reaction (differential method, half life period method,method of isolation and integration)

Catalysis: characteristic of catalysed reactions, classification of catalysis

[10hrs]

FHMF209	Business Communication English	2-0-0	2

Module – I

The Elements of Business Communication (10 hours) 1.1 patterns of communication in the business world: upward, downward, horizontal, grapevine etc 1.2 internal and external channels of communication; formal and informal channels. 1.3 Introduction to cross-cultural communication. 1.4 avoiding gender, racial and other forms of bias in communication 1.5 common forms of oral and written communication in the business world: Oral presentations, interviews and group discussions Memos, reports, summaries and abstracts, e-mails

Module-II

Reading and writing (15 hours) 2.1 the importance of developing reading skills 2.2 the sub-skills of reading : a. understanding the main idea and supporting details b. reading between the lines : inferential reading c. understanding the writer's point of view d. making predictions e. guessing the meanings of unfamiliar words f. skimming and scanning g. note-making 2.3 the importance of writing skills 2.4 the differences between speech and writing 2.5 the qualities of effective writing : coherence, cohesion, logical structuring and organization, clarity of language, stylistic variation etc. 2.6 the writing process : pre-writing, drafting, re-writing 2.7

Module –III

Soft skill development (5 hours) 4.1 soft skills: becoming a good leader and team-player 4.2 inter-relating soft skills and communication skills

Text Books:

1. Business Communication Today by Bovee et al (Pearson)
2. Business Communication by Meenakshi Raman and Prakash Singh (Oxford)

RecommendedBooks :

1. Crash Course in Personal Development by Brian Clegg (Kogan Page)
2. Activities for Developing Emotional Intelligence by Adele B.Lynn (HRD Press)
3. Lateral Thinking by Edward De Bono (Penguin)

FBEF211	OOPS using C++	3-0-0	3

Module I

Introduction to object oriented programming, user defined types, structures, unions, polymorphism, encapsulation. Getting started with C++ syntax, data-type, variables, strings, functions, default values in functions, recursion, namespaces, operators, flow control, arrays and pointers.

Module II

Abstraction mechanism: Classes, private, public, constructors, destructors, member data, member functions, inline function, friend functions, static members, and references.

Inheritance: Class hierarchy, derived classes, single inheritance, multiple, multilevel, hybrid inheritance, role of virtual base class, constructor and destructor execution, base initialization using derived class constructors.

Polymorphism: Binding, Static binding, Dynamic binding, Static polymorphism: Function Overloading, Ambiguity in function overloading, Dynamic polymorphism: Base class pointer, object slicing, late binding, method overriding with virtual functions, pure virtual functions, abstract classes.

Operator Overloading: This pointer, applications of this pointer, Operator function, member and non member operator function, operator overloading, I/O operators.

Exception handling: Try, throw, and catch, exceptions and derived classes, function exception declaration.

Module III

Dynamic memory management, new and delete operators, object copying, copy constructor, assignment operator, virtual destructor.

Template: template classes, template functions.

Namespaces: user defined namespaces, namespaces provided by library.

Essential readings:

1. Object Oriented Programming with C++ - E. Balagurusamy, McGraw-Hill Education (India)
2. ANSI and Turbo C++ - Ashoke N. Kamthane, Pearson Education
3. Big C++ - Wiley India
4. C++: The Complete Reference- Schildt, McGraw-Hill Education (India)
5. C++ and Object Oriented Programming – Jana, PHI Learning.
6. Object Oriented Programming with C++ - Rajiv Sahay, Oxford

Practical

FPYC-251 Electrical Lab

1. Determination of magnifying power of a telescope.
2. Resistance of a resister using meter bridge (applying end correction)
3. Determination of a resistor high resistance using Galvanometer.
4. Charging and discharging of a capacitor through resister.
5. Reduction factor of tangent Galvanometer.
6. Figure of merit of a moving coil Galvanometer.
7. Calibration of millimeter.
8. Calibration of meter bridge wire.
9. Calibration of Platinum resistance thermometer.
10. Calibration of thermocouple.
11. Resistance of a galvanometer by Kelvin's method.
12. Comparison of emf by stretched wire potentiometer.

FCYE258	Chemistry Lab -II	0-0-3	2

To determine the percentage composition of a given mixture(non-reacting system) by viscosity method.
To determine the viscosity of amyl alcohol in water at different concentrations and calculation of excess viscosity of these solutions
To determine the percentage composition of a given binary mixture (acetone and ethylmethyl ketone) by surface tension method.
Estimation of Ca^{2+} and Mg^{2+} by EDTA
Determination of pH of a buffer solution
Determination of viscosity of a lubricating oil.
Determination of flash and fire point of an oil by Pensky-Marten apparatus.
Determination of concentration of a coloured solution by a spectrophotometer.

FHMF259	Business Communication English Lab	0-0-3	2

a. Communication Practice 30 hours i Speaking : oral communication in social and 10 hours work-related situations, e.g.: Greeting an acquaintance/ friend, introducing oneself, introducing a friend to another friend, breaking off a conversation politely, leave-taking; making and responding to inquiries; expressing an opinion; expressing agreement/ disagreement, contradicting/ refuting an argument; expressing pleasure, sorrow, regret, anger, surprise, wonder, admiration, disappointment etc. Narrating or reporting an event; Describing people, objects, places, processes etc. Ordering / directing someone to do something Making requests; accepting / refusing a request Expressing gratitude; responding to expressions of gratitude Asking for or offering help; responding to a request for help Asking for directions (e.g. how to reach a place, how to operate a device etc.) and giving directions asking for and granting/ refusing permission prohibiting someone from doing something suggesting, advising, persuading, dissuading, making a proposal praising, complimenting, felicitating expressing sympathy (e.g. condolence etc.) Complaining, criticizing, reprimanding ii Reading 10 hours Students will be given practice in reading and comprehending 6-8 simple passages of 100-300 words each, on topics of general as well as professional interest. The texts will be supported by suitable exercises designed to foster comprehension skills and vocabulary enrichment, together with study skills (note making) and reference skills (using a dictionary). Practice will be provided in the important sub-skills of reading which are introduced in Module 2 of the theory component. iii Writing 10 hours Writing short paragraphs on given topics or topics of one's choice; social and business letters; reports; applications ; resumes ; summaries The principles of 'Process Writing' should be used to teach writing skills. i pre-writing : generating ideas, brain-storming, idea mapping, outlining ii writing : generating a first draft ; reviewing, redrafting, editing iii post-writing : making a presentation ; discussion and feedback, preparing the final draft b. Soft skills practice 10 hours Activities designed to highlight leadership and 'team' skills ; Group discussion

FBEF261	**OOPS using C++ Lab**	**0-0-3**	**2**

1. Programs on concept of classes and objects
2. Programs using inheritance
3. Programs using static polymorphism
4. Programs on dynamic polymorphism
5. Programs on operator overloading
6. Programs on dynamic memory management using new, delete operators
7. Programs on copy constructor and usage of assignment operator
8. Programs on exception handling
9. Programs on generic programming using template function & template class
10. Programs on file handling

2ND Semester (Pass Theory)

(Course for the students opting for mathematics and chemistry)

FPYE-206 Electricity, Magnetism and Electronics(Pass)

Unit-I

Scalar and vector triple product. Differentiation of a vector with respect to a scalar. The gradient operator. The divergence and curl of vector. Gauss divergence theorem, Strokes theorem. Gauss law in electrostatics and application, Computation of fiel due to linear spherical and plane charge distribution, Differential form of Gauss law, the energy of a point charge, discrete and continuous distribution,

Unit-II

energydensity,dielectrics,Susceptibility,permeability,dielectric constant.Magnetic field B,Lorentz force law,The Biot savart law B due to a straight, circular, and solenoidal currents. The vector potential, Ampere ' circuital law & its differential form. Differential form of electromagnetic induction. (12)

UNIT-III

Maxwell equation and physical significance. Wave equation, Electromagnetic waves.wave properties,speed,growth and decay current in RC and LR circuits. Phase diagram,impedance,Power in ac circuit,power factor, series and parallel resonant circuits, Sharpness of resonance, Bandwidth and Q-factor. (8)

UNIT-IV

Rectifier:Haif wave & full wave rectifier(semiconductor devices)Principle,circuit,operation & theory.Use of L & π filters in rectifier circuits(qualitative idea)Amplifier: Classification of amplifier,compairsion,Voltage & power gain inCB,CE &CC configuration.RC coupled amplifier, Class B Push/pull amplifier(principle of amplification circuit description operation, theory and frequency response curve)Necessary of feed back ,positive & negative feedback, criteria for sustained oscilation,Hartly and colpitt's oscillator(principle,circuit,operation,th eory and use),feedback Amplifier: Basic circuit,operation,advantage of negative feedback, Modulation & demodulation:Princple of modulation.A.m &F.M(Theory and differences between them).Principle of demodulation Function & basic theory of linear diode detectors.

(10)

Books:

1. Introduction to Electrodynamics- D. J Griffiths (PHI)
2. Foundation of electromagnetic theory- Ritz and Milford (Narosa)
3. Electricity and magnetism- E. Purcell (Berkely Physics Course) TMH
4. Electronics- Chattopadhyay& Rakshit (New Age)
5. Electronics- B. B Swain
6. Electricity and magnetism- D. C Tayal
7. Electricity and magnetism- Satyaprakash

FPYE-256 ELECTRICITY, MAGNETISM AND OPTICS (PASS PRACTICAL)

1. Determination of wavelength of sodium light by using Newton's ring method.
2. Determination of grating element of grating spectra.
3. Determination of wave length of Laser.
4. Determination of magnifying power of a microscope.
5. Determination of magnifying power of a telescope.
6. Determination of High resistance using Galvanometer.
7. Figure of merit of a Galvanometer.
8. Resistance of a resistor using meterbridge (applying end correction).
9. Determination of wavelength of a monochromatic light using Bi-prism and optical bench.
10. Determination of refractive index of a prism by I-D curve method using spectromethod.

THIRD SEMESTER THEORY

FPYC-301Classical Mechanics and special theory of relativity- II (HONS)

Unit-I

Central force motion, reduction of two body central force of motion into equivalent one body motion, general features of central force motion, differential equation of orbit, Kepler's laws of planetary motion, virial theorem, Unbound motion ,Rutherford scattering Centre of mass and Laboratory co-ordinates.

UNIT-II

Motion of a system of particles:- conservation of linear momentum ,angular momentum and total energy of a system of particles, Kinematics of rigid body motion, moment of inertia-parallel axes and perpendicular axes theorem, Rotational kinetic energy and angular momentum of rigid body about a fixed axis, Torque free motion of a rigid body.

Unit-III

Stable and unstable equilibrium, small oscillation about an equilibrium configuration, review of the one dimensional problem. Normal mode analysis of couple oscillator, properties of T,V &ω forced and damped oscillator, Normal co-ordinates, parallel pendulum, double pendulum. (4)

Unit-IV

Einstein's special theory of relativity- constancy of velocity of light as a postulate, Derivation of Lorentz transformation , Length contraction and time dilation, Mass energy relation, Doppler shift, Minkowski space-time diagram, 4-D space time continuum, Lorentz transformation as coordinate transformation.

REFERENCE:

1. Classical mechanics-GUPTA, KUMAR, SHARMA (Pragati prakashan)
2. Classical mechanics- H.Goldstein
3. Classical mechanics-J.C UPADHYA
4. Classical mechanics-Rana and Jog
5. Classical mechanics-Simon
6. Classical mechanics-Gupta, satyaprakash

FPYC-302FLUIDMECHANICS AND PROPERTIES OF MATTER

UNIT-I

Hydrostatics: Fluids, hydrostatic pressure, Pascal's law, principle of Archimedes, equilibrium of floating bodies, stability of equilibrium, determination of metacentric height, pressure due to a compressible fluid or gas, ,measurement of atmospheric pressure, correction of Barometer reading. (6)

UNIT-II

Flow of liquid and viscosity: Rate of flow of a liquid, energy of the liquid, Bernoulli's theorem and its applications, critical velocity, Poiseuille's equation for flow of liquid through a tube, Motion in a viscous medium , determination of coefficient of liquid , Stoke's method, variation of viscosity of a liquid with temperature. (7)

Unit-III

Surface tension: Molecular range, Sphere of influence, surface tension, surface film and surface energy, free energy of a surface, pressure difference across a liquid surface, Drops and Bubbles: excess pressure inside a liquid drop, excess pressure inside a soap bubble, determination of the surface tension of a bubble.(5)

UNIT-IV

Capillarity: Layer of liquid between two plates, Shape of liquid meniscus in a capillary tube, Angle of contact, measurement of angle of contact, rise of liquid in a capillary tube, energy required to raise a liquid in a capillary tube, raise of liquid between two parallel plates. (5)

Properties of matter: Stress and strain, Hook's law, three types of elasticity, Poisson's ratio, effect of a suddenly applied load, twisting couple on a cylinder, alternative expression for strain energy in terms of stress, Torsional pendulum , determination of moment of inertia with the help of a Torsional pendulum, bending of Beams, Bending moment, cantilever, transverse vibration of a loaded cantilever, Searle's method for comparison of young's modulus and coefficient of rigidity in a given material.(7)

REFERENCE:-

1. Properties of matter -FH. Newman V.H.L. Searle (Edward Arnold publication)
2. Properties of matter –D.S. Mathura(S.chand)
3. Mechanics –K.R. Symon(Addision Wesley)
4. Mechanics -D.S. Mathur(S.chand)

FMCE307	**Math –III**	**3-0-0**	**3**

MODULE-I (14 Hours)

Asymptotes in Cartesian coordinates, intersection of curve and its asymptotes, asymptotes in polar coordinates, curvature, radius of curvature for Cartesian curves, polar curves, Newton's method, centre of curvature, circle of curvature .

MODULE-II(13 Hours)

Points of inflexion, Multiple points, Cusp, Nodes & conjugate points, Types of cusps, Tracing of curves in Cartesian, Parametric, and Polar coordinates .Trace (Folium of Descartes, Strophoid, Astroid, Cycloid, Cardioids, Lemniscates of Bernoulli)

MODULE-III(13 Hours)

General equation of the Sphere, intersection of a sphere and a plane, intersection of two spheres, family of spheres, Intersection of a sphere and a line, Tangent plane ,condition of tangency, equation of a cone , Enveloping cone of a sphere ,cylinder, Enveloping cylinder of a sphere, Right circular cone & cylinder.

Essential readings:

1. Differential Calculus by Shanti Narayan & P K Mittal , S.Chand Publication Chapters: 14 (14.1-14.5), 15, 16, 17
2. Analytical Geometry of Quadratic Surfaces by B P Acharya & D C Sahu Chapters: 2 ,3
3. Analytical Solid Geometry by Shanti Narayan
4. Topics in Calculus by Panda Satapathy

FCYE308	**Chemistry -III**	**3-0-0**	**3**

Compounds containing active methylene groups: Introduction, Keto-enoltautomerism, acidic character of such compounds

Preparation and Application towards the synthesis of monocarboxylic acid, dicarboxylic acid, keto acids, ketones, diketones, Unsaturaed acids, heterocyclic compounds etc. of aceto acetic ester and malonic ester.

Organometallic Compounds:

Grignards' Reagent: Preparation, Reaction of compounds containing active hydrogen, carbonyl compounds, epoxides, carbon dioxide, nitriles, oxygen, sulphure, carbon disulphide, sulphure dioxide, iodine, inorganic halides, alkyl halides, □ □ □unsaturated carbonyl compounds.

Organolithium compounds: Preparation, Reaction of compounds containing active hydrogen, carbonyl compounds, alkenes, carbon dioxide, nitriles, electrophilic displacement, nucleophilic displacement, □ □ □unsaturated carbonyl compounds.

Heterocyclic Compounds: Introduction, Structure and aromaticity, Preparation and properties of Five membered Heterocyclic compounds(Pyrrole, Furan and Thiophene), Six membered Heterocyclic compounds(Pyridine) and fused Heterocyclic system(Quinoline)

FPYE-303 Organizational Behaviour

UNIT- I : (7)

The study of Organizational Behaviour : Definition and Meaning, Why Study OB

Learning – Nature of Learning, How Learning occurs, Learning and OB.

Foundations of Individual Behaviour : Personality – Meaning and Definition, Determinants of Personality, Personality Traits, Personality and OB.

UNIT II : (8)

Perception – Meaning and Definition, Perceptual Process, Importance of Perception in OB. Motivation – Nature and Importance, Herzberg's Two Factor Theory, Maslow's Need Hierarchy Theory, Alderfer's ERG Theory, Evaluations.Organizational Behaviour Process : Communication – Importance, Types, Gateways and Barriers to Communication, Communication as a tool for improving Interpersonal Effectiveness,

UNIT-III(7)

Groups in Organizations – Nature, Types, Why do people join groups, Group Cohesiveness and Group Decision-making Managerial Implications, Effective Team Building. Leadership-Leadership & Management, Theories of Leadership-Trait theory, Leader Behaviour theory, Contingency Theory, Leadership and Follower ship, How to be an effective Leader, Conflict-Nature of Conflict and Conflict Resolution. An Introduction to Transactional Analysis (TA).

UNIT-IV: (8)

Organization : Organizational Culture – Meaning and Definition, Culture and Organizational Effectiveness. Introduction to Human Resource Management-Selection, Orientation, Training and Development, Performance Appraisal, Incentives Organizational Change – Importance of Change, Planned Change and OB techniques. International Organisational Behaviour – Trends in International Business, Cultural Differences and Similarities, Individual and Interpersonal Behaviour in Global Perspective.

Text Books :

1. Keith Davis, Organisational Behaviour, McGraw-Hill.
2. K.Aswathappa, Organisational Behaviour, Himalaya Publishing House.

Reference Books :

1. Stephen P. Robbins, Organisational Behaviour, Prentice Hall of India
2. Pradip N. Khandelwal, Organizational Behaviour, McGraw-Hill, New Delhi.
3. Uma Sekaran, "Organizational Behaviour", TATA McGraw-Hill, New Delhi.
4. Steven L McShane, Mary Ann Von Glinow, Radha R Sharma" Organizational Behaviour" , TATA McGraw- Hill.
5. D.K. Bhattachayya, "Organizational Behaviour", Oxford University Press

FBEF -310 DATA STRUCTURE USING C AND C++

Unit – I [6 hours]

Introduction to data structures: storage structure for arrays, sparse matrices, Stacks and Queues: representation and application. Linked lists: Single linked lists, linked list representation of stacks and Queues. Operations on polynomials, Double linked list, circular list.

Unit – II [10 Hours]

Dynamic storage management-garbage collection and compaction, infix to post fix conversion, postfix expression evaluation. Trees: Tree terminology, Binary tree, Binary search tree, General tree, B+ tree, AVL Tree, Complete Binary Tree representation, Tree traversals, operation on Binary tree-expression Manipulation.

Unit –III [9 Hours]

Graphs: Graph terminology, Representation of graphs, path matrix, BFS (breadth first search), DFS (depth first search), topological sorting,

Unit-IV[5 Hours]

Warshall's algorithm (shortest path algorithm.) Sorting and Searching techniques – Bubble sort, selection sort, Insertion sort, Quick sort, merge sort, Heap sort, Radix sort. Linear and binary search methods, Hashing techniques and hash functions.

Text Books:

1. Gilberg and Forouzan: "Data Structure- A Pseudo code approach with C" by Thomson publication
2. "Data structure in C" by Tanenbaum, PHI publication / Pearson publication.
3. Pai: "Data Structures & Algorithms; Concepts, Techniques & Algorithms "Tata McGraw Hill.

Reference Books:

1. Fundamentals of data structure in C" Horowitz, Sahani & Freed, Computer Science Press.
2. "Fundamental of Data Structure" (Schaums Series) Tata-McGraw-Hill.

THIRD SEMESTER PRACTICAL

FPYC-351 (Mechanicsand thermal Lab – II)

1. Young's modulus by bending of beam by cantilever.
2. Coefficient of viscosity by viscometer.
3. Determination of viscosity of liquid by Poisuelies method.
4. Determination of Young's modulus,modulus of rigidity,and poissions ratio of material of a wire using Searles method.
5. Error analysis using vernier callipers,screw gauge and spherometer.
6. Specific resistance of the given material of the wire using carey foster bridge
7. Determination of g by Kater's pendulum
8. Determination of rigidity modulus of a wire by dynamic method.
9. Determination of surface tension of soap solution.
10. Specific heat of a liquid by method of cooling.
11. Mechanical equivalent of heat by Joule's calorimeter.
12. Velocity of sound by resonance column method
13. Temperature coefficient of surface tension by Jaeger's method .
14. Thermal conductivity of a bad conductor by lee's method.

FEBF-360 DATA STRUCTURE LAB

(Minimum 10 experiments to be done)

Experiment No.1

Write a C program to perform matrix multiplication using array.

Experiment No.2

(a) Write a C program to create a stack using an array and perform
(i) push operation (ii) pop operation

(b) Write a C program to create a queue and perform
i) Push ii) pop iii) Traversal

Experiment No. 3

Write a C program that uses Stack operations to perform the following:
i) Converting infix expression into postfix expression
ii) Evaluating the postfix expression

Experiment No. 4

Write a C program that uses functions to perform the following operations on Single linked list:
i) Creation ii) Insertion iii) Deletion iv) Traversal in both ways

Experiment No. 5

Write a C program that uses functions to perform the following operations on Double linked list:
i) Creation ii) Insertion iii) Deletion

Experiment No. 6

Write a C program that uses functions to perform the following operations on Binary Treei) Creation ii) Insertion iii) Deletion

Experiment No. 7

Write C programs that use both recursive and non recursive functions to perform the Linear search operation for a Key value in a given list of integers:
i) Linear search

Experiment No. 8

Write C program that use both recursive and non recursive functions to perform the Binary searchoperation for a Key value in a given list of integers:

Experiment No.9

Write a C program that implement Bubble Sort method to sort a given list of integers in descending order.

Experiment No.10

Write a C program that implement Quick Sort method to sort a given list of integers in ascending order:

Book:- "Data structure using C" by Sudipta Mukherjee, TMH Publication

FCYE358	**Chemistry Lab -III**	**0-0-3**	**2**

1. Acid-base titration using pH meter (only HCl)
2 Acid-base titration using pH meter (mixture, HCl and CH3COOH)
3. Acid-base titration using conductivity meter (only HCl)
4. Acid-base titration using onductivity meter (mixture, HCl and CH3COOH)
5. Determination of cell constant of a conductivity cell.
6. Determination of equivalent conductance at infinite dilution of a strong electrolyte.
7. Determination of critical micellar concentration(CMC) by using conductivity meter.

Third Semester (Pass Theory)
FPYE-306 Thermodynamics, Atomic Physics and Nuclear Physics

Unit-I

Thermodynamic system and thermodynamic equilibrium, Reversible and irreversible process ,internal energy, first law of thermodynamics, difference between molar specific heat of an ideal gas, Derivation of relation PV^{γ} =constant for adiabatic process, work done in isothermal and adiabatic process.Entropy change in various processes.T-S diagram, Carnot cycle , Carnot engine and its efficiency ,Carnot theorem, second law of thermodynamics-Kelvin plank and Clausius formulation, their quivalence, thermodynamic scale of temperature. (7)

Unit-II

Thermodynamic co-ordinates P.V.T and1st Tds equation, 2nd Tds equation . Clausius-Clapeyron equation, effect of pressure on melting point and boiling point,thermal conductivity,differential equation of heat flow in one dimension,experimental determination of of thermal conductivity by Ingen-Haus and Searl's method.

Vandewall's equation of state for real gases, critical constants, reduced equation of state.(7)

Unit-III

Black body radiation,Stefans law, energy distribution in the blackbody spectrum.

Wien' displacement law,Wein's formula and Rayleigh –jeans formula (only statement and discussion).Planck' radiation formula, derivative of Rayleigh-jeans formula.Wein's formula and Stefan Boltzmann law using Planck's formula.

Rutherford's atomic model and its short coming, Bohr's theory of hydrogen atom. Energy levels,explanation of

spectra,correction for nuclear motion,Bohr's correspondence principal.Frank-Hertz experiment, critical potential. Photoelectric effect, Photon,Einstein's photoelectric effect, photon ,Einstein's photoelectric equation, Compton effect. Particle nature of radiation.(8)

Unit-IV

The atomic nucleus:its size,mass,charge, spin,magnetic moment, Mass defect ,binding energy, stability of nuclear force-its characterstics,Radioactive decay law, activity decay law,activity,half-life, average life, elementary idea of nuclear fission and fusion. Linear accelerator,cyclotron. (8)

Reference

1. Heat and Thermodynamics-A.B.Gupta& H.B. Ray(New Central)
2. Sound-M.Ghosh (S.Chand)
3. Physics for degree students-vol-I, II, M.Das
4. Modern Physics-R.Murugeshan
5. Introduction to Modern physics-H.S. Mani, G.K. Mehta (Affiliated East West)
6.Atomic physics-G.P.Harnwerll & W.E. Stephens.Mc Graw-HILL book company,Inc.
7.Atomic and nuclear physics-Satyapraksh
8.Atomic and nuclear physics-Shatendra Sharma (pearson publication)
9.Atomic and nuclear physics-Gupta Ghosha

THIRD SEMESTER PASS PRACTICAL
FPYE-256 PROPERTIES OF MATTER AND HEAT

1. Young's modulus by bending of beam by cantilever.
2. Coefficient of viscosity by viscometer.
3. Determination of Young's modulus, modulus of rigidity, and poissions ratio of material of a wire using Searle's method.
4. Error analysis using vernier callipers, screw gauge and spherometer.
5. Specific resistance of the given material of the wire using Carey foster
6. Determination of g by Kater's pendulum
7. Determination of rigidity modulus of a wire by dynamic method.
8. Mechanical equivalent of heat by Joule's calorimeter.
9. Velocity of sound by resonance column method
10. Thermal conductivity of a bad conductor by lee's method.

FOURTH SEMESTER THEORY
FPYC-401MODERN PHYSICS

UNIT–I(7 HOURS)

Radioactivity and nuclear reactions: Introduction, radioactivity, exponential decay law, Beta decay and neutrino. Natural radioactive series, nuclear reactions, Accelerators: Van De Graph, Tandem, linear accelerator, cyclotron, Betatron.

UNIT-II(7 HOURS)

Lasers: purity of spectral line, coherence length and coherence time, Einstein's A and B coefficients, Types of emission, metastable state, population inversion, 3 and 4 level lasers and its application, ruby laser, He-Ne laser, semiconductor laser, uses of laser .

UNIT-III(8 HOURS)

Electron spin: Introduction, spin angular momentum, magnetic moments, Zeeman Effect, Spin magnetic moment, anomalous Zeeman effect, stark effect, fine structures, Magnetic Resonance Imaging.

UNIT-IV(8 HOURS)

Nano material: Introduction to nano materials, Basic principles of Nano science and technology, Fabrication of nano materials, Physical and chemical properties of nano materials, carbon nano tubes, application of nano technology.

Spectroscopy: IR and Raman spectroscopy, Photoemission and X-ray spectroscopy, Magnetic resonance.

Text Books

1. Modern physics, Arthur Beiser, TATA Mc graw Hill Edition
2. Modern physics for scientists and Enginners- John R. Taylor, Chris D. zafiratos, Michael A. Dubson. (Pearson)
3. Applied physics: P.K. palanisamy (Scitech)
4. Introduction to Nanotechnolgy- Charles P. Poole, Jr., Frank J. Owens (Wiley)
5. Atomic Molecular spectra and laser – Rajkumar.

FPYC-402 ELECTRONICS

UNIT-I(7)

Extrinsic andintrinsic semiconductors, p-type and n-type semiconductors, pn-junction as rectifier, half wave and full wave rectifiers (centre tap and bridge type), efficiency, ripple factor, filter circuits, types of filter circuits, Zener diode, equivalent circuit of Zener diode, Zener diode as voltage stabiliser, solving zener diode circuits, transistor as an amplifier, transistor connections and its characteristics, transistor load line analysis, operating point.

UNIT-II(7)

Single stage transistor amplifier with its practical circuit, phase reversal, D.C. and A.C. equivalent circuit, load line analysis of single stage transistor amplifier, multi-stage transistor amplifiers, role of capacitors in transistor amplifiers, gain, frequency response, decibel gain with its advantages and properties, band width, RC coupled amplifier, transistor audio power amplifier, classification of power amplifiersand efficiency comparison, push-pull amplifier.

UNIT-III(8)

Oscillatory circuit, un-damped oscillation from tank circuit, positive and negative feedback amplifier, criterion for sustained oscillation, Hartley and Colpitt's oscillator, phase shift oscillator, (Principle, Circuit operation, Theory and use)

UNIT -IV(8)

Modulation and demodulation: A.M. and F.M. Modulation index and its significance, Principle of demodulation –linear diode detector, Integrated circuits –advantages, fabrication of monolithic ICS, Digital electronics, binary and decimal number system. Logic gates AND, OR, NOT, NAND, NOR gates, truth table.

References:

1. Solid State Physics –C. Kittel (Wiley Eastern)
2. Solid State Physics –Srivastav
3. Fundamentals of electronics –Chattopadhyay, Rakshit
4. Integrated Electronics –Milkman and Halkias
5. Principles of Electronics –B.V.N Rao, Vol-I, Vol-II
6. Principles of Electronics –V.K. Meheta

FMCE407	**Math-IV**	**3-0-0**	**3**

MODULE-I(14 Hours)

Errors ,Algorithims and Convergence,Transcendental and polynomial equations: Introduction, Bisection method, Regula-falsi method, Secant method, Fixed Point iteration, Newton-Raphson method, Rate of convergence .Error Analysis for iterative methods,

System of Linear Algebraic Equations:Pivoting Strategies, Matrix inversion, LU-Decomposition , Gauss Jacobi, Gauss –Seidel Method , Relaxation Techniques.

MODULE-II(14 Hours)

Interpolation and Approximations: Introduction ,Langrages and Newton Interpolation, Least Square Approximation, Uniform Approximation.Differentiation .

MODULE-III(12 Hours)

Numerical Integration : Newton Cotes Algorithm, Trapezoidal rule, Simpson's rule, Gauss –Legendre Integration Method, Ordinary Differential Equations: Euler's Method ,Euler Modified Method, Runge -kutta Method.

Essential readings:

1. Numerical Mathematics and Computing : by W. Cheney, David Kincaid, Cengage.
2. Numerical Methods by B.P. Acharya & R.N. Das.
3. Numerical Methods for Scientific and Engineering Computation; M.K. Jain,S.R.K. Iyengar, R.K. Jain.
4. A Introduction to Numerical Analysisby K.Aitkinson ,Wiley

FCYE408	Chemistry -IV	3-0-0	3

Carbohydrates [08 Hrs]

Classification and nomenclature: Monosaccharides, mechanism of osazone formation, interconversion of glucose and fructose, chain lengthening and shortening of aldoses. Configuration of monosaccharides. Erythro and threo-diastereomers. Conversion of glucose into mannose.Formation of glycosides, ethers and esters. Determination of ring size of monosaccharides. Cyclic structure of D(+)-glucose . Mechanism of mutarotation.

Structure of ribose and deoxyribose.

An introduction to disaccharides (maltose, sucrose and lactose) and polysaccharides (starch and cellulose) without involving structure determination.

Coodination compounds [05Hrs]

Warner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes.

Electrochemistry [10 Hrs]

Types of reversible electrodes – gas-metal ion, metal-metal ion, metal-insoluble salt-anion and redox electrodes. Electrode reactions, Nernst equation, derivation of cell EMF and single electrode potential, standard hydrogen electrode- reference electrodes- standard electrode potential, sign conventions, electrochemical series and its significance.

Electrolytic and Galvanic cells – reversible and irreversible cells, conventional representation of electrochemical cells.

EMF of a cell and its measurements.Computation of cell EMF.Calculation of thermodynamic quantities of cell reactions (ΔG, ΔH and K), polarization, over potential and hydrogen overvoltage.

Concentration cell with and without transport, liquid junction potential, application of concentration cells, valency of ions, solubility product and activity coefficient, potentiometric titrations.

Definition of pH and pKa, determination of pH using hydrogen, quinhydrone and glass electrodes by potentiometric methods.

Buffers – mechanism of buffer action, Henderson – Hazel equation. Hydrolysis of salts. Corrosion types, theories and methods of combating it.

Solutions, Dilute Solutions and Colligative Properties [07 Hrs]

Ideal and non-ideal solutions, methods of expressing concentrations of solutions, activity and activity coefficient.

Dilute solution, colligative properties, Raoult's law, relative lowering of vapour pressure, molecular weight determination. Osmosis, law of osmotic pressure and its measurement, determination of molecular weight from osmotic pressure. Elevation of boiling point and depression of freezing point. Thermodynamic derivation of relation between molecular weight and elevation in boiling point and depression in freezing point. Experimental methods for determining various colligative properties.

Abnormal molar mass, degree of dissociation and association of solutes.

Essential readings:

1. J.D. Lee, Concise Inorganic Chemistry, 5th edition, Blackwell Publishing, 2008
2. Huheey, Keiter and Keiter, Inorganic chemistry Principle, structure and reactivity. 4Thedn
3. Inorganic Chemistry R.D.Madan, S.Chand Publication
4. Basic Inorganic Chemistry Cotton &Willikinson
5. P.W. Atkins and Julio de Paula, Elements of Physical Chemistry, Oxofrd University Press, 1992
6. Principles of Physical Chemistry by Puri, Sharma and Pathania, Vishal Publication Co
7. Principles of Bio-Chemistry – Lehinger, Nelson and Cox
8. Fundamentals of Bio-Chemistry – Voet&Voet
9. Bio-Chemistry by Zubay
10. Bio-Chemistry, Rastogi, Tata McGraw Hill

FHMF409 Economics

UNIT -I: (7 hours)

Economics – Nature and scope, General concepts on micro & macro economics. The Theory of demand, Demand function, Law of demand and its exceptions, Elasticity of demand, Law of supply and elasticity of supply, Determination of equilibrium price under perfect competition (Simple numerical problems to be solved), Theory of production, Law of variable proportion, Law of returns to scale.

UNIT -II: (8 hours)

Time value of money – Simple and compound interest, Cash flow diagram, Principle of economic equivalence. Evaluation of engineering projects – Present worth method, Future worth method, Annual worth method, internal rate of return method, Cost-benefit analysis in public projects.

UNIT -III(7 hours)

Depreciation policy, Depreciation of capital assets, Causes of depreciation, Straight line method and declining balance method. Banking: Meaning and functions of commercial banks; functions of Reserve Bank of India. Overview of Indian Financial system

UNIT -IV: (8 hours)

Cost concepts, Elements of costs, Preparation of cost sheet, Segregation of costs into fixed and variable costs. Break-even analysis-Linear approach. (Simple numerical problems to be solved)

Text Books:

1. Riggs, Bedworth and Randhwa, "Engineering Economics", McGraw Hill Education India.
2. D.M. Mithani, Principles of Economics. Himalaya Publishing House

Reference Books :

1. Sasmita Mishra, "Engineering Economics & Costing ", PHI
2. Sullivan and Wicks, " Engineering Economy", Pearson
3. R.Paneer Seelvan, " Engineering Economics", PHI
4. Gupta, " Managerial Economics", TMH
5. Lal and Srivastav, " Cost Accounting", TMH

FBEF410 RDBMS

UNIT I : (10 hours)
Database System Architecture - Data Abstraction, Data Independence, Data Definitions and Data Manipulation Languages.

UNIT:II
Data models - Entity Relationship(ER), Mapping ER Model to Relational Model, Network .Relational and Object Oriented Data Models, Integrity Constraints and Data Manipulation Operations.

UNIT III: (12 hours)
Relation Query Languages, Relational Algebra and Relational Calculus, SQL. Relational Database Design: Domain and Data dependency, Armstrong's Axioms, Normal Forms, Dependency Preservation, Lossless design. Query Processing Strategy.

UNIT IV: (8 hours)
Transaction processing: Recovery and Concurrency Control. Locking and Timestamp based Schedulers.
Database Recovery System: Types of Data Base failure & Types of Database Recovery, Recovery techniques .

Text Books:
(1) Database System Concepts by Sudarshan, Korth (McGraw-Hill Education)
(2) Fundamentals of Database System By Elmasari & Navathe- Pearson Education
References Books:
(1) An introduction to Database System – Bipin Desai, Galgotia Publications
(2) Database System: concept, Design & Application by S.K.Singh (Pearson Education)
(3) Database management system by leon &leon (Vikas publishing House).
(4) Fundamentals of Database Management System – Gillenson, Wiley India
(5) Database Modeling and Design: Logical Design by Toby J. Teorey, Sam S. Lightstone, and Tom Nadeau, "", 4th Edition, 2005, Elsevier India Publications, New Delhi

FOURTH SEMESTER PRACTICAL
FPYC-451 Electromagnetism and optics Lab

1. Transverse vibrations by Meldes' experiment.
2. Angle of minimum deviation (I-D curve) using spectrometer.
3. Determination of magnifying power of a microscope.
4. comparison of emf's using stretched wire potentiometer.
5. Coefficient of viscosity by oscillating disc method.
6. Temperature coefficient of surface tension by Jaegar's method .
7. Thermal conductivity of a bad conductor by lee's method.
8. Optical rotation of sugar solution by polarimeter.
9. Horizontal component of earth's magnetic field and magnetic moment of a magnet.
10. Determination of magnifying power of a telescope.
11.To study series and parallel resonant LCR circuit.
12. Figure of merit of a galvanometer.
13 To measure voltage and Frequency of a sinusoidal wave form using a CROand to find unknown frequency by producing Lissajous figure.
14. Resistance of a resister using Meter Bridge.

FCYE458	Chemistry Lab -IV	0-0-3	2

1. Detection of extra elements (N S and halogen),
2. Detection of functional groups containing C,H,O C,H,N in organic compounds
3. Determination of unknown organic compound
4. Organic preparations:
   a. Oxidation of ethanol/ isopropanol (Iodoform reaction).
   b. Hydrolysis of amides and esters.

FBEF461	RDBMS Lab	0-0-3	2

1. Use of SQL syntax: insertion, deletion, join, updation using SQL. (1 class)
2. Programs on join statements and SQL queries including where clause. (1 class)
3. Programs on procedures and functions. (1 class)
4. Programs on database triggers. (1 class)
5. Programs on packages. (1 class)
6. Programs on data recovery using check point technique. (1 class)
7. Concurrency control problem using lock operations. (1 class)
8. Programs on ODBC using either VB or VC++. (1 class)
9. Programs on JDBC. (1 class)
10. Programs on embedded SQL using C / C++ as host language. (1 class)

FOURTH SEMESTER PASS THEORY
FPYE-406 OPTICS AND QUANTUM MECHANICS

UNIT-I(7)

Fermat's principle, reflection and refraction at plane interference, cardinal points of a coaxial optical system, cardinal points of (i)combination of two thin lenses and (ii) thick lens, elementary ideas of monochromatic aberrations and remedies, chromatic aberration, achromatic combination, removal of chromatic aberration in a separated doublet, Ramsden's and Huygens's eyepieces,

UNIT-II(8)

Wave theory of light,Huygen's principle, reflection and refraction at plane surfaces, condition of interference, division of wave front,biprism,interference by plane parallel thin film illuminated by a point source, colour of thin films, Newton's ring, determination of wave length of monochromatic light by Newton's ring.

UNIT-III(7)

Diffraction of light, Fresnel and Fraunhoffer diffraction, Fresnel's half period zones, Zone plate act as a convex lens. Fraunhoffer diffraction by a single slit, double slit Plane transmission grating.

Electromagnetic nature of light, Polarized and unpolarized light. Plane polarized, circularly polarized and elliptically polarized light. Polarization by reflection and refraction, Brewster's law, Malus's law. Double refraction, ordinary and extraordinary rays, construction, working and uses of Nicol prism. Half wave plate and quarter wave plate.

UNIT -IV(8)

Inadequacy of classical physics: review of black body radiation. Particle nature of wave, photoelectric effect, Compton effect, dual nature of radiation. Wave nature of particle – De Broglie hypothesis and wave-particle duality. Superposition of two waves, group velocity and phase velocity, wave packet. Experimental confirmation of matter waves (Davisson – Germer experiment). Heisenberg's uncertainty principle and applications (Ground state energy of harmonic oscillator and hydrogen atom. Time dependent Schrodinger equation in one and three dimension. The wave function, equation of continuity, probability current density and probability density. Normalization of the wave function, Expectation value of an observable (6)

References:

1. optics- A.K. Ghatak
2. Principle of optics – B.K.Mathur
3. Optics – P.K. Chakravarty
4. Physics for degree students – VOL III and IV (Srikrishna Prakashan)
5. Introduction to Quantum mechanics – M. Das, P.K.Jena (Srikrishna Prakashan)
6. Quantum mechanics –J.L. Powell, B. Crasemann

FOURTH SEMESTER PASS PRACTICAL
. FPYE-456 HEAT, OPTICS AND ELECTROMAGNETISM

1. Angle of minimum deviation (I-D curve) using spectrometer.
2. Determination of magnifying power of a microscope.
3. Comparison of emf's using stretched wire potentiometer.
4. Thermal conductivity of a bad conductor by lee's method.
5. Optical rotation of sugar solution by polarimeter.
6. Determination of magnifying power of a telescope.
7. To study series and parallel resonant LCR circuit.
8. Figure of merit of a galvanometer.
9. To measure voltage and Frequency of a sinusoidal wave form using a CRO and to find unknown frequency by producing Lissajous figure.
10. Resistance of a resister using Meter Bridge

SEMESTER-V
FCYE-508 - ENVIRONMENTAL ENGINEERING

Unit – I

Ecological Concepts and Natural Resources: Ecological perspective and value of environment. Environmental auditing, Biotic components, Ecosystem Process: Energy, Food Chain, Water cycle, Air cycle etc., Environmental gradients, Tolerance levels of environment factor, EU, US and Indian Environmental Law, Global Perspective. Chemistry and Microbiology in Environmental Engineering : Physical and chemical properties of water, Atmospheric chemistry, Soil chemistry, Microbiology, Chemical and biochemical reactions, Material balances and Reactor configurations. Concept in Hydrology : Hydrological cycle, Water balance, Energy budget, Precipitation, Infiltration, evaporation and evapotranspiration, Rainfall-runoff relationships, Urban hydrology, Ground water, Ground water chemistry, Water contamination and pollution prevention.

Unit – II

Water Pollution : water quality standards and parameters, Assessment of water quality, Aquatic pollution, Freshwater pollution, Estuarine water quality, Marine pollution, Organic content parameters, DO and BOD demand in streams, Transformation process in water bodies, Oxygen transfer by water bodies, Turbulent mixing, Water quality in lakes and preservers , Ground water quality. Air Pollution : Air pollution and pollutants, criteria pollutants, Acid deposition, Global climate change –green house gases, non-criteria pollutants, emission standard form industrial sources, air pollution metereology, Atmospheric dispersion. Noise Pollution: Physical Properties of sound, Noise criteria, Noise Standards, Noise measurement, Noise control.

Unit – III

Water Treatment : Water quality standards, Water sources and their quality, Water treatment processes, Pretreatment of water, Conventional process, Advanced water treatment process. Waste Water Treatment : Water flow rate and characteristics, Design of waste water network, Waste water treatment process, pretreatment, primary and secondary treatment of waste water, Activated sludge treatment : Anaerobic digestion and its microbiology, Reactor configurations and methane production. Application of anaerobic digestion. Bio-solids regulations, Characteristics and processing of bio-solids, first and second stage processing of sludge. Sludge disposal,. Integrated sewage and sludge management. Solid Waste Management : Source classification and composition of MSW : properties and separation, storage and transportation, MSW Management, Waste minimization of MSW, Reuse and recycling, Biological treatment, Thermal treatment, Landfill, Integrated waste management. Hazardous Waste Management, Hazardous waste and their generation, Medical hazardous waste, Household waste, Transportation and treatment of hazardous waste: Incinerators, Inorganic waste treatment, Treatment systems for hazardous waste, handling of treatment plant residue. 38 Industrial Air Emission Control: Characterization of air stream, Equipment selection, Equipment design, Special Methods: Flue gas desulphurization, NOx removal, Fugitive emissions.

Unit – IV

Waste Minimization: Concept, Life Cycle Assessment, Elements of waste minimization strategy, Benefits of waste minimization, Elements of waste minimization programme, Waste reduction techniques. Environment impact Assessment, Origin and procedure of EIA, Project Screening for EIA, Scope studies, Preparation and review of EIS.

REFERENCE:

1. G. Kiely – Environmental Engineering Irwin/ McGraw Hill International Edition, 1997
2. M. L. Davis and S. J. Masen, Principles of Environmental Engineering and Science, McGraw Hill International Edition, 2004.

FPYC-501 (Mathematical Method -I)

UNIT-I

Calculus:

Calculus of functions of more than one variable: Partial derivatives, exact and inexact differentials. Integrating factor, with simple illustration. Constrained Maximization using Lagrange Multipliers. (4 Lectures)

Unit-II

Dirac Delta function and its properties:

Definition of Dirac delta function. Representation as limit of a Gaussian function and rectangular function. Properties of Dirac delta function. (3 Lectures)

Orthogonal Curvilinear Coordinates:

Orthogonal Curvilinear Coordinates. Derivation of Gradient, Divergence, Curl and Laplacian in Cartesian, Spherical and Cylindrical Coordinate Systems. Comparison of velocity and acceleration in cylindrical and spherical coordinate system. (7 Lectures)

UNIT-III

Vector Calculus:

Recapitulation of vectors: Properties of vectors under rotations. Scalar product and its invariance under rotations. Vector product, Scalar triple product and their interpretation in terms of area and volume respectively. Scalar and Vector fields. (5 Lectures)

Vector Differentiation: Directional derivatives and normal derivative. Gradient of a scalar field and its geometrical interpretation. Divergence and curl of a vector field. Del and Laplacian operators. Vector identities, Gradient, divergence, curl and Laplacian in spherical and cylindrical coordinates. (8 Lectures)

UNIT-IV

Vector Integration: Ordinary Integrals of Vectors. Multiple integrals, Jacobian. Notion of infinitesimal line, surface and volume elements. Line, surface and volume integrals of Vector fields. Flux of a vector field. Gauss' divergence theorem, Green's and Stokes Theorems and their applications (no rigorous proofs). (13 Lectures)

Reference Books:

1. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 2013,7th Edn., Elsevier.
2. An introduction to ordinary differential equations, E.A. Coddington, 2009, PHI learning.
3. Differential Equations, George F. Simmons, 2007, McGraw Hill.
4. Mathematical Tools for Physics, James Nearing, 2010, Dover Publications.
5. Mathematical methods for Scientists and Engineers, D.A. McQuarrie, 2003, Viva Book
6. Advanced Engineering Mathematics, D.G. Zill and W.S. Wright, 5 Ed., 2012, Jones and Bartlett Learning
7. Advanced Engineering Mathematics, Erwin Kreyszig, 2008, Wiley India.
8. Essential Mathematical Methods, K.F.Riley & M.P.Hobson, 2011, Cambridge Univ. Press
9. Mathematical Physics and Special Relativity --M. Das, P.K. Jena and B.K. Dash
10. (Srikrishna Prakashan) 2nd Edition 2009
11. Mathematical Physics--H. K. Dass, Dr. Rama Verma (S. Chand Higher Academics)
12. 6th Edition 2011.
13. Mathematical Physics –C. Harper, (Prentice Hall India) 2006.
14. Mathematical Physics-Goswami (Cengage Learning) 2014
15. Mathematical Method for Physical Sciences -- M. L. Boas (Wiley India) 2006

FPYC-502FUNDAMENTALS OF QUANTUM MECHANICS – I

UNIT-I

Origins of Quantum Physics: Historical Perspective, Particle Aspect of Radiation, Wave Aspect of Particles, Heisenberg Uncertainty Principle, Probabilistic Interpretation, Atomic Transitions and Spectroscopy, Wave Packets

UNIT-II

Mathematical Tools of Quantum Mechanics: The Linear Vector Space, The Hilbert Space, Dimension and Basis of a Vector Space, Square-Integrable Functions, Dirac Notations, HermitianOperator, Projection Operator, Commutation Algebra, Uncertainty Relation between Two Operators,

UNIT-III

Functions of Operators, Inverse and Unitary Operators, Eigenvalues and Eigenvectors of an Operator, Infinitesimal and Finite Unitary Transformations, Representation in Discrete Bases: Matrix Representation of Kets, Bras and Operators, Unitary Transformation, Matrix Representation of Eigenvalue Problem, Representation in Continuous Bases: Position and Momentum Representation, Parity Operator, Matrix and Wave Mechanics;

UNIT-IV

Postulates of Quantum Mechanics: The Basic Postulates of Quantum Mechanics, The State of a System, Observables and Operators, Measurement in Quantum Mechanics, Time Evolution Operator, Stationary States, Schrödinger Equation, The Conservation of Probability, Time Evolution of Expectation Values, Symmetries and Conservation Laws, Connecting Quantum to Classical Mechanics

Books:

1. Quantum Mechanics S. Gasiorowicz
2. Quantum Mechanics J. Sukurai
3. Quantum Mechanics R. Shankar
4. Quantum Mechanics S.N. Biswas
5. Quantum Mechanics A. Das
6. Quantum Mechanics A. Ghatak and S. Lokanath
7. Quantum Mechanics (Non Relativistic theory) L.D. Landau and E.M. Lifshitz
8. Principles of Quantum Mechanics P.A.M. Dirac
9. Quantum Mechanics, concepts and application, N Zettili

FPYC-503STATISTICAL MECHANICS - I

UNIT-I

Classical probabilities: Binomial distribution of probabilities, variance, mean value;Poisson's distribution, fluctuation,variance, mean value; Gaussian distribution, variance, mean value and applications. (10)

UNIT-II

Classical statistical mechanics:

Basic principles and application of classical statistical mechanics, micro canonical ensemble , Density distribution function, Liouvilles theorem Review of thermodynamics, , classical ideal gas in microcanonical ensemble, Gibbs paradox and its resolution, Sakur-Tetrode equation equipartition theorem (15)

UNIT-III

Canonical ensemble. partition function in canonical ensemble , Energy fluctuation in canonical ensemble ,Ideal gases in canonical ensemble, Concept of Grand canonical ensemble and its partition function , density fluctuation and Equivalence of Canonical and grand canonical ensemble.

UNIT-IV

Quantum statistical mechanics:

The density matrix, ensembles in quantum statistical mechanics.

Books:

1. Statistical physics - K. Huang
2. Statistical physics - R.K. Pathria
3. Statistical physics - F. Mohling
4. Elementary Statistical physics - C.Kittel
5. Statistical physics - Landau and Lifsitz
6. Physics Transitions & Critical Phonomena H.E. Stanly
7. Thermal Physics C. Kittel
8. Fundamental of statistical & Thermal physics- F. Reif
9. Statistical physics –B.B Laud

FPYC-504 FUNDAMENTALS OF ATOMIC AND MOLECULAR PHYSICS

UNIT-I

Alfa particle scattering and Rutherford scattering formula, Rutherford model of atom, Atomic spectra, Series spectra of H-atom Ritz-Rydberg combination principle. Bohr theory of H-atom and explanation of series spectra. Correction of finite mass of the nucleus, Bohrs corresponding principle. Sommer feld's modification of Bohr theory, fine structure H line. General characteristics of Sommer field's orbits ,descret energy exchange by atoms and Frank-Hertz experiment. Continuous X ray spectrum , characteristics of emission and absorption spectra, comparision of optical and X ray spectra, Moseley's law

Unit-2

Qualitattive idea about wave mechanical solution of Hydrogen Atom and discussion of quantum numbers , space quantization, Larmor's theorem , Magnetic moment and the Bohr magneton , Series spectra of alkali metals and elementary idea regarding double fine structure , spinning electron and the vector atom model, Electron spin orbit interaction energy and fine structure separations (P, D,F levels) due to spin-orbit interaction . Normal Zeeman effect ,anomalous Zeeman effect and Paschen – Black effect in one electron system

Unit -3

The atom model for two valence electrons ,l-l coupling and s-s coupling , L-S coupling ,jj coupling and terms arising from the interaction of two electrons in these coupling schenes.

Unit-IV

Pauli exclusion principle and quantization of vibrational and rotational energy in molecules. Pure rotational and rotation- vibration spectra. Raman effect, stokes and anti stokes lines . Character of Raman Spectra . Experimental arrangement of Raman Spectroscopy .

Reference Books

1. Introduction to Atomic spectra: Havery Elliott White (Mc-Graw Hill Book Company)
2. Concepts of Physics : Arthur Beiser (TMH)
3. Fundamentals of Spectroscopy- Raj kumar (Pragati Prakasan)

FPYC-505 OPTICAL ELECTRONICS

Unit-I

Special frequency filtering-Introduction,The fourior transform and some of its properties,The fourior transforming property of a thin lens,Some elementary examples of the Fourior transforming properties of thin lens,applications

Unit-II

Laser:Introduction,The Einstein co-efficient,light amplification,The threshold condition,laser rate equation,variation of laser power around threshold,optimum output coupling,line broadening mechanisim,additional problems.the quality factor,mode selection,Q-switching,mode locking in Lasers.

Unit-III

Laser system:Introduction,Ruby Laser,The He-Ne Laser,The CO_2 Laser,Dye Laser,Semiconductor Laser,Applications

Unit-IV

Electrooptic effect:Introduction, Electrooptic effect in KDP crystal :longitudinal mode, Electrooptic effect in KDP crystal:transverse mode, The Electrooptic effect in Lithium niobate and lithium tantalite crystals,General consideration on modulator design,The index ellipsoid in the presence of an external electric field,additional problems.

FPYC 551 Physics Lab [Electricity & magnetism lab]

1. To use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current,
and (d) checking electrical fuses.
2. Ballistic Galvanometer:
(i) Measurement of charge and current sensitivity
(ii) Measurement of CDR
(iii) Determine a high resistance by Leakage Method
(iv) To determine Self Inductance of a Coil by Rayleigh's Method.
3. To compare capacitances using De'Sauty's bridge.
4. Measurement of field strength B and its variation in a Solenoid (Determine dB/dx)
5. To study the Characteristics of a Series RC Circuit.
6. To study a series LCR circuit LCR circuit and determine its (a) Resonant frequency, (b) Quality factor
7. To study a parallel LCR circuit and determine its (a) Anti-resonant frequency and
(b) Quality factor Q
8. To determine a Low Resistance by Carey Foster's Bridge.
9. To verify the The venin and Norton theorems
10. To verify the Superposition, and Maximum Power Transfer Theorems .

11. To determine value of Boltzmann constant using V-I characteristic of PN diode.
12. To determine work function of material of filament of directly heated vacuum diode.
13. To determine the ionization potential of mercury.
14. To determine value of Planck's constant using LEDs of at least 4 different colours.
15. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light
16. To determine the value of e/m by (a) Magnetic focusing or (b) Bar magnet.

FPYC-552 Physics Lab [Electronics]

1. To measure (a) Voltage, and (b) Frequency of a periodic waveform using a CRO
2. To verify and design AND, OR, NOT and XOR gates using NAND gates.
3. To minimize a given logic circuit.
4. Half adder, Full adder and 4-bit Binary Adder.
5. Adder-Subtractor using Full Adder I.C.
6. To design an astable multivibrator of given specifications using 555 Timer.
7. To design a monostable multivibrator of given specifications using 555 Timer.
8. To study IV characteristics of PN diode, Zener and Light emitting diode
9. To study the characteristics of a Transistor in CE configuration.
10. To design a CE amplifier of a given gain (mid-gain) using voltage divider bias.
11. Study of frequency response of LCR circuit.
12. To determine frequency of oscillation of a Hartley Oscillator.
13. To determine frequency of oscillation of a Colpitt's Oscillator.
14. To determine the band gap in a semiconductor using PN junction diode.

SIXTH SEMESTER
FPEF-601FIBRE OPTICS AND HOLOGRAPHY

UNIT-I

Introduction, Principles of optical fibre: Acceptance angle and acceptance cone, Numerical aperture, Types of optical fibres: Single and multimode fibres, Step index fibre, Step index fibre, Graded index fibre, TE and TM modes, Dispersion, Attenuation in Optical Fibres: Scattering losses, Absorption losses, Bending losses, Loss in decibel.

UNIT-II

Fibre materials: Glass fibres, Plastic fibres, Optical fibres in communication: Light sources for fibre optics, LEDs as light source, Lasers as light source, Modulation, Photodetectors, Functioning of Fibre Optic Communication system, Advantages of Fibre Optic communication, Application of Optical Fibres in Medicine and Sensors, Coherent and incoherent fibre –optic bundles

UNIT-III

Optical Fibres in Sensing Application: Displacement sensors, Microbending concept, Phase-modulated sensors, Characteristic advantage of fibre optic sensors, Fibre-optic Medical Endoscopy: Some applications of fibre-optic endoscopy

UNIT-IV

Holography: Basic principles of Holography, Construction (Recording) of a Hologram, Reconstruction of a Hologram, Applications of Holography: Holographic interferometry.

References:

Applied physics : P. K. palanisami

FPYC-602Mathematical Method -II

UNIT-I

Fourier Series: Periodic functions. Orthogonality of sine and cosine functions, Dirichlet Conditions (Statement only). Expansion of periodic functions in a series of sine and cosine functions and determination of Fourier coefficients. Complex representation of Fourier series. Expansion of functions with arbitrary period. Expansion of non-periodic functions over an interval. Even and odd functions and their Fourier expansions. Application. Summing of Infinite Series. Term-by-Term differentiation and integration of Fourier Series. Parseval Identity.
(10 Lectures)

Some Special Integrals: Beta and Gamma Functions and Relation between them. Expression of Integrals in terms of Gamma Functions. Error Function (Probability Integral). (4 Lectures)

UNIT-II

Frobenius Method and Special Functions: Singular Points of Second Order Linear Differential Equations and their importance, Frobenius method and its applications to differential equations: Legendre & Hermite Differential Equations. Properties of Legendre & Hermite Polynomials: Rodrigues Formula, Generating Function, Orthogonality. Simple recurrence relations. Expansion of function in a series of Legendre Polynomials. Associated Legendre polynomials and spherical harmonics. (12 Lectures)

UNIT-III

Theory of Errors: Systematic and Random Errors. Propagation of Errors. Normal Law of Errors. Standard and Probable Error. (4 Lectures)

UNIT-IV

Partial Differential Equations: Solutions to partial differential equations, using separation of variables: Laplace's Equation in problems of rectangular, cylindrical and spherical symmetry. Conducting and dielectric sphere in an external uniform electric field. Wave equation and its solution for vibrational modes of a stretched string. (10 Lectures)

Reference Books:

2. Mathematical Methods for Physicists: Arfken, Weber, 2005, Harris, Elsevier.
3. Fourier Analysis by M.R. Spiegel, 2004, Tata McGraw-Hill.
4. Mathematics for Physicists, Susan M. Lea, 2004, Thomson Brooks/Cole.
5. Differential Equations, George F. Simmons, 2006, Tata McGraw-Hill.
6. Partial Differential Equations for Scientists & Engineers, S.J. Farlow, 1993, Dover Pub.
7. Mathematical methods for Scientists & Engineers, D.A. McQuarrie, 2003, Viva Books
8. Mathematical Physics and Special Relativity --M. Das, P.K. Jena and B.K. Dash (Srikrishna Prakashan) 2nd Edition 2009
9. Mathematical Physics--H. K. Dass, Dr. Rama Verma (S. Chand Higher Academics) 6th Edition 2011.
10. Mathematical Physics –C. Harper, (Prentice Hall India) 2006.
11. Mathematical Physics-Goswami (CENGAGE Learning) 2014
12. Mathematical Method for Physical Sciences -- M. L. Boas (Wiley India) 2006
13. Mathematics for Physicists, P. Dennery and A. Krzywicki Dover)
14. Advanced Engineering Mathematics, E. Kreyszig (New Age Publication) 2011.

FPYC-603 SOLID STATE PHYSICS

Unit-I

Crystal structure: Types of lattices, unit cell, Wigner Seitz cell, simple cubic (SC), Body centered cubic (BCC), face centered cubic (FCC), hexagonal closed packed (HCP) and miller indices, elementary idea about symmetry elements.

Crystal diffraction: Crystal structure, determination of diffraction of x-rays, electrons and neutrons, Bragg's law, reciprocal lattice, Brilluoin zones, Laue's derivation, atomic form factor and geometrical structure factor.

Unit II

Crystal Binding: Inert gas crystals, vander waals- London interaction, Repulsive interaction, cohesive energy, ionic crystals, electrostatic energy, Evaluation of Madelung constant, Covalent binding, metallic binding, Hydrogen bonded crystals.

Conduction in metals: Drude's theory of electrical conduction, thermal conductivity of metals, density of states and Fermi- Dirac distribution of electron gas, heat capacity of electron gas.

Unit III

Lattice Vibrations: Elastic and Atomic force constants, Dynamics of chains of atoms, monoatomic and diatomic chains, optical and acoustic modes, interaction of light with ionic crystals.

UNIT-IV

Superconductivity: experimental survey, Zero resistivity, Meissner's effect, Type-I and Type-II superconductors, specific heat and thermal conductivity.

References

1. Introduction to Solid State Physics- Kittel
2. Solid State Physics- Omar
3. Solid State Physics-Srivastava

FPYC-604FUNDAMENTALS OF NUCLEAR AND PARTICLE PHYSICS

UNIT –I

General nuclear properties:

Nuclear structure, Nuclear forceses, Nuclear stability, Nuclear radius, mass, binding energy, mass defect, packing fraction, Nuclear spin, angular momentum and parity, Nuclear electric quadrupole moment.

UNIT – II

Nuclear models:

Liquid drop model, semi empirical mass formula, Nuclear shell models , predictions of Nuclear shell model, collective model .

UNIT- III

Nuclear Reactions:

Conservation laws in Nuclear reactions, energetic of Nuclear reaction: Q value , Nuclear reaction cross section , types of Nuclear reactions , mechanism of Nuclear reactions.

UNIT- IV

Nuclear Energy and Nuclear decay:

Nuclear fission , energy released in fission, Nuclear chain reaction , Nuclear reactor , Nuclear fusion , properties of α , β , γ rays. Rutherford and Soddy theory of radioactive disintegration mean life, half life period , decay constant . α decay , β decay , γ decay.

UNIT- V

Particle physics:

The Standard model of particle physics, particle classification, fermions and bosons, lepton, quark Flavours, electromagnetic, weak and strong processes, Spin and parity, Isospin, strangeness, hypercharge, and baryon number, lepton number, Gell-Mann-Nishijima Scheme, Quarks in hadrons: Meson and baryon octet, Elementary ideas of SU(3) symmetry, charmonium, charmed mesons and B mesons, Quark spin and colour(15)

BOOKS:

1. Nuclear physics,Satyaprakash.
2.Nuclear and Particle Physics, Mital,Verma,Gupta.
3.Nuclear Physics, Dr.S.N.GHOSAL.
4.Atomic and Nuclear physics, Shatendra Sharma.
5.Nuclear and particle physics, D C Toyal

FPYC-605FUNDAMENTALS OF QUANTUM MECHANICS-II

UNIT-I

Eigen function and Eigenvalues of operatorEigen values spectrum,degeneracy,Eigenvalues and eigen function of hermitian operators.Orthonormality of eigen function,linear dependancer.The Schmidt method of Orthogonalization of degenerate eigen function.

eigen function expansion com pleteness and closer relation.Properties of eigen function of operators with continous spectrum,Compatibility.

Proof of uncertainity relation Δx, $\Delta p_x \geq \hbar/2$ and the minimum uncertainity wave packet.The time energy uncertainty relation.

Unit-II

The time independent Schrodinger equation in three dimension and stationary states ,constants of motion in quantum mechanics,Ehrenfest theorems using quantum equation of motion.

The time independent Schrodinger equation in one dimension ,boundary and continuity equation, on degenerate energy level for one dimensional problems.

UNIT-III

Symmetry and antisymmetry of Ψ and the parity operator. Properties of parity operator .properties of parity operator, projection operator

Unit-IV

General feature of solutions of one dimensional problems particle in a one dimensional box, the free particles, the potential step and rectangular potential barrier(evaluation of transmission and reflection co-efficient)The finite square well(bound states)Linear Harmonic oscillator.

Books:

1. Quantum Mechanics S. Gasiorowicz
2. Quantum Mechanics J. Sukurai
3. Quantum Mechanics R. Shankar
4. Quantum Mechanics S.N. Biswas
5. Quantum Mechanics A. Das
6. Quantum Mechanics A. Ghatak and S. Lokanath
7. Quantum Mechanics (Non Relativistic theory) L.D. Landau and E.M. Lifshitz
8. Principles of Quantum Mechanics P.A.M. Dirac
9. Quantum Mechanics, concepts and application, N Zettili

FBEF-610 (Computational methods in Physics).

UNIT-I

Introduction to computer hardware and software , introduction to storage in computer memory, stored program concepts, storage media computer operating system, LINUX, Commands;

UNIT-II

Programming with C:

Programme solving on computers-algorithm and flow charts in PROGRAMMING IN "C"

77 data types,

UNIT-III

Exercises for acquaintance:

1. To find the largest or smallest of a given set of numbers
2. To generate and print first hundred prime numbers
3. Sum of an AP series, GP series, Sine series, Cosine series
4. Factorial of a number
5. Transpose of a square matrix
6. Matrix multiplication and addition
7. Evaluation of log and exponentials 8.Solution of quadratic equation
9. Division of two complex numbers
10. To find the sum of the digits of a number

FPYC-651 Physics Lab [Modern Physics]

1. To determine the frequency of an electric tuning fork by Melde's experiment and verify $\lambda 2$ –T

law.

2. Familiarization with: Schuster`s focusing; determination of angle of prism.
3. To determine refractive index of the Material of a prism using sodium source.
4. To determine the dispersive power and Cauchy constants of the material of a prism using mercury source.
5. To determine wavelength of sodium light using Fresnel Biprism.
6. To determine the thickness of a thin paper by measuring the width of the interference fringes

produced by a wedge-shaped Film.

7. To determine wavelength of (1) Na source and (2) spectral lines of Hg source using plane diffraction grating.
4. To determine dispersive power and resolving power of a plane diffraction grating

10To measure (a) Voltage, and (b) Time period of a periodic waveform using CRO.

11. To test a Diode and Transistor using a Multimeter.
12. To design a switch (NOT gate) using a transistor.
13. To verify and design AND, OR, NOT and XOR gates using NAND gates.
14. Half Adder, Full Adder and 4-bit binary Adder.
15. Measurement of Planck's constant using black body radiation and photo-detector

FBEF-660 Computational Physics Lab

1. Interpolation by Lagrange methods
2. Numerical solution of simple algebraic equation by Newton-Raphson Methods
3. Least square t using rational functions
4. Numerical integration: Trapizoidal methods,Simsons method,Romberg method,Gauss quadra-ture method.
5. Eigen values and eigen vectors of a matrix
6. Solution of linear homogenius equations
7. Trace of a matrix
8. Matrix invertion
9. Solution of ordinary differential equation by Runge-Kutta Method
10. Introduction to Monte carlo techniques

7th SEMESTER

FPYC-701: CLASSICAL MECHANICS

Marks-100

UNIT-I: Mechanics of a system of particles:

Inertial and non-inertial frames of reference. Lagrangian Formulation, Velocity dependent potentials and Dissipation Function, conservation theorems and symmetry properties, Homogeneity and Isotropy of space and Conservation of linear and Angular momentum, Homogeneity of time and conservation of energy.

Hamiltonian Formulation:

Calculus of variations and Euler Lagranges equation, Brachistochrone problem , Hamiltons principle, extension of Hamiltons principle to nonholonomic systems , Legendre transformation and the Hamilton equations of motion, physical significance of Hamiltonian , Derivation of Hamiltons equations of motion from a variational principle , Rouths procedure , Principle of least action. (12)

UNIT-II: Canonical transformations:

Canonical Transformation , types of generating function , conditions for Canonical Transformation , integral invariance of Poincare , poissons theorem , Poisson and Lagrange bracket , Poisson and Lagrange Brackets as canonical invariant , Infinitesimal canonical Transformation and conservation theorems , Liouvilles theorem.

Hamilton -Jacobi Theory:

Hamilton - Jacobi equation for Hamiltons principal function , Harmonic oscillator and Kepler problem by Hamilton - Jacobi method , Action angle variables for completely separable system , Kepler problem in Action angle variables , Geometrical optics and wave mechanics. (15)

UNIT-III: Small oscillation:

Problem of small oscillations , Example of two coupled oscillator , General theory of small oscillations, Normal coordinates and Normal modes of vibration , Free vibrations of a linear Triatomic molecule.

Rigid body motion:

The independent of coordinates of a rigid body, orthogonal transformations , The Eulers angles , The Cayley-Klein parameters , Eulers theorems on the motion of a rigid body , infinitesimal rotations , rate of change of a vector, The Coriolis Force.

Rigid body dynamics:

Angular Momentum and kinetic energy of motion about a point. : The Inertia Tensor and momentum of Inertia ,Eigenvalues of Inertia Tensor and the principal Axis transformation. The Heavy symmetrical Top with one point Fixed .Elementary idea about non- linearity and chaos. (13)

BOOKS:

1. Classical Mechanics H. Goldstein
2. Classical Mechanics - Landau and Liftshitz
3. Classical Mechanics Corben&Stehle
4. Classical Dynamics Marion & Thornton
5. Analytical Mechanics L. Hand and J. Finch
6. Classical Mechanics J. C. Upadhyaya

FPYC-702: MATHEMATICAL METHOD IN PHYSICS-I

Full Marks-100

Unit-I

Complex Analysis: Brief Revision of Complex Numbers and their Graphical Representation. Euler's formula, DeMoivre's theorem, Roots of Complex Numbers. Functions of Complex Variables. Analyticity and Cauchy-Riemann Conditions. Examples of analytic functions. Singular functions: poles and branch points, order of singularity, branch cuts. Integration of a function of a complex variable. Cauchy's Inequality. Cauchy's Integral formula. Simply andmultiply connected region. Laurent and Taylor's expansion. Residues and Residue Theorem. Application in solving Definite Integrals. **(10lectures)**

UNIT-II

Integrals Transforms:

Fourier Transforms: Fourier Integral theorem. Fourier Transform. Examples. Fourier transform of trigonometric, Gaussian, finite wave train & other functions. Representation of Dirac delta function as a Fourier Integral. Fourier transform of derivatives, Inverse Fourier transform, Convolution theorem. Properties of Fourier transforms (translation, change of scale, complex conjugation, etc.). Three dimensional Fourier transforms with examples. Application of Fourier Transforms to differential equations: One dimensional Wave and Diffusion/Heat Flow Equations. **(10 Lectures)**

UNIT-III

Laplace Transforms: Laplace Transform (LT) of Elementary functions. Properties of LTs: Change of Scale Theorem, Shifting Theorem. LTs of Derivatives and Integrals of Functions, Derivatives and Integrals of LTs. LT of Unit Step function, Dirac Delta function, Periodic Functions. Convolution Theorem. Inverse LT. Application of Laplace Transforms to Differential Equations: Damped Harmonic Oscillator, Simple Electrical Circuits.

Groups and Group representation: Definition of groups, Finitegroups, example from solid state physics, sub groups and classes, Group Representation, Characters, Infinite groups and Lie groups, Liealgebra, application, Irreducible representation of SU(2), SU(3)and O(3). Beta, gamma functions, Greens function and its application .Partial differential equations. (20)

BOOKS:

1. Mathematical methods of physics J. Mathews & R. L. Walker.
2. Mathematical methods of physics Arfken and Weber.
3. Mathematical methods for physicists Dennery&Krzywicki.
4. Mathematical methods of physics H. K. Das
5. Mathematical methods of physics Dr. Rama verma (s. Chand)
6. Mathematical methods of physics Satyaprakash (S. Chand)
7. Mathematical methods of physics Binoy Bhattacharya. (NCBA Publication)
8. Introduction to Tensor calculus - Goreux S. J.
9. Mathematical methods of physics Dettman J. W.
10. Mathematical Methods for Physics and Engineers, K. F Riley, M. P. Hobson and S. J. Bence, 3rd ed. , 2006, Cambridge University Press
11. Advanced Engineering Mathematics, E. Kreyszig (New Age Publication) 2011.
12. Complex Variables, A. S. Fokas& M. J. Ablowitz, 8th Ed. , 2011, Cambridge Univ. Press
13. Complex Variables and Applications, J. W. Brown & R. V. Churchill, 7th Ed. 2003, Tata McGrawHill
14. First course in complex analysis with applications, D. G. Zill and P. D. Shanahan, 1940, Jones & Bartlett.
15. Mathematical Physics –C. Harper, (Prentice Hall India) 2006.
16. Mathematical Physics-Goswami (Cengage Learning) 2014
17. Mathematical Method for Physical Sciences -- M. L. Boas (Wiley India) 2006
18. Introduction to the theory of functions of a complex variable- E. T. Copson (Oxford) Univ. Press.

FPYC-703: QUANTUM MECHANICS-I

Marks-100

Unit-I

General principle of Quantum mechanics:

Linear Vector Space Formulation: Linear vector Space(LVS) and its generality. Vectors:Scalar product, metric space, basis vectors, linear independence, linear superposition of general quan-tum states, completeness and orthogonal relation, Schmidtsorthonormalisation procedure, Dual space, Bra and Ket vectors, Hilbert space formalism for quantum mechanics.

Operator:

Linear, Adjoint, hermitian, , unitary, , inverse, , antilinearoperators, Noncommutativity and uncertainty relation, complete set of compatible operators, simultaneous Measurement, Projection operator, eigen value and Eigen vector of linear, hermitian, unitary operators, Matrix representation of vectors and operators, matrix elements, eigen value equation and expectation value, algebraic result on Eigen values, transformation of basis vectors, similarity transformation of vectors and operators, diagonalisation. Vectors of LVS and wave function in co-ordinate, momentum and energy representations .

Unit-II

Quantum Dynamics

Time evolution of quantum states, time evoluation of operators and its properties, Schrodinger picture, Heisenberg picture, Dirac/Interaction picture, Equation of motion, Operator method of solution of 1D Harmonic oscillator, time evolution and matrix representation of creation and annihilation operators, Density matrix.

Rotation and orbital angular momentum:

Rotation matrix, Angular momentum operators as the generation of rotation, components of angular momentum Lx; Ly; Lz and L2 and their commutator relations, Raising and lowering operators (L+ and L), Lx; Ly; Lz and L2 in spherical polar co-ordinates, Eigen value and eigen function of Lz; L2(operator method), Spherical harmonics, matrix representation of L+; L and L2, Spin angular momentum: Spin 1/2 particle, Pauli spin matrices and their prop-erties Eigen values and Eigen function, Spinor transformation under rotation.

UNIT-III

Addition of angular momentum:

Total angular momentum J. Eigen value problem of Jz and J2, Angular momentum matrices, Addition of angular momenta and C. G. Coeffcients, Angular momentum states for composite system in the angular momenta(1/2, 1/2) and (1, 1/2).

Motion in Spherical symmetric Field:

Hydrogen atom, Reduction to one dimensional one body problem, radial equation, Energy eigen value and Eigen function, degeneracy, radial probability distribution.

Free particle problem:

Incoming and outgoing spherical waves, expansion of plane waves in terms of spherical waves. Bound states of a 3-D square well, particle in a sphere.

Books:

1. Quantum Mechanics S. Gasiorowicz
2. Quantum Mechanics J. Sukurai
3. Quantum Mechanics R. Shankar
4. Quantum Mechanics S. N. Biswas
5. Quantum Mechanics A. Das
6. Quantum Mechanics A. Ghatak and S. Lokanathan
7. Advanced Quantum Mechanics P. Roman
8. Quantum Mechanics (Non Relativistic theory) L. D. Landau and E. M. Lifshitz
9. Elementary Theory of Angular Momentum M. E. Rose
10. Principles of Quantum Mechanics P. A. M. Dirac
11. Quantum Mechanics, concepts and application, N Zettili

FPYC-704: PHYSICS OF SEMICONDUCTOR DEVICES

Mark-100

Unit-I: Introduction to the quantum theory of solids:

Formation of energy bands, The k-space diagram (two and three dimensional representation), conductors, semiconductors and insulators. Electrons and Holes in semiconductors: Silicon crystal structure, Donors and acceptors in the band model, electron effective mass, Density of states, Thermal equilibrium, Fermi-Dirac distribution function for electrons and holes, Fermi energy. Equilibrium distribution of electrons & holes: derivation of n and p from D(E) and f(E), Fermi level and carrier concentrations, The np product and the intrinsic carrier concentration. General theory of n and p, Carrier concentrations at extremely high and low temperatures: complete ionization, partial ionization and freeze-out. Energy-band diagram and Fermi-level, Variation of E_F with doping concentration and temperature. Motion and Recombination of Electrons and Holes: Carrier drift: Electron and hole mobilities, Mechanism of carrier scattering, Drift current and conductivity. Motion and Recombination of Electrons and Holes: Carrier di ffusion: diffusion current, Total current density, relation between the energy diagram and potential, electric field. Einstein relationship between diffusion coeffcient and mobility. Electron- hole recombination, Thermal generation. 12

Unit-II: PN Junction:

Building blocks of the pn junction theory: Energy band diagram and depletion layer of a pn junction, Built-in potential; Depletion layer model: Field and potential in the depletion layer, depletion-layer width; Reverse-biased PN junction; Capacitance-voltage characteristics; Junction breakdown: peak electric field. Tunneling breakdown and avalanche breakdown; Carrier injection under forward bias-Quasi- equilibrium boundary condition; current continuity equation; Excess carriers in forward- biased pn junction; PN diode I-V characteristic, Charge storage. 13

Unit-III: The Bipolar Transistor:

Introduction, Modes of operation, Minority Carrier distribution, Collector current, Base cur-rent, current gain, Base width Modulation by collector current, Breakdown mechanism, EquivalentCircuit Models - Ebers -Moll Model.

Metal-Semiconductor Junction: Schottky Diodes: Built-in potential, Energy-band diagram, I-V characteristics, Comparison of the Schottky barrier diode and the pn-junction diode. Ohmic contacts: tunneling barrier, speci c contact resistance.

MOS Capacitor:

The MOS structure, Energy band diagrams, Flat-band condition and at-band voltage, Sur-face accumulation, surface depletion, Threshold condition and threshold voltage, MOS C-V characteristics, Qinv in MOSFET. 10

MOS Transistor:

Introduction to the MOSFET, Complementary MOS (CMOS) technology, V-I Characteris-tics, Surface mobilities and high-mobility FETs, JFET, MOSFETVt, Body effect and steep retrograde doping, pinch-o voltage, 5

BOOKS:

1. Physics of Semiconductor Devices - Donald A. Neamann
2. Physics of Semiconductor Devices - B. B. Swain
3. Physics of Semiconductor Devices - AnjanaAcharya
4. Physics of Semiconductor Devices - Calvin Hu.
5. Physics of Semiconductor Devices - Dilip K Roy
6. Fundamentals of Semiconductor Devices- M. K. Achthanand K. N. Bhatt
7. Solid state Electronics Devices Bhattacharya , Rajnish Sharma
8. Semiconductor Materials and Devices J. B. Gupta
9. Physics of Semiconductor Devices - JivanJyotiMohanty.

FBEF-705: RESEARCH METHODOLOGY

Literature Survey: (10 Lectures)

Print: Sources of information: Primary, secondary, tertiary sources; Journals: Journal abbreviations, abstracts, current titles, reviews, monographs, dictionaries, text-books, current contents Subject Index, Substance Index, Author Index, Formula Index, and other Indices with examples.

Digital: Web resources, E-journals, Journal access, TOC alerts, Hot articles, Citationindex, Impact factor, H-index, E-consortium, UGC infonet, E-books, Internet discussion groups and communities, Blogs, Preprint servers, Search engines, Scirus, Google Scholar, Wiki-Databases, Science Direct, SciFinder, Scopus. Information Technology and Library Resources: The Internet and World WideWeb. Internet resources for Physics. Finding and citing published information.

Methods of Scientific Research and Writing Scientific Papers: (10 Lectures)

Reporting practical and project work. Writing literature surveys and reviews. Organizing a poster display. Giving an oral presentation. Writing scientific papers – justification for scientific contributions, bibliography, description of methods, conclusions, the need for illustration, style, publications of scientific work. Writing ethics. Avoiding plagiarism.

Data Analysis (10 Lectures)

The Investigative Approach: Making and Recording Measurements. SI Units and their use. Scientific method and design of experiments. Analysis and Presentation of Data: Descriptive statistics. Choosing and using statistical tests. Analysis of variance (ANOVA), Correlation and regression, Curve fitting, fitting of linear equations, simple linear cases, weighted linear case, analysis of residuals, General polynomial fitting, linearizing transformations, exponential function fit, r and its abuse. Basic aspects of multiplelinear regression analysis.

Reference Books

- Dean, J. R., Jones, A. M., Holmes, D., Reed, R., Weyers, J. & Jones, A.(2011) *Practical skills in chemistry*. 2nd Ed. Prentice-Hall, Harlow.
- Hibbert, D. B. & Gooding, J. J. (2006) *Data analysis for chemistry*. OxfordUniversity Press.
- Topping, J. (1984) *Errors of observation and their treatment.* Fourth Ed., Chapman Hall, London.
- Levie, R. de, *How to use Excel in analytical chemistry and in generalscientific data analysis.* Cambridge Univ. Press (2001) 487 pages.

Practical/Sessionals

FPYC-751: ELECTROMAGNETISM AND OPTICS LAB

1. Michelson's interferometer: determination of wavelength of sodium lines.
2. Magneticfield measurement by search coil
3. Study of polarization using Malus law
4. Specific rotation by sugar solution using polarimeter
5. Brewster'slaw.
6. To study the Hall Effect in semiconductors and determine
    a. Hall coefficient and Hall voltage.
    b. No. of charge carriers / unit volume
    c. Hall mobility andHall angle.
7. Todetermine the wavelength of (1) sodium and (2) Spectral lines of mercury light using plane diffraction Grating.
8. Determination of magneto resistance of bismuth.
9. Calibration of magnetic field using Hall apparatus.
10. Study of Fabry-perot interferometer.
11. Study of Babinet compensator.
12. To determine (1) wavelength and (2) angular spread of He-Ne laser using plane diffraction grating
13. To study the interference using laser and a double slit and find the wavelength of He-Ne laser source

FBEF-755: ADVANCED COMPUTATIONAL PHYSICS LAB

Marks-100

Introduction to computer hardware and software, introduction to storage in computer memory, stored program concepts, storage media computer operating system, LINUX , Com-mands;

JAVA programs on:

1. Introduction, Compiling & executing a java program.
2. Data types & variables, decision control structures: if, nested if etc.
3. Loop control structures: do, while, for etc.
4. Classes and objects.
5. Data abstraction & data hiding, inheritance, polymorphism.
6. Threads, exception handlings and applet programs
7. Interfaces and inner classes, wrapper classes, generics

Programing with FORTRAN:

Programme solving on computers-algorithm and flow charts in FORTRAN 77 data types, Exercises for acquaintance:

1. find the largest or smallest of a given set of numbers
2. To generate and print rst hundred prime numbers
3. Sum of an AP series, GP series, Sine series , Cosine series
4. Factorial of a number
5. Transpose of a square matrix
6. Matrix multiplication and addition
7. Evaluation of log and exponentials
8. Solution of quadratic equation
9. Division of two complex numbers
10. Tofind the sum of the digits of a number

Numerical Methods:

1. Interpolation by Lagrange methods
2. Numerical solution of simple algebraic equation by Newton-Raphson Methods
3. Least square fit using rational functions
4. Numerical integration: Trapezoidal methods, Simsons method, Romberg method, Gauss quadra-ture method.
5. Eigen values and Eigen vectors of a matrix
6. Solution of linear homogenous equations
7. Trace of a matrix
8. Matrix inversion
9. Solution of ordinary differential equation by Runge-Kutta Method
10. Introduction to Monte carlo techniques

8th SEMESTER
FPYC-801: QUANTUM MECHANICS-II

Marks-100

Unit-I

Approximation Method for stationary states:

Rayleigh-Schrodinger Method for Time-independent Non degenerate Perturbation theory, First and second order correction, perturbed harmonic oscillator, Anharmonic oscillator, The stark e ect, Quadratic Stark Effect and polarizability of hydrogen atom, Degenerate perturbation theory, Removal of Degerancy, parity selection rule, linear stark effect of hydrogen atom, Spin orbit Coupling, Relativistic correction, ne structure of Hydrogen like atom, normal and anomalous Zeeman effect, The strong- field Zeeman effect, The weak-field Zeeman effect and Landes g-factor. Elementary ideas about field quantizition and particle processes. (10)

Unit-II

Variational Methods:

General formalism, Validity of WKB approximation method, Connection Formulas, Bohrquantisation rule, Application to Harmonic oscillator , Bound states for potential well with one rigid wall and two rigid walls, Tunneling through potential Barrier, Cold emission, Alpha decay and Geiger-Nutal relation.

Time dependent perturbation Theory:

Transition probability, constant and harmonic perturbation, Fermi golden rule, and electric dipole Radiation and Selection Rule, Spontaneous emission EinsteinsA, B- coefficient, Basic principle of laser and Maser. (15)

Unit-III

Scattering Theory:

Scattering amplitude and Cross section. Bornapproximation, Application to Columb and Screened coulmbpotential, Partial wave analysis for elastic and inelastic Scattering. Effective range and Scattering length, Opticaltheorem, Black Disc Scattering, Hard-sphere Scattering, Resonance Scattering from square well potential. (15)

Books:

1. Quantum Mechanics S. Gasiorowicz
2. Quantum Mechanics J. Sukurai
3. Quantum Mechanics R. Shankar
4. Quantum Mechanics S. N. Biswas
5. Quantum Mechanics A. Das
6. Quantum Mechanics A. Ghatak and S. Lokanathan
7. Advanced Quantum Mechanics P. Roman
8. Quantum Mechanics (Non Relativistic theory) L. D. Landau and E. M. Lifshitz
9. Elementary Theory of Angular Momentum M. E. Rose
10. Principles of Quantum Mechanics P. A. M. Dirac
11. Quantum Mechanics, Concept and Applications, N Zettili

FPYC-802: STATISTICAL MECHANICS

Marks-100

UNIT-I

Classical Statistical Mechanics:

Classical probabilities: Binomial distribution of probability, variance,

mean value; Poisson's distribution, fluctuation, variance, mean value; Gaussian distribution, variance, mean value and applications. Basic principles and application of classical statistical mechanics, Liouville'stheorem, micro canonical ensemble, Review ofthermodynamics, equipartition theorem , classical ideal gas , Gibb'sparadox, Canonical ensemble and energy fluctuation , grand canonicalEnsemble and density fluctuation ,Equivalence of Canonical andgrand canonical ensemble. (14 classes)

UNIT-II

Quantum Statistical Mechanics:

The density matrix, ensembles in quantum mechanics, Ideal gas inmicro canonical and grand canonical ensemble ; equation of state forideal Fermi gas, Theory of white dwarf stars. Ideal Bose gas, photonsandplanck's law, statistics of photon and phonon gas, Bose-Einsteincondensation. Distribution function for Fermi-Dirac system, Equation ofstates for idealFermi gas, The theory of White Dwarf star; Landau Diamagnetism; Thequantised Hall effect, Pauli Paramgnetism, The De Haas-Van AlphenEffect.

Ising model: Definition of Ising model, One dimensional Ising model, application to Ferromagnetism. (**20 classes**)

UNIT-III

Phase Transition: Thermodynamics description of Phase Transitions,

Phase Transitions of second kind, Landau theory of phase transitionbeyond mean field, Gaussian fluctuation and Ginzbergcriteria, Discontinuity of specific heat ,change in symmetry in Phase atransition of second kind. (10 classes)

Books:

1. Statistical physics - K. Huang
2. Statistical Physics- B B Laud
3. Statistical physics - R. K. Pathria
4. Statistical physics - F. Mohling
5. Elementary Statistical physics - C. Kittel
6. Statistical physics - Landau and Lifsitz
7. Physics Transitions & Critical Phonomena – H. E. Stanly
8. Fundamental of statistical & Thermal physics- F. Reif

FPYC-803: BASIC CONDENSED MATTER PHYSICS

MARKS-100

Unit-I

Crystallography:-

Crystal lattice, crystal structure, symmetry elements in crystal, proper rotation axis, plane of symmetry, inversion center, screw axis, glide plane, types of bravais lattices, crystal structure: simple cubic, body centre cubic face centred cubic, HCP structure, Diamond structure, Zinc blende structure, Fluorite structure , perovskite structure, , Weigner –Seitz cell, Miller indices, Liquid crystals, quasi crystals, carbon clusters, carbon nano tubes.

Phonons and lattice vibrations Vibrations of monoatomic and diatomic lattices, dispersion, optics& acoustic modes, quantum of lattice vibrations and phonon momentum, Inelastic scattering of neutron and photons by phonons. Thermal properties of insulators Lattice heat capacity, debye& Einstein model, Anharmonic Crystal interactions, Thermal conductivity & thermal expansion. (12)

Unit-II:

Free electron Fermi gas:

Density of state in one dimention, effect of temperature on Fermi-Dirac distribution, Free electron gas in three dimentions, heat capacity of electron gas, electrical and thermal conductivity of metals.

Band theory:

Electrons in periodic potential, Blochstheorem, Kronig Penney model, origin of band gap,

Unit-III:

Superconductivity:

Experimental survey, Meisnerseffect, Type-I & Type-II superconductors, Thermodynamics of superconductors, Londonstheory, Josephsonseffect, Basic concepts of cooper pairing in BCStheory, Ginz-Landau Theory, fluxquantization, applications of superconductors.

BOOKS:

1. Introduction to solid state physics C. Kittel
2. Solid state physics Ashcroft and Mermin
3. Principles of Condensed Matter physics P. M. Chaikin and T. C. Lubensky
4. Solid state physics A. J. Dekker
5. Solid state physics O. E. Animaler
6. Quantum Theory Solid State J. Callaway
7. Solid state physics C. G. Kuper
8. Solid state physics David W. Snoke (LPE Publication)

FPYC-804: MATHEMATICAL METHOD IN PHYSICS -II

Marks-100

Unit-I:

Tensor analysis and differential geometry:

Cartesian tensor in three space, Curves in three space and Frenet Formula, General Tensor analysis, Covarient derivative and Christofoel symbol. (10)

Unit-II:

Special functions:

Solution of Bessel, Laguerre, hypergeometric and con uentHyper geometric Equation by generating function method and their properties. (15)

Unit-III:

Functions of complex variable, Ordinary differential equations ,differential operations and Sturm Liouville theory, Partial differential equations, Greens function, Solution of inhomogeneous partial differential equation by Green function method. (15)

BOOKS:

1. Mathematical methods of physics J. Mathews & R. L. Walker.
2. Mathematical methods of physics Arfken and Weber.
3. Mathematical methods for physicists Dennery&Krzywicki.
4. Mathematical methods of physics H. K. Das
5. Mathematical methods of physics Dr. Rama verma (S. Chand)
6. Mathematical methods of physics Satyaprakash (S. Chand)
7. Mathematical methods of physics Binoy Bhattacharya. (NCBA Publication)
8. Introduction to Tensor calculus - Goreux S. J.
9. Mathematical methods of physics Dettman J. W.

FPYC-805: ELECTRONICS

Marks-100

Unit-I

Amplifiers:

Frequency response of linear amplifiers, amplifier pass band, R. C. L. C. and transformer coupled amplifiers, Frequency response, gain band-width product, Feedback amplifiers, e ffects of negative feedback, Boot-strapping the FET, Multistage feedback, stability in amplifiers, noise in amplifiers.

Operational amplifiers:

The differential amplifiers, integral amplifier, rejection of common mode signals. The operational amplifier input and output impedances, application of operational amplifiers, unit gala buer, summing, integrating and differentiating amplifiers, comparators and logarithmic amplifiers. (12)

Unit-II

Oscillator Circuits:

Feedback criteria for oscillation, phase shift, Wien bridge oscillator, crystal controlled oscillator, klystron oscillator, Principle of multivibrator. (10)

Unit-III

Digital Circuits:

Logic fundamentals, Boolean theorem, Logic gates RTL, DTL and TTL gates, CMS switch RS flip-op, JK flip-flop

Radio Communication:

Ionosphericpropation, Antennas of different types, super heterodyne, receiver (Block dia-gram). Various types of optical fibers and optical communications. (15)

Books :

1. Electronic Fundamental and application J. D. Ryder
2. Int. Digital Electronics Heap and Martin
3. Integrated Electronics Millman and Halkias 3. . Foundation of Electronics Chattopadhyay, Rakshit, Saha and Purkalt

Practical/Sessionals

FPYC-851: GENERAL PHYSICS LAB

Marks-100

1. To calculate the velocity of ultrasonic sound through different liquid media using ultrasonic interferometer.
2. To calculate the adiabatic compressibility of the given liquid using ultrasonic interferometer
3. Stefan's constant measurement.
4. Young's modulus of glass by Coronus method.
5. Determination of magnetic susceptibility of a paramagnetic solution using Quinck's tube method.
6. Determination of magnetic susceptibility of a paramagnetic solution using Gouys method.
7. Measurement of dielectric constant by plate capacitor.
8. To determine the Planck's constant using LEDs of at least 4 different colors.
9. Measurement of Planck's constant using black body radiation and photo-detector
10. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light
11. To determine work function of material of filament of directly heated vacuumdiode.

9th SEMESTER

FPYC-901: ADVANCED QUANTUM MECHANICS &QUANTUM FIELD THEORY

Marks-100

Unit-I

Relativistic Quantum Mechanics:

Klein-Gordon equation and its drawbacks, need for Dirac equation, Properties of Dirac matrices, Non-relativistic reduction of Dirac equation, magnetic moment, Darwins term, Spin-Orbit coupling, Poincare transformation, Lorentz group, Covariant form of Dirac equation, Bilinear covariants, Gordon decomposition. (12)

Unit-II

Free particle solution of Dirac equation, Projection operators for energy and spin, Physi-cal interpretation of free particle solution, Zitterbewegung, Hole theory, Charge conjugation, space reflection and time reversal symmetries of Dirac equation. Continuous systems and fields. Transition from discrete to continuous systems, Lagrangian and Hamiltonian Formulations, Noether's theorem. (13)

Unit-III

Quantization of freefields:

Second quantization, Equal Time Commutators, Normal Ordering, covariant quantization of electromagnetic field, Quantization of scalar, e. m, and Dirac fields, Propagators for scalar, spinor and vector fields(15)

Books:

1. Advanced Quantum Mechanics - J. J. Sakurai
2. Relativistic Quantum Mechanics - J. D. Bjorken and S. D. Drell Relativistic Quantum Fields - J. D. Bjorken and S. D. Drell Quantum Field Theory - F. Mandl and G. Shaw

Reference books:

1. Quantum Field Theory - C. Itzykson and J. Zuber Quantum Field Theory - M. E. Peskin and D. V. Schroeder
2. Quantum Field Theory - L. H .Ryder
3. Quantum Field Theory - S. Weinberg

FPYC-902: NUCLEAR AND PARTICLE PHYSICS

Marks-100

Unit-I

General nuclear properties: Radius, mass, binding energy, nucleon separation energy, angular momentum, parity, electromagnetic moments, excited states.

Two Nucleon Problem:

Central and noncentral forces, deuteron and its magnetic moment and quadrupole moment; Force dependent on isospin, exchange force, charge independence and charge symmetry of nuclear force, mirror nuclei. Nuclear models:

Liquid drop model, fission, magic numbers, shell model, analysis of shell model predic-tions, beta stability line, collective rotations & vibrations, Nuclear Structure: Form factor and charge distribution of the nucleus, Hofstadter form factor. (15)

Unit-II

Nuclear reaction:

Energetics of nuclear reaction, conservation laws, classification of nuclear reaction , radio active decay, radio active decay law , production and decay of radioactivity, radioactive dating , alpha decay:Gamow theory and branching ratios, beta decay: energetic angular momentum and parity selection rules, compound nucleus theory, resonance scattering, Breit- Wigner formula, Fermi's theory of beta decay, Selection rules for allowed transition, parity violation. (10)

Unit-III

Particle Physics:

The Standard model of particle physics, particle classification, fermions and bosons, lepton avors, quarkFlavors, electromagnetic, weak and strong processes, Spin and parity determi-nation, Isospin, strangeness, hypercharge, and baryon number, lepton number, Gell-Mann-Nishijima Scheme, Quarks in hadrons: Meson and baryon octet, Elementary ideas of SU(3) symmetry, charmonium, charmed mesons and B mesons, Quark spin and colour(15)

BOOKS:

1. Nuclear physics, Satyaprakash.
2. Nuclear and Particle Physics, Mital, Verma, Gupta.
3. Nuclear Physics, Dr. S. N. GHOSAL.
4. Atomic and Nuclear physics, Shatendra Sharma.

FPYC-903: CLASSICAL ELECTRODYNAMICS

Marks-100

Unit-I

Electrostatics and magnetostatics, Boundary value problems and conservation laws. Maxwell's Equations:

Maxwells equations in free space; Magnetic charge; Maxwells equations inside matter; Dis-placement current; Vector and scalars potentials; Wave equation for potentials; Lorentz and Coulomb gauge conditions; Wave equation for Electric and Magenticfields in absence of sources.

Covariant Formulation of Maxwells Equation:

Lorentz transformation; Scalars, vectors and Tensors; Maxwells equations and equations of continuity in terms of A and J ; Electromagnetic field tensor and its dual; Covariant form of Maxwells equations; Lagrangian for a charged particle in presence of external electromagnetic eld and Maxwells equation as Euler-Lagrange equations. (15)

Unit-II

Plane Waves in Non-Conducting Media:

Plane waves in non-conducting media;velocity of wave propagation and energy flow;linear, circular and elliptic polarization; Reflection and refraction of electromagnetic waves at a plane inter-face between dielectrics; normal and oblique incidence;total internal reflection and polarization by reflection; waves in dispersive media, Kramer-Kronig relation.

Plane Waves in Conduction Media:

Plane waves in conduction media; Reflection and transmission at a conducting surface; Cylindrical cavities and wave guides; Modes in rectangular wave guide and resonant cavities. (15)

Diffraction:

Kirchoff 's formulation of diffraction by a circular aperature. (12)

Unit-III

Green's Function Solution for Retarded Potential

Green's function solution of potential form of Maxwell's equations, Retarded and advanced Green's Functions.

Multipole Radiation:

Potential, Fields and radiation due to an oscillating electric dipole; radiation due to a centre - fed linear antenna; angular distribution of power radiated; Rayleigh Scattering. Magnetic dipole and Electric Quadrupole radiation.

Radiation by Point Charge:

Lienard-Weichert potential, Field due to a point charge, Angular distribution of radiation and total power radiated by an accelerated charge, Larmor's formula, Thomson's scattering. (13)

Books:

1. Classical Electrodynamics - J. D. Jackson
2. Classical Theory of Fields - L. LandauLifsitz
3. Introduction to Electrodynamics - D. J. Griths.
4. Principles of Optics-M. Born and E. Wolf

Core Electives –A

FPYE-904: CONDENSED MATTER PHYSICS-I

Mark-100

UNIT –I

Lattice vibration:

Born openheimer Approximation, Hamiltonian for lattice vibration in the harmonic Approximation, Normal modes of system and quantization of lattice vibrations-phonons. Electron phonon interaction, Second quantized form of Hamiltonian for electrons and phonons in interaction. Energy Bands:
Wave equation for an electron in a periodic potential, Bloch functions, Brillouin zones E-K diagram under free electron approximation, Nearly free electron approximation-Diffraction of electrons by lattice planes and opening of gap in E-K diagram. Effective mass of electrons in crystals, Holes, Tight binding approximation,

Unit-II

Fermi surface

Construction of Fermi surface, Experimental methods of study of Fermi surface, Cyclotron resonance, de Hass van Alphen effect .

Electron Interaction:

Pertrubation formulation, Dielectric function of an interacting electron Gas(Lindhard's expression), static screening, screened impurity, Kohn effect, Friedel oscillations and sum rule, dielectric constant of semiconductor, plasma oscillation.

UNIT-III

Transport properties:

The Boltzmann equation, Electrical conductivity, General transport coefficients, Thermalconductivity, thermoelectric effect, Hall effect, Elementary ideas about Quantum hall effect, magnetoresistance, Elementary ideas about giant magnetoresistance and colossal magnetoresistance,

Books:

1. D. Pines: Elementary Excitations in Solids S. Raimes: Many Electron Theory
2. O. Madelung: Introduction to Solid State Theory
3. N. H. March and M. Parrinello: Collective E ects in Solids and Liquids
4. H. Ibach and H. Luth: Solid State Physics: An Introduction to Theory and Experiments J. M. Ziman: Principles of the Theory of Solids
5. C. Kittel: Quantum Theory of Solids

Core Electives –B

FPYE-905: PARTICLE PHYSICS -I

Mark-100

Unit-I

Lorentz Group:
Continuous and discrete transformations, Group structure, Proper and improper Lorentz Transformations, SL(2, C) representations, Poincare group.
Interactingfields:
Interaction picture, Covariant perturbation theory, S-matrix, Wicks theorem, Feynman diagrams. (12)

Unit-II

QED:
Feynman rules, Example of actual calculations: Rutherford, Bhabha, Moeller, Compton, $e^+ e^- \rightarrow \mu+ \mu -$. Decay and scattering kinematics. Mandelstam variables and use of crossing symmetry.
Higher order corrections:
One-loop diagrams. Basic idea of regularization and renormalization. Degree of divergence. Calculation of self-energy of scalar in Φ^4-theory using cut-of or dimensional regularization. Elementary discussions on running couplings and renormalization group. (13)

Unit-III

Gauge theories:
Gauge invariance in QED, non-abelian gauge theories, QCD (introduction), Spontaneous symmetry breaking, Higgs mechanism.
Electroweak Theory:
Gauge boson and fermion masses, Neutral current, Experimental tests. Calculation of FB asymmetry in $e^+e^- \rightarrow \mu+ \mu -$ and decay widths of W and Z (only at tree-level). Higgs physics. (13)

BOOKS:

1. M. Peskin and F. Schroeder: Quantum Field Theory
2. J. D. Bjorken and S. D. Drell: Relativistic Quantum Fields
3. D. Bailin and A. Love: Introduction to Gauge Field Theory
4. A. Lahiri and P. B. Pal: A First Book of Quantum Field Theory
5. F. Mandl and G. Shaw: Quantum Field Theory
6. P. Ramond: Field Theory: A Modern Primer
7. C. Itzykson and J. B. Zuber: Quantum Field Theory

Practical/Sessionals
FPYC-951: DISSERTATION/PROJECT

Marks-100

Project evaluation guidelines:

Every student will have to complete one project each in Semester III with four credits (100 marks) each. Students can take one long project (especially for SSP/SSE/Material Sc/Nanotechnology/Nuclear etc). However for the project students have to submit disser-tation consisting of the problem definition, literature survey and current status, objectives, methodology and some preliminary experimental work in Semester IV and actual experimental work, results and analysis with four credits each. The project can be a theoretical or experimental project, related to advanced topic, electronic circuits, models, industrial project, training in a research institute, training of handling a sophisticated equipments etc. Maximum three students can do a joint project. Each one of them will submit a separate project report with details/part only he/she has done. However he/she can in brief (in a page one or two) mention in Introduction section what other group members have done. In case of electronic projects, use of readymade electronic kits available in the market should be avoided. The electronics project / models should be demonstrated during presentation of the project. In case a student takes training in a research institute/training of handling sophisticate equipment, he/she should mention in a report what training he/she has got, which instruments he/she handled and their principle and operation etc.

Each project will be of 100 marks by internal evaluation.
The project report should be le bound/spiral bound/hard bound and should have fol-lowing format

- Title Page/Cover page
- Certificate endorsed by Project Supervisor and Head of Department
- Declaration
- Abstract of the project
- Table of Contents
- List of Figures
- List of Tables

Chapters of Content:
Introduction and Objectives of the project Experimental/TheoreticalMethodology/Circuit/Model etc. details Results and Discussion if any
Conclusions
References

Evaluation by Internal examiner will be based on following criteria:

Criteria	Maximum Marks
Literature Survey	10
Objectives/Plan of the project	10
Experimental/Theoretical methodology/Working condition of project or model	20
Significance and originality of the study/Society application and Inclusion of recent	10
References	
Depth of knowledge in the subject / Results and Discussions	20
Presentation	30
Total marks	100

FPYC-952: BASIC ELECTRONICS LAB

Marks-100

1. Frequency response of transistor amplifier with the without feedback .
2. Characteristics of Hartley oscillator.
3. Determination of different parameters of transistor.
4. Study of multivibratorAstable. .
5. Study of multivibratorBistable.
6. Study of multivibratorMonostable.
7. To measure the divergence of a laser beam.
8. To find the band gap in a semiconductor using pn junction diode.
9. To show the tunneling effect in tunnel diode using I-V characteristics.
10. To design a Wien bridge oscillator for given frequency using an op-amp.
11. To design a phase shift oscillator of given specifications using BJT.
12. To add two dc voltages using Op-amp in inverting and non-inverting mode
13. To design a precision Differential amplifier of given I/O specification using Op-amp.
14. To investigate the use of an op-amp as an Integrator.
15. To investigate the use of an op-amp as a Differentiator.

CORE ELECTIVE-PRACTICAL

Core Elective-A

FPYE-954: CONDENSED MATTER PHYSICS-I LAB

Marks-100

1. Study of energy gap of Germanium by four probe method.
2. Study of Laue's spot of mica sheet using X-ray diffraction technique.
3. Determination of magneto resistance of bismuth.
4. To study the PE Hysteresis loop of a Ferroelectric Crystal.
5. To draw the BH curve of Fe using Solenoid & determine energy loss from Hysteresis.
6. To measure the Magnetic susceptibility of Solids.
7. To determine the Coupling Coefficient Piezoelectric crystal.
8. e/m measurement by Thomson Method .
9. Verification of Richardson's T 3/2 law.
10. Calibration of Oscilloscope.
11. DeterminationofPlank'sconstantbyreversephotoelectriceffectmethod.

Core Elective-B

FPYE-955: PARTICLE PHYSICS-I LAB

Mark-100

1. Study of surface barrier detector.
2. Determination of value for DPPH using ESR.
3. Study of counter technique.
4. Study of single channel analyzer.
5. Study of photo detector and photo multiplier.
6. Study of wide-band amplifier.
7. Emulsion photograph studies.

10th SEMESTER

FPYC-1001: ATOMIC AND MOLECULAR PHYSICS

Marks-100

Unit-I

One Electron Atom:

Introduction:

Quantum States; Atomic orbital; Parity of the wave function; Angular and radial distribution functions.

Hyperfine structure:

Review of Fine structure and relativistic correction, Lamb shift. Hyper ne interaction and isotope shift; Hyper fine splitting of spectral lines; selection rules.

Many electron atom:

Independent particle model; He atom as an example of central field approximation; Central field approximation for many electron atom; Slater determinant; L-S and j-j coupling; Equiva-lent and nonequivalent electrons; Energy levels and spectra; Spectroscopic terms; Hunds rule; Lande interval rule; Alkali spectra. (13)

Unit-II

Molecular Electronic States:

Concept of molecular potential, Separation of electronic and nuclear wavefunctions, Born-Oppenheimer approximation, Electronic states of diatomic molecules, Electronic angular mo-menta, Approximation methods for the calculation of electronic Wave function, The LCAO approach, States for hydrogen molecular ion, Coulomb, Exchange and Overlap integral, Symmetries of electronic wave functions; Shapes of molecular orbital; and bond; Term symbol for simple molecules.

Rotation and Vibration of Molecules:

Solution of nuclear equation; Molecular rotation: Non-rigid rotator, Centrifugal distortion, Symmetric top molecules, Molecular vibrations: Harmonic oscillator and the anharmonic oscillator approximation, Morse potential. (12)

Unit-III

Spectra of Diatomic Molecules:

Transition matrix elements, Vibration-rotation spectra: Pure vibrational transitions, Pure ro-tational transitions, Vibration-rotation transitions, Electronic transitions: Structure, Franck-Condon principle, Rotational structure of electronic transitions, Fortrat diagram, Dissocia-tion energy of molecules, Continuous spectra, Raman transitions and Raman spectra.

Vibration of Polyatomic Molecules:

Application of Group Theory Molecular symmetry; Matrix representation of the symmetry elements of a point group; Reducible and irreducible representations; Character tables for C 2v and C 3v point groups; Normal coordinates and normal modes; Application of group theory to molecular vibration. (15)

BOOKS:

- B. H. Bransden and C. J. Joachain: Physics of Atoms and Molecules
- C. Cohen-Tannoudji, B. Dier, and F. Laloe: Quantum Mechanics vol. 1 and 2
- R. Shankar: Principles of Quantum Mechanics
- C. B. Banwell: Fundamentals of Molecular Spectroscopy
- G. M. Barrow: Molecular Spectroscopy
- K. Thyagarajan and A. K. Ghatak: Lasers, Theory and Applications
- O. Svelto: Principles of Lasers
- B. H. Eyring, J. Walter and G. E. Kimball: Quantum Chemistry
- W. Demtroder: Molecular Physics
- H. Herzberg: Spectra of Diatomic Molecules
- J. D. Graybeal: Molecular Spectroscopy
- M. C. Gupta: Atomic and Molecular Spectroscopy
- B. B. Laud: Lasers and Non-linear Optics
- A. Thorne, U. Litzen and J. Johnson: Spectrophysics

FPYC-1002: NANO SCIENCE AND TECHNOLOGY

Mark-100

Properties of individual Nanoparticles:

Magic numbers, Theoretical modeling of nanoparticles, Geometric structure, Electronic structures, relativity, fluctuations, magic clusters, Bulk to nanostriction

Semiconducting Nanoparticles:

Optical properties, photofragmentation, Coulombic explosion.

Carbon nanostructures

Carbon molecules:Nature of the carbon Bond, New carbon structures

Small Carbon Clusters, Discovery of C_{60}, Structure of C_{60} and its crystal, Alkali doped C_{60},Larger and Smaller Fullerenes, Other Bucky balls,

Carbon Nanotubes

Fabrication, Structure, Electricalproperties, Vibrationalproperties, Mechanical properties

Applications of carbon nanotubes: Field emission and shielding, computers, Fuel cells, Chemical Sensors, Catalysis, Mechanical Renforcement.

Bulk Nanostructured materials:

Solid Disordered Nanostructures: Methods of synthesis, Failure mechanism of Conventional Grain-Sized Materials, Mechanical properties, Nanostructured Multilayers, Electrical properties, Other properties, Metal Nanocluster Composite Glasses, Porous Silicon

Nanostructured Crystals: Natural Nanocrystals, Computational Prediction of Cluster Lattices, Arrays of nanoparticles in Zeolites, Crystals of Metal Nanoparticles, Nanoparticle Lattices in Colloidal suspensions, Photonic Crystals

Nanostructured Ferromagnetism: Basics of ferromagnetism, Effect of bulk Nanostructuring of magnetic properties, Dynamics ofnanomagnets, Nanopore Containment of magnetic properties, Nanocarbonferromagnets, Giant and colossal Magneto resistance, Ferro fluids

Optical and vibrational spectroscopy:

Infrared frequency range: Spectroscopy of semiconductors; Excitons,Infrared surface spectroscopy, Raman spectroscopy, Brillouin spectroscopy,

Luminescence: Photoluminescence, Surface states, thermo luminescence nanostructures in Zeolite Cages**.**

Quantum wells , Wires and Dots : Preparation of quantum nanostructures , size and Dimensionallyeffects: Size effects, Conduction electron and dimensionality, Fermi gas and density of states, potentialwells, partial confinement Properties dependent on Density of states, Excitons, Single electron tunneling, Applications: infrared detectors, Quantum Dot Lasers, Superconductivity.

References:

Introduction to Nanotechnology: Charles P. Poole, Jr. ,Frank J. Owens

Core Elective-A (Theory)
FPYE-1004: CONDENSED MATTER PHYSICS-II

Mark-100

Unit-I

Magnetism:

Landau diamagnetism and Pauli paramagnetism, Weiss theory of ferromagnetism, Currywiss law for suscsptibility, Heisenberg model- condition for ferro and anti ferromagnetic order, spin waves and magnons, Bloch $T^{3/2}$Law, Antiferro magnetic order, Neeltemperature. Diluted magnetic Semiconductors.

Ferroelectricity:

Ferroelectric crystals, classification of Ferroelectric crystals, Polarisationcatastrophe, Soft optical phonons, Landau theory of phase transition-second and first order transition, Multiferroics-Elementary concept

UNIT-II

Electronic and lattice defects:

Lattice defects, Frenkel and schottkydefects, Linedefects, Edge and screw dislocations-Burger'sVector, planner(stacking) Faults- twin planes and grain boundaries Color centers-mechanism of coloration of a solid, F-center, other color centers.

Excitons: Loosely bound, tightly bound, ExcitonicWaves, Electron –hole droplets.

Exotic Solids

Amorphous materials, Quasi-crystals, Nano structured materials-Classification based on spatial extention(0-D, 1-D, 2-D). 0-D nanostructures-quantum dots, Widening of band gap in quantum dots, 1-D nano structures-Quantum wells-superlattices.

Unit-III

Electron-phonon interaction, Second quantized form of Hamiltonian for electrons and phonons interaction, electron-electron attractive interaction due to virtual phonon exchange, Cooper pairs and BCSHamiltonian, Solution of BCS Hamiltonian- spin analog method.

Josephson effect: Microscopic quantum mechanical effect, Dc Josephson effect, Effect of electric field Ac/Inverse Ac Josephson effect, Effect of magnetic field, SQUID.

Books:

1. M. Tinkham: Group Theory and Quantum Mechanics
2. M. Sachs: Solid State Theory
3, A. O. E. Animalu: Intermediate Quantum Theory of Crystalline Solids
4. N. W. Ashcroft and N. D. Mermin: Solid State Physics
5. J. M. Ziman: Principles of the Theory of Solids
6. C. Kittel: Introduction to Solid State Physics

Core Elective-B (Theory)
FPYE-1005: PARTICLE PHYSICS-II

Marks-100

Unit-I

Symmetry:

Different types of symmetries and conservation laws. Noethers theorem.

Symmetry groups and Quark model:

SU(2) and SU(3): root and weight diagrams, Composite representation, Youngs tableaux, quark model, colour, heavy quarks and their hadrons.

Hadron structure:

Elastic e-p scattering, electromagnetic form factors, electron-hadron Deep Inelastic Scatter-ing, structure functions, scaling, sum rules, neutrino production. (12)

Unit-II

Strong interactions:

QCD, asymptotic freedom, gluons and jets in $e^+e\rightarrow$ hadrons, Scaling violation.

Low energy weak interactions:

Fermi theory, calculation of decay widths of muon and π^+.

Neutrino physics:

Theory of two- flavour oscillation. Solar and atmospheric neutrino anomalies. Neutrino experiments. The Indian Neutrino Observatory. (13)

Unit-III

Flavour physics:

Quark mixing, absence of tree-level FCNC in the Standard Model, the CKM matrix, oscillation in K and B systems, CP violation.

HEP experiments:

Relative merits and demerits of e^+e^-andhadronic colliders, LEP, LHC, B-factories. (15)

Books

1. F. Halzen and A. D. Martin: Quarks and Leptons
2. J. Donoghue, E. Golowich and B. Holstein: Dynamics of the Standard Model
3. T. -P. Cheng and L. -F. Li: Gauge Theories in Particle Physics
4. E. Leader and E. Predazzi: An Introduction to Gauge Theories and Modern Particle Physics
5. F. E. Close: An Introduction to Quarks and Partons

Open elective-A

FPYE-1006: ADVANCED CHARACTERIZATION TECHNIQUES

Mark-100

Unit-I

X-ray diffraction and reciprocal lattices

Choice of x ray , electron and Neutron for crystal structure determination, Bragg diffraction, Reciprocallattices, Thebragg's condition and ewald construction, Brillouinzones, Brillouin zones of SC, BCC, FCC lattices, Atomic scattering factor, Geometrical Structure factor, Lauemethod, Rotating crystal method, powder method, Electron diffraction, Geometrical nature of electron diffraction patterns, Indexing of electron diffraction spot pattern, electron microscope , transmission electron microscopy, scanning electron microscopy, DebyeScherrer Technique, - Analysis of the powder photograph, The determination of lattice type and space group, crystal structure determination. (20)

Unit-II

Microscope techniques:

Electron Microscope:SEM, TEM, FESEM, HRTEM

Scanning probe microscopy:Atomic Force microscopy, Scanning tunneling microscopy. (10)

Unit-III

Spectroscopic Techniques:

UV-visible spectroscopy, Ramanspectroscopy, electronspectroscopy, Neutronscattering, X-ray scattering, x-ray photoelectron spectroscopy (10)

Open elective-B

FPYE-1007: VACUUM SCIENCE AND CRYOGENICS

Mark-100

Unit-I

Behavior of gases; Gas Transport phenomenon, Viscous ,molecular and transition flow regimes, measurement of pressure, Residual gas analyses. (10)

Unit-II

Production of vacuum-mechanical pumps, Diffusionpump, Getter and ion pumps, cryopumps, material in vacuum;high Vacuum and ultra high vacuum systems;Leak detection. (10)

Unit-III

Properties of engineering material at low temperature;cryogenic fluids-Hydrogen, Helium3, Helium4, superfuidity, experimentalmethod at low temperature:closedcycle, Refrigerators, single and double cycle He 3 refrigerator, He4 refrigerator, He3-He4 dilution refrigerator, pomeranchunkcooling, pulsed refrigerator system, magneticrefrigerators, Thermoelectriccoolers;CryostatDesign: Cryogenic level sensors, Handling of cryogenic liquids, Cryogenic thermometry**. (20)**

Open Elective-C

FPYE-1008: MATERIAL SCIENCE

Mark-100

Unit-I

Mechanical, Thermal and elecetrical properties of materials, Mechanical properties:TensileStrength, stress-strainbehavior, Ductile and brittle material, Toughnes, hardness, fatigue, creep and fracture.

Thermal properties:Thermalconductivity, thermoelectric effects, Electrica properties: electricalconductivity, energy band structure of conductors, semiconductors and insulators, type-I and Type-II superconductors and their application, dielectric, ferroelectric and piezoelectric materiala and their application. (13)

Unit-II

Laser Physics:

Basic elements of a laser; Threshold condition; Four-level laser system, CW operation of laser; Crit-ical pumping rate; Population inversion and photon number in the cavity around threshold; Output coupling of laser power. Optical resonators; Cavity modes; Mode selection; Pulsed operation of laser: Q-switching and Mode locking; Experimental technique of Q-switching and mode locking Different laser systems: Ruby, CO_2, Dye and Semiconductor diode laser; properties-scattering, refraction, reflection, an Optical materials: optical transmission d absorption, opticalfibres-principle and application. (12)

Unit-III

Soft condensed matter:

Polymeric materials: Types of polymers, Mechanism of polymerization, Mechanical behaviourofpolymers, Fracture in polymers, Rubber types and applications, Thermosetting and thermoplastics, Conducting polymers:

Composite Materials: Microcomposites&Macrocomposites, fibre reinforced composites, Continuousfibre composites, Short fibre composites, Polymer matrix composites, Metal-matrix composites:

Ceramic-matrix composites, Carbon-carbon Composites, Hybrid composites.

Ceramics: Types, structure, properties and application of ceramic materials

Other materials: Brief description of other materials such as Corrosion resistant materials, Nanophase materials, Shape memory alloy, SMART materials(15)

Practical/Sessionals

FPYC-1051: SEMINAR

Marks-100

Each student has to give a seminar on any advanced topic from its core electives of 30minutes presentation before the faculty members who shall give marks out of 100 on the following criteria:

1. Preliminary Seminar-30
2. Final seminar-70

FPYC-1052: MODERN PHYSICS LAB

Marks-100

1. Measurement of Rydberg constant.
2. e/m measurement by Braun tube .
3. e/m measurement by Magnetron Valve Method .
4. To setup the Millikan oil drop apparatus and determine the charge of an electron.
5. To show the tunneling effect in tunnel diode using I-V characteristics.
6. Magneticfield measurement by search coil .
7. Ferroelectric transition point by Dielectric Constant Measurement.
8. Rectification by junction Diode using various filters .
9. Dielectric constant of solid (wax) by Lecher Wire .
10. Existenceof discrete energy level by Frank Hertz experiment

Core Elective-A

FPYE-1054: CONDENSED MATTER PHYSICS-II LAB

1. Characterization of Solar cell .
2. Synthesis of thin films samples by thermal evaporation method and determination of its resistance.
3. Determination of precise lattice parameter and grain size of crystalline materials by X-Ray powder diffractometer.
4. Study of Laues spot of mica sheet using X-ray diffraction technique.
5. Study of the dispersion relation for the monoatomic and lattices using the given electrical transmission line.
6. Find the Youngs modulus for the given metal using composite piezoelectric oscillator technique.
7. Determination of magnetic susceptibility by Guoy-balance.
8. Velocity of ultrasonic waves in a given medium at different temperatures.
9. Measurement of Lande's g factor of DPPII by ESR at Microwave frequency.
10. Study of thermoluminescence of F-centre in alkali halide crystals. 11. Study of phase transition using feedback amplifier circuit.

Core Elective-B

FPYE-1055: PARTICLE PHYSICS-II LAB

1. Calibration of the x-ray spectrometer and determination of x-ray energy of unknown sources.
2. Determination of resolving poser of x-ray spectrometers.
3. Study of β spectrum.
4. Determination of absorption co-efficient of Aluminum using G. M Counter.
5. X-test and operating point determination using G-N tube.
6. Characteristics of G. M. counter.