Fatima Mata National College (Autonomous) Kollam

Scheme & Syllabus of

Post Graduate Degree in Physics

2019 Admission Onwards

Semester	Paper Code	Title of Paper	Contact hours per week			Exam duration (h)	Maximum mark		
			L	T	P		IA	UE	Total
I	19PPH11	Classical Mechanics	6	1	…	3	25	75	100
	19PPH12	Mathematical Physics	6	1	…	3	25	75	100
	19PPH13	Basic Electronics	6	1	…	3	25	75	100
	19PPH51	General Physics Practicals	…	1	3	…	…	…	…
	19PPH52	Electronics & Computer Science Practicals	…	1	4	…	…	…	…
	Total for Semester I (S1)		18	5	7	…	75	225	300
II	19PPH21	Modern Optics & Electromagnetic Theory	6	1	…	3	25	75	100
	19PPH22	Thermodynamics, Statistical Physics & Basic Quantum Mechanics	6	1	…	3	25	75	100
	19PPH23	Computer Science & Numerical Techniques	6	1	…	3	25	75	100
	19PPH51	General Physics Practicals	…	1	3	6	25	75*	100
	19PPH52	Electronics & Computer Science Practicals	…	1	4	6	25	75*	100
	Total for Semester II (S2)		18	5	7	…	125	375	500
III	19PPH31	Advanced Quantum Mechanics	6	1	…	3	25	75	100
	19PPH32	Advanced Spectroscopy	6	1	…	3	25	75	100
	19PPH33	Basic Nuclear and Particle Physics	6	1	…	3	25	75	100
	19PPH61	Advanced Physics Practicals	…	1	4	…	…	…	…
	19PPH62	Advanced Electronics Practicals	…	1	3	…	…	…	…
	Total for Semester III (S3)		18	5	7	…	75	225	300
IV	19PPH41	Condesed Matter Physics	6	1	…	3	25	75	100
	19PPH42 X	Special Paper I		1	…	3	25	75	100
	19PPH43 X	Special Paper II	6	1	…	3	25	75	100
	19PPH61	Advanced Physics Practicals	…	1	3	6	25	75*	100
	19PPH62	Advance Electronics Practical	…	1	4	6	25	75*	100
	19PPH01	Project		…	…	…	…	100	100
	19PPH02	Viva Voce		…	…	…	…	100	100
	Total for Semester IV (S4)		18	5	7	…	125	575	700
Grand Total			72	**20**	**28**	**…**	**400**	**1400**	**1800**

* 10 marks for records

L- Lecture IA - Internal Assesment

T - Tutorial UE - University Exam

P- -Practical

B: SPECIAL PAPERS FOR THIRD AND FOURTH SEMESTERS

Special Paper Category		Course Code	Name of Special Papers
1	ELECTRONICS	19PPH43E	Advanced Electronics-I
		19PPH44E	Advanced Electronics-II
2	MATERIALS SCIENCE	19PPH43M	Materials Science-I
		19PPH44M	Materials Science-II
3	NUCLEAR PHYSICS	19PPH43N	Advanced Nuclear Physics
		19PPH44N	Radiation Physics
4	SPACE PHYSICS	19PPH43S	Space Physics and Plasma Physics
		19PPH44S	Advanced Astrophysics
5	THEORETICAL PHYSICS	19PPH43T	Theoretical Physics-1
		19PPH44T	Theoretical Physics-2

C. GENERAL GUIDELINES

C-1 Theory papers

Books of study and corresponding chapters are given for most of the theory papers in the syllabus to define the scope of the syllabus.
For internal evaluation of theory papers at least one Viva must be conducted for each paper
For assignments and seminars current developments in the areas of the syllabus may be chosen for improving the general awareness of the student
In tutorial sessions of theory papers problem solving in different topics of the syllabus may be discussed.

C-2 Lab Courses

Rough records may be properly maintained for each practical paper and should be produced during the University Practical Examinations along with original record book.
Each student is encouraged to include critical comments on each experiments done in the original records including sources and estimates of errors, limitations in the experiments done and scope for improvements/ additions in the experimental work.
In performing Electronics Practicals: Bread Board Practice is recommended in addition to soldering of electronic circuits.

C-3 Special papers

Depending on the expertise and facilities available in a College (with approval of the University and Government as per rules) one of the five Specialisations (Special paperCategory) may be chosen by a student for the third and /or fourth semesters of the MSc ProgrammeinPhysics.At present for all specialisations practical courses are common.

C-4 Project work and Project Evaluation

The Project may be started during the second semester of the MSc programme.
25 marks of the project is to be awarded on the basis of internal assessment carried out in the College for each student concerned. A Project rough record may be maintained by each student to help to evaluate the progress of the project. Each student is required to present the completed project along with experimental demonstration if any in the college before the final University examinations in the Fourth Semester of the MSc (Physics) Programme.
For University Examinations for the Project: 50 marks is allotted for Project report evaluationand 25 marks allotted for Project based Viva Voce to be conducted along with General Viva Voce examination by the University.

D. Pattern of UniversityQuestion papers

D-1 Theory Papers

Each question Paper has three parts: Part A, Part B and Part C
Part A: Eight short answer questions covering the entire syllabus.*One of the question from this section may be used to test the CURRENT AWARENESS (general knowledge) of the student in the areas of syllabus covered for this paper.*Each question carries 3 marks.

Par B: contains three compulsory questions with internal choice. Questions cover all the three units in the syllabus. Each question carries 15 marks.
Part C: contains six problems covering the entire syllabus. The students need to answer any three. Each question carries five marks.
The question paper pattern for the theory papers is given separately.

D-2 PRACTICALS

Each practical paper carries a total of 75 marks. 10 marks are allotted for practical records.
19PPH52: Electronics and Computer Science: Unit A-Electronics practical (4h ,45 marks)
Unit B- Computer Science (2h, 20 marks)
19PPH61: Advanceed Physics has two parts : Physics Experiment (5h,45 marks)
Data Analysis of given scientific data (1 h,20 marks)
19PPH62: Advanced Electronics has two parts : (i)Electronics Practicals (4h,45 marks)
(ii) Microprocessor Practicals (2h,20 marks)

19PPH01 Project: Internal Evaluation for project is 25 marks
For University Examinations: 50 marks for Project Dissertation/report evaluation and 25 marks for Project based Viva Voce

19PPH02 General Viva Voce: For General Viva Voce covering the entire MSc Syllabus,University Examinations: 100 marks

Question Paper Pattern
MSc Degree Examination
Branch II PHYSICS
19PPHxy: ……………………

Duration : 3 hours **Maximum marks : 75**

Instructions to question paper setter

1. Each question paper has three parts - Part A, Part B and Part C
2. Part A contains eight short answer questions spanning the entire syllabus, of which the candidate has to answer any *five* question carries *three* marks.
3. Part B contains *three* compulsory questions with internal choice. Each question shall be drawn from each unit of the syllabus. Each question carries 15 marks
4. Part C contains six problems spanning the entire syllabus . The cndidate has to answer any *three*. Each question carries *five* marks

PART A

(Answer any five question. Each question carries three marks)

I. a)
b)
c)
d)
e)
f)
g)
h)

(5 x 3 = 15 marks)

PART B

(Answer all questions Each question carries 15 marks)

II A)

OR

II B)

III A)

OR

III B)

IV A)

OR

IV B)

(3 x 15= 45 marks)

PART C

(Answer any three questions. Each question carries five marks)

V a)
b)
c)
d)
e)
f)

(3 x 5= 15 marks)

Semester I

19PPH11: CLASSICAL MECHANICS (6L,1T)

Course outcome

Upon completion of the course, students will be able:

CO1: To use the analytical methods of mechanics based on generalized coordinates and momenta.

CO2: To solve the practical problems using these concepts

CO3: To develop an understanding of aspects in theory of relativity, non-linear dynamics, chaos etc

Unit I

Lagrangian Mechanics (12 hours)

Mechanics of a particle and system of particles- constraints-D'Alemberts principle and Lagrange's equations-simple applications of Lagrangian formulation-Hamilton's prin-ciple-techniques of calculus of variations-Euler Lagrange equation-Brachistochrone problem-derivation of Lagrange's equations from Hamilton's principle-conservation theorems and symmetry properties

Two body central force problem (14 hours)

Reduction to one body problem-equations of motion-equivalent one dimensional prob-lem-diffrential equation for the orbit in the case of integrable power law potentials-Kepler's problem-inverse square law of force-scattering in central force field-Ruther-ford formula- Virial theorem

Theory of small oscillations (10hours)

Equilibrium and potential energy-theory of small oscillations-normal modes with examples-longitudinal vibrations- longitudinal vibrations of carbon dioxide molecule

Unit II

Hamiltonian mechanics (12 hours)

Generalized momentum and cyclic coordinates-Hamilton's equations-examples in Hamiltonian dynamics-simple pendulum –compound pendulum-motion of a particle in a central force field-charged particle in an EM field-canonical transformations-generating functions-Poisson brackets and its properties- application to simple problems

Hamilton Jacobi equations (10 hours)

Hamilton-Jacobi equation-harmonic oscillator as an example-separation of variables in Hamilton-Jacobi equation-action angle variables-Kepler's problem

Rigid body dynamics(14 hours)

Generalized coordinates of rigid body-Euler's angles-infinitesimal rotations as vectors-angular momentum and inertia tensor-Euler's equations of motion of a rigid body-force free motion of symmetrical top

Motion of heavy symmetrical top -Lagrange's equations, First integrals of motion, condition for steady precession

Unit III

Special and General Relativity theory(14 hours)

Lorentz transformation in four dimensional spaces-covariant four dimensional formulations-force and energy equations in relativistic mechanics-Lagrangian formulation of relativistic mechanics-covariant Lagrangian formulation

General theory of relativity-principle of equivalence and applications-ideas of Riemannian geometry-space time curvature-geodesics-Einsteins equations of General theory of Relativity-observational evidences to General relativity

Introduction to non-linear dynamics(12 hours)

Linear and nonlinear systems-integration of second order non-linear differential equations-pendulum equation-phase plane analysis of dynamical systems-linear stability analysis-limit cycles

Elements of classical chaos(10 hours)

Bifurcation **Types of bifurcation: basic three types with examples—Bead on a ring,**-logisitc map-strange attractors-Lyapunov exponent and Chaos-ideas of fractals and solitons

Books for study

1. H.Goldstein,C.PooleabdS.Safko,*Classical Mechanics*,3rdEdn,Pearson Education Inc (2008 Print)
2. J.C.Upadyaya,*ClassicalMechanics*,RevisedEditon,Himalaya Publishing Company (2005)

3. G.Aruldas,*ClassicalMechanics*,Prentice Hall of India Pvt Ltd (2008 Print)
4. K.D.Krori,*Fundementals of Special and General Relativiy*,PHI Learning Pvt Ltd (2010)
5. S.K.Srivastava,*General Relativity and Cosmology*,PHI learning Pvt Ltd (2008)
6. P.G Drazin and R.S Johnson,*Solitons –an Introduction*,Cambridge University Press(1989)

References

1. N.C.Rana and B.S.Joag,ClassicalMechanics,TataMcGrawHill (1991)
2. V.B.Bhatia,Classical Mechanics with introduction to nonlinear oscillations and chaos,Narosa Publishing House (1997)
3. M.Tabor ,Chaos and integrability in nonlinear dynamics,Johnwiley& Sons (1989)
4. R.K.Pathria,The Theory of Relativity,SecondEdition,dover Publications (2003)

MODEL QUESTION PAPER

19PPH11: Classical Mechanics

Time: 3Hrs **Max Marks: 75**

Section A

(Answer any five questions. Each carries 3 marks. 3x5=15marks)

I a) What are generalized coordinates?

b) What are constraints? Distinguish between holonomic and non holonomic constraints.

c) State and prove any three properties of Poisson bracket.

d) Write down the Hamilton Jacobi equation. What is the physical significance of the Principal function S present in it?

e) Give two examples of Lorentz four vectors. What is the first approximation to the relativistic expression for the energy of a free particle for $v<<c$?

f) How many independent co-ordinates are necessary to specify the motion of a rigid body? Establish this in any one way.

g) What is a strange attractor? Give an example.

h) What are action angle variables? Why are they called so?

Section B

(Answer all questions. Each carries 15 marks 15x3=45 marks)

II A) State Hamilton's Principle. Derive Lagrange's equation from Hamilton's Principle.

OR

II B) what are normal modes of vibrations? Discuss on the longitudinal vibrations of CO_2 molecule.

III A) Derive the expressions for the generating functions of canonical transformation of a system.

OR

III B) Derive the Euler's equations of motion of a rigid body and hence solve the problem of force free motion of a symmetrical top.

IV A) Describe the theory of how solitonic solutions can arise in a non linear dispersive medium.

OR

IV B) a) Discuss the phase plane analysis of any one dynamical system.

b) What are limit cycles? Give examples.

Section C

(Answer any three questions. Each carries 5 marks. 5x3=15marks)

V a) Using Lagrangian method obtain the equation of motion of an Atwood's machine

b) Obtain the equation of motion of a simple pendulum by using Lagrangian method and hence deduce the formula for its time period for small amplitude oscillation.

c) Show that the transformation $Q= 1/p$ and $P=qp^2$ is canonical.

d) Prove that the Poisson bracket of two integrals of motion is itself an integral of motion.

e) Obtain the connection between Hamilton's Principal function S and the Lagrangian of a system.

f) Obtain the expressions for the force and energy in relativistic mechanics.

19PPH12: Mathematical Physics (6L 1T)

Course outcome

Upon completion of the course, students will be able:

CO1: To use mathematical methods for solving complex physical problems such as vector space and matrices, and curvilinear coordinates.

CO2: to gain familiarization of various techniques for solving differential equations and the Fourier and Laplace Transforms for different applications.

CO3: To enhance their knowledge about Complex variables, Tensors, Group Theory, and Probability.

Unit I

Vector analysis and matrices (8 hours)

Review of vector analysis-vector calculus operators-orthogonal curvilinear coordinates –Gradient, divergence, curl, Laplacian in cylindrical and spherical polar coordinates-orthogonal and unitary matrices-Hermitian matrices-Caley Hamilton Theorem, Eigen Values, Eigen vectors, normalized eigen vectors- diagonalization of matrices-normal matrices.

Complex analysis (8 hours)

Analytical function-Cauchy-Riemann conditions-Cauchy's integral theorem and formula-singularities and mapping-calculus of residues-dispersion relations.

Fourier series and applications (8 hours)

General principles of Fourier series-advantages and applications-Gibbs phenomenon-Discrete Fourier Transform-Fast Fourier transform.

Probability (12 hours)

Definitions and simple properties of probability-random variables-Chebyshev inequality and moment generating function-discrete and continuous probability distributions-binomial distributions-Poisson distributions-Gauss Normal distribution-error analysis and least square fitting-chi-square and student 't' distributions.

Unit II

Differential equations (16 hours)

Partial differential equations-first order equations-separation of variables-singular points-series solutions and Frobenius method-non homogeneous partial differential equations- Laplace transforms, shifting properties and inverse Laplace transforms-applications to solution of simple differential equations.

Special functions (20 hours)

Bessel functions of the first kind-orthogonality-Neumann functions-Hankel functions-modified Bessel functions-spherical Bessel functions-Legendre functions-generating function-recurrence relations and orthogonality-associated Legendre functions-spherical harmonics-Hermite functions-Laguerre functions-Chebyshev polynomials-hypergeometric functions(basic ideas only), Green's function.

Unit III

Tensor Analysis (18 Hours)

Notations and conventions in tensor analysis-Einsteins summation convention-covariant and contravariant and mixed tensors-algebraic operations in tensors-symmetric and skew symmetric tensors-Kroneker delta-Quotient law-conjugate symmetric tensor-metric tensor: covariant & contravariant-tensor calculus- differentiation of a tensor-covariant derivative-intrinsic derivative-Christoffel symbols-kinematics in Riemann space-Riemann—Christoffel tensor.

Group theory (18 hours)

Definitions of a group-elementary properties- group multiplication table-conjugate elements & classes-sub groups-homomorphism and isomorphism of groups-representation of groups-reducible and irreducible representations-orthogonality theorem-simple applications in crystallography and molecular symmetry-Lie groups-SU(2) groups and their representations.

Books for study

1. G.B.Arfken and H.J.Weber, *Mathematical methods for Physicists*, 6th Edition,Elsavier (2005).
2. H.K.Dass and R.Verma,*MathematicalPhysics,S.Chand& Co Pvt Ltd* (1997)
3. A.W.Joshi,*Matrices and Tensors in Physics*,3rd Edition,New Age International Pub (1995)
4. A.W.Joshi, *Elements of Group Theory for Physicists*,Fourth Edition, New Age International Pub (1997).

5. B. D. Gupta, Mathematical Physics,
6. B. S. Rajput, Mathematical Physics,

References

1. Harry Lass,Vector and Tensor Analysis,McGraw Hill Pub (1950)
2. M.L.Jain,Vector Spaces and Matrices in Physics,Alpha Science International (2001)
3. W.W.Bell,Special Functions for Scientists and Engineers,Dover Publications (2004)
4. W.K.Tung,Group theory in Physics,World Scientific Pub Co (1999)
5. C.Harper,Introduction to MathemaicalPhysics,Prentice Hall (1986)
6. A.K.Ghatak,I.C.GoyalamdS.T.Chua,MathematicalPHYsics,Macmillan India (1985).

MODEL QUESTION PAPER

19PPH12: Mathematical Physics

Time: 3Hrs **Max Marks: 75**

Section A

(Answer any five questions. Each carries 3 marks. 3x5=15marks)

I a) Distinguish between homorphism and isomorphism with examples.
b) Define a cyclic group .Give an example.
c) Show that the characteristic roots of a hermitian matrix are real.
d) What is Laguerre's associated equation and its solution.
e) Obtain the relation between the solution of Legendre equation and the associated Legendre equation.
f) Find the inverse of matrix A

$$A = \begin{bmatrix} 1 & -1 \\ 1 & 1 \end{bmatrix}$$

g) State the axioms of a linear vector space.
h) Define Dirac delta function and mention its properties.

Section B

(Answer all questions. Each carries 15 marks)

II A) a) Show that permutation element formed by three objects (1,2,3) form a group .
b) Construct the multiplication table of the above group.

OR

II B) a) What are tensors? Describe the algebraic operations in tensors?
b) What are Christoffel symbols?

III A) a) Obtain the polynomial solution of Legendre differential equation
b) Show that Legendre polynomials forms an orthonormal set of functions

OR

III B) a) Define Laplace transform. Obtain the Laplace transform of a) Coshkt and b) Coskt.
b) Obtain the orthogonality property of Bessel's function.

IV A) a) Explain the diagonalisation of matrix comment on its application .
b) Find the diagonalising matrix for the matrix given below .Also find A^5

$$\boldsymbol{A} = \begin{bmatrix} 2 & 1 & -1 \\ 3 & 2 & -3 \\ 3 & 1 & -2 \end{bmatrix}$$

OR

IV B) Express the Laplacian operator in cylindrical and in spherical polar co-ordinates.

Section C

(Answer any three questions. Each carries 5 marks)

V a) Show that the set of element **{ 1,-1,I, -i}** under multiplication forms a cycle group .
b) Obtain multiplication table for group of symmetry operation of a square .
c) Evaluate $\int_{-1}^{+1} [P_n(x)]^2 dx$ where $P_n(x)$ is the Legendre polynomials.
d) Find and $L_2^2(x)$ and $L_3^1(x)$.

e) Show that $\begin{bmatrix} i & 0 \\ 0 & 1 \end{bmatrix}$ is a unitary matrix.

f) Calculate the moment of the force ***F=5i+2j*** about the origin if the force act at the point (2,1)

19PPH13: BASIC ELECTRONICS

Course outcome

Upon completion of the course, students will be able:

CO1: To design the basic electronic circuits by using the components like BJT, FET, Op amp etc

CO2: To enhance knowledge about Optoelectronic and microwave devices etc.

CO3: To gain knowledge about electronic instrumentation and digital electronics operations.

Unit I

Transistor Amplifiers (10 hours)

Frequency response of an amplifier circuits-decibel voltage gain and decibel power gain-impedance matching - Bode plots-Miller effects-rise time bandwidth relations-frequency analysis of BJT and FET amplifier stages

Operational Amplifier and its applications (18 hours)

Op amp - frequency response, poles and zeroes, transfer functions (derivation not required), expression for phase angle- Active filters-first order and second order Butterworth transfer function-first order and second order active filters-low pass , high pass and band pass filters-comparators-OP Amp as a voltage comparator-zero crossing detectors-Schmitt trigger-voltage regulators-square , triangular and saw tooth wave form generators-Oscillator principle-Wein bridge oscillator (derivation not required) - monostable and astable multivibrator circuits using IC 555 timer-Phase Locked Loop circuits (PLL) (qualitative ideas only)

Microwave solid state devices (12 hours)

Tunnel diode-Varacter diode-IMPATT diode-Gunn diode- QWITT diode- TRAPATT diode (Characteristics and applications)

Unit II

Digital Electronics

Arithmetic and data processing digital circuits (16 hours)

Binary adder and subtractor- arithmetic logic unit- binary multiplication and division- arithmetic circuits using HDL- multiplexers- demultiplexers- BCD to decimal decoder- seven segment decoder- parity generators and checkers- magnitude comparator- programmable logic arrays .

Sequential digital circuits (20 hours)

Flip flops- edge triggered- SR flip flops- JK flip flop- D- flip flop- JK master-slave flip flop - different types of registers (SISO, SIPO, PISO, PIPO)- universal shift registers- applications counter asynchronous and synchronous electronic counters- decade counters-digital clock.

Unit III

Optoelectronics (22 hours)

Optical fiber as a wave guide-mode theory of circular wave guide- modes in step index fibers signal distortion in optical fibers- group delay, material dispersion, wave guide dispersion- sources of attenuation- absorption, scattering, bending loss, core and cladding loss- optical sources- LED’s structure, quantum efficiency and power- laser diodes- modes and threshold conditions, rate equations, efficiency and resonant frequency-photo detector- pin and avalanche photo diodes principles- optical amplifier- basic applications and types, semiconductor optical amplifiers, erbium doped fiber amplifiers.

Electronic Instrumentation (14 hours) Electronic measurements and instruments-comparison between analog and digital instruments performance and dynamic characteristics-ideas of errors and measurement standards voltmeters ammeters- CRO- Block diagram, CRT, CRT circuits, vertical deflection system- delay line, multiple trace, horizontal deflection system, oscilloscope probes and transducers, oscilloscope techniques, storage oscilloscope, digital storage oscilloscope- classification of transducers-active and passive transducers-force and displacement transducers-strain gauges temperature measurements, Thermistors -thermocouples-flow measurements.

Books for study

1. A. Malvino and D.J.Bates, Electronics Prinicples,7thEdition,Tata McGraw Hill(2007)
2. R.A. Gayakwad, Operational Amplifiers and Linear integrated Circuits, Prentice Hall of India (2000)
3. M.S. Tyagi, Introduction to semiconductior materials and devices, Wiley India (2005)
4. B.G. Streetman, S.K. Banerjee, Solid state electronic devices. Pearson Inc (2010)
5. J. Millman, C. Halkias and C.D. Parikh,Integrated Electronics,TataMcGrawHill (2010)
6. D.P. Leach,A.P. Malvino, and G. Saha ,Digital principles and applications,Tata Mc Graw Hill (2011)
7. G.Keiser, Optical Fibre Communication,3rdedition,McGraw Pub (2000)
8. Lal Kishore, Electronic measurements and Instrumentation, Dorling Kindersley (India) Pvt Ltd (2010)
9. W.D. Cooper, A.O. Helfrik and H. Albert, Electronic Instrumentation and measurement Techniques, PHI (1997)

References

1. T.F. Bogart Jr, J.S. Beasley and G. Reid, Electronic devices and circuits, Sixth Edition, Pearson Inc (2004)
2. Thomas. L. Floyd, Digital Fundamentals, 10th edition, Dorling Kindersley (India) Pvt Ltd (2011)
3. Joachion Piprek, Semiconductor Optoelectronic Devices, Academic Press (2003)

MODEL QUESTION PAPER

19PPH13: Basic Electronics

Time: 3Hrs **Max Marks: 75**

Section A

(Answer any five questions. Each carries 3 marks. 5x3=15marks)

I a) Write a short note on frequency response of an amplifier.
b) Describe the working of a half adder.
c) Sketch a 4-to-1 line multiplexer and explain its working.
d) Explain the low pass and high pass filter behaviors of an RC Circuit.
e) Define the rise time. Show that the rise time is 2.2RC in charging a capacitor.
f) What is mean by gain roll-off rate? How is it affected by the presence of more than one pole?
g) Compare analog and digital instruments.
h) What are the static characteristics of instruments?

Section B

(Answer all questions. Each carries 15 marks. 3x15=45marks)

II A) What are Bode plots? Discuss the Bode plots of voltage gain and phase angle for an RC circuit

OR

II B) Discuss the working of a 555 timer with a neat diagram. How is it used as a monostable multivibrator?

III A) Explain the working of clocked SR flip flops and JK flip flops

OR

III B) What are registers? Write a note on shift registers and their applications.

IV A) Describe the source of attenuation and signal distortion in the optical fiber.

OR

IV B) Mention the different methods used for analog to digital converter. Explain any one method in detail.

Section C

(Answer any three questions. Each carries 5 marks. 3x5=15marks)

V a) Design a low pass filter for a cut off frequency of 1.5 KHz and gain of 20, using OP- AMP-741. Draw the circuit diagram and mark the components
b) Neatly sketch a 16-to-1 line multiplexer. .
c) Sketch and explain the working of a 4-bit binary adder –subtractor.
d) A sinusoidal voltage source is connected across the series combination of a20kΩ resistor and 200μF capacitor. Draw the bode plot of the voltage gain if the output is taken across the capacitor.
e) An amplifier with a gain 10000 has an upper cut-off frequency 100 Hz. Draw its ideal bode plot. what is its unity –gain frequency.
f) We have a multimode step index optical fiber that has a core radius of 25μm, a core index of 1.48 and index difference Δ=0.01 .What are the number of modes in the fiber at wavelength 860,1310 and 1550nm?

Semester II

19PPH21: Modern Optics & Electromagnetic Theory (6L 1T)

Course outcome

Upon completion of the course, students will be able:

CO1: To understand the basics concepts of modern optics, non linear optics etc

CO2: To gain a deep knowledge on electromagnetic waves and relativistic electrodynamics.

CO3: To analyze the theory of guided waves and radiation systems.

UNIT l

Modern optics (24 hours)

Multiple beam interference-Fabry-Perot interferometer- theory of multilayer films-antireflection films and high reflectance films -Fresnel- Kirchoff integral theorem and formula- Fraunhofer and Fresnel diffraction patterns and theory-applications of Fourier transforms to diffraction- acoustic- optic modulation- basic ideas of Raman-Nath diffraction and Bragg diffraction holography as wave front reconstruction-propagation of light in crystals-optical activity and Faraday rotation

Non-linear optics (12 hours)

Harmonic generation- second harmonic generation- phase matching- third harmonic generation optical mixing-paramagnetization of light- self focusing- multi quantum photoelectric effecttwo photon process and theory-multiphoton processes- three photon processes- second harmonic generation- parametric generation of light.

UNIT II

Electrodynamics (12 Hrs)

Potential formulation of electrodynamics-scalar and vector potential-gauge transformation-Coulomb gauge and Lorentz gauge-Lorentz force law in potential form-Energy and momentum in electrodynamics-Newton's third law in electrodynamics-Poynting's theorem-Maxwell's stress tensor

Electromagnetic waves (12 hours)

Electromagnetic wave equations-electromagnetic waves in non-conducting media-plane waves in vacuum-energy and momentum of electromagnetic waves-reflection and transmission at normal and oblique incidence-electromagnetic waves in conductors –modified wave equations and plane waves in conducting media-reflection and transmission at a conducting interface

Relativistic electrodynamics (12 hours)

Magnetism as a relativistic phenomena-transformation of the field-electric field of a uniformly moving point charge-electrodynamics in tensor notation-electromagnetic field tensor-potential formulation of relativistic electrodynamics

UNIT III

Electromagnetic Radiation (9Hrs)

Dipole radiation-retarded potential- electric dipole radiation-magnetic dipole radiation-radiation from arbitrary distribution of charge and current- Leinard Wiechert potential-field of a point charge in motion- power radiated by a point charge.

Transmission lines (9 hours)

Transmission line parameters and equations-input impedance-standing wave ratio and power-The Smith Chart-applications of transmission lines

Wave guides(9 hours)

Rectangular wave guides-transverse magnetic (TM) modes-Transverse electric (TE) modes-wave propagation in the wave guide-power transmission and attenuation

Antennas (9 hours)

Radiation from Hertzian dipole-half wave dipole antenna-quarter wave mono-pole antenna-antenna characteristics-antenna arrays-effective area and Friji's equations

Books for study

1. G.R.Fowles,, Introduction to Modern Optics, Second Edition, Dover Publications (1989)
2. A.Yariv, Introduction to Optical electronics, Holt, Reinhart and Winston (1976)
3. A.Ghatak and K.Thyagarajan, Optical Electronics,Cambridge University Press (1998)

4. D.Roody and J.Coolen,,Elecronic Communications, FourthEdition, DorlingKindersley (India) Pvt Ltd (2008)
5. D.J.Griffiths, Introduction to Electrodynamics, PHI Learning India Pvt Ltd (2007)
6. M.N.O.Sadiku, Elements of electromagnetics, Oxford University Press (2007)
7. D.K.Cheng,Field and Wave electromagnetics , Second Edition ,Addison Wesley (1999)

References

1. J.R.Meyer-Arendt, Introduction to Classical and Modern Optics, Prentice Hall Intl (1995)
2. J.C.Palais, Fibre optic communications, Fifth Edition, Pearson Education Inc (2005)
3. E.C.Jordan and K.G.Balmain, Electromagnetic waves and radiating systems, Second Edition, Pearson Education (2002)
4. L.Ganesan and S.S.Sreejamole, Transmission lines and wave guides, Second Edition, Tata McGraw Hill (2010).

MODEL QUESTION PAPER

19PPH21: Modern Optics and Electromagnetic Theory

Time:3 hours **Max.Marks:75**

Part A

Answer any 5 questions .Each question carries 3 marks (5x3=15marks)

I a) Explain the theory of multiple beam interference. Obtain an expression for transmitted intensity.
b) Differentiate between phase and amplitude holograms. How can we reconstruct image from a hologram?
c) Briefly discuss optical activity. Write down the expression for specific rotatory power.
d) Establish the fact that TEM wave transmission is not possible in a rectangular waveguide.
e) What is meant by intrinsic impedance(η) of a wave guide?
f) Distinguish the terms K,γ and β in a wave guide transmission.
g) What are scalar and vector potentials?
h) Explain the validity of Newton's third law in electrodynamics.

Part B

Answer all questions. Each carries 15 marks (3x15=45marks)

II A) Deduce (1) Fresnel –Kirchoff integral formula .(2) Discuss with theory, the Fraunhoffer diffraction pattern of the double slit.

OR

B) Explain the working of electro-optic modulator. Derive an expression for the half wave voltage of the crystal used in it.

III A) Derive the mathematical expression for Poynting's vector.

OR

B) Obtain the wave equation for electromagnetic waves in a conducting medium. Explain the significance of "skin depth" and show that it depends on frequency of electromagnetic wave.

IV A) Obtain the expression for critical frequency of a TE wave transmission in a rectangular wave guide.

OR

B) Determine the expressions for input impedance, standing wave ratio and power flow through a transmission line.

Part C

Answer any 3 Questions. Each carries 5 marks (3x5=15marks)

V a) A point source is to be used in the diffraction experiment. Distance from the source to the aperture is 5m. If the aperture is 1mm in diameter determine whether Fraunhoffer or Fresnel's diffraction takes place when separation of the aperture and screen is (1)10cm (2) 5m. (Given λ=500nm)
b) The cutoff frequency of an air-filled rectangular waveguide is 2.4GHz for TE10 mode. What would be the cutoff frequency if the wave guide is filled with a lossless nonmagnetic medium with dielectric permittivity is six times that of air.
c) An air filled copper X-band waveguide, with dimensions a =2.286cm, b=1.016cm. Find the cut-off frequencies of the TE_{11}, TE_{21} and TE_{22} modes.

d) Deduce Lorentz force law in potential form.
e) What do you mean by gauge transformation? What are the conditions of Lorentz gauge and Coulomb's gauge?
f) The specific rotation of quartz in light of wavelength 589nm is 21.7deg/mm. What thickness of quartz cut perpendicular to its axis and inserted between parallel polarizers will cause no light to be transmitted?

19PPH22: THERMODYNAMICS, STATISTICAL PHYSICS AND BASIC QUANTUM MECHANICS (6L, 1T)

Course outcome

Upon completion of the course, students will be able:

CO1: To gain a thorough idea about the fundamentals of statistical physics and to understand the various statistical methods involved in explaining thermodynamics

CO2: To define the concepts of identical particles and quantum statistics, and phase transitions

CO3: To independently solve the Schrödinger equation for simple one-dimensional systems, atomic and molecular systems etc.

Unit I

Thermodynamic relations and consequences (20 hours)

Thermodynamic functions and Maxwells's equations- Clausius -Clapeyron's equations- Properties of thermodynamic potentials-Gibbs-Helmholtz relation-thermodynamic equilibrium, Nernst –heat theorem and its consequences-Gibb's phase rule-chemical potential-vapour pressure relation and chemical constants .

Foundations of classical statistical physics (16 hours)

Phase space-ensembles-Liouville's theorem-statistical equilibrium-micro canonical ensemble partition functions and thermodynamic quantities-Gibb's paradox-Maxwell-Boltzmann distribution laws-grand canonical ensemble

Unit II

Quantum statistics (26 hours)

Quantum statistics of classical particles-density matrix in microcanonical, canonical and grand canonical ensembles-Bose Einstein statistics and Bose Einstein distribution law-Maxwell Boltzmann statistics and Maxwell Boltzmann distribution law—Fermi Dirac statistics and Fermi Dirac distribution law-comparison of three types of statistics-applications of quantum statistics-Planck radiation laws-Bose Einstein gas and Bose Einstein condensation—Fermi Dirac gas -electron gas in metals-thermionic emission-statistical theory of white dwarfs

Phase transitions (10 hours)

Triple point-Vander Wal's equation and phase transitions-first and second order phase transitions Ehrenfest's equations- Isingmodel .

Unit III Foundations of quantum mechanics (14 hours)

Basic postulates if quantum mechanics- Hilberts space- observables- Hermitian operators general statistical interpretation-Uncertainty principle-minimum uncertainty wave packet energy time uncertainty principle-Dirac notation-Matrix representation of state vectors and operators-change of representations- eigenvalue problem in matrix mechanics-energy and momentum representationsunitary transformations involving time-Schrodinger, Heisenberg and interaction pictures.

Energy eigen valueproblems (22 hours)

One dimensional eigen value problems-square well potential-potential barrier-alpha particle emission-Bloch waves in periodic potential-linear harmonic oscillator problem using wave mechanics and operator methods-free particle wave functions and solutions-three dimensional eigen value problems-particle moving in spherical symmetric potential-rigid rotator-hydrogen atom problem-three-dimensional potential well- Deuteron

Books for study

1. R. K. Pathria, Statistical Mechanics, Pergamon Press (1991)
2. SatyaPrakash, Statistical Mechanics, Kedarnath Ram Nath Publishers, Meerut and Delhi (2009)

3. Roger Bowley and Mariana Sanchez, Introductory statistical mechanics,secondedition,Clarendon press, Oxford(1999).
4. B.K. Agarwal and HariPrakash, Quantum Mechanics, Prentice Hall of India (2002)
5. S. Devanarayanan, Quantum Mechanics, Sci Tech Publications (India) Pvt Ltd (2005)
6. D.J. Griffiths, Introduction to Quantum Mechanics, Second Edition, Pearson Education Inc (2005)
7. G. Aruldas, Quantum Mechanics, Second Edition, PHI learning Pvt Ltd (2009).

References

1. R.K. Srivastava and J. Asok , Statistical Mechanics, Wiley Easter Ltd (2005)
2. S.K. Sinha, Statistical Mechanics-Theory and Applications, Tata McGraw Hill
3. P.M. Mathews and K.Venkitesan, A Text Book of Quantum Mechanics, Tata McGraw Hill (2010)
4. A. Ghatak and S. Lokanathan ,Quantum Mechanics Theory and Applications, Kluewer Academic Publishers (2004).
5. V.K. Thankappan, Quantum Mechanics, Second Edition, New Age International Pvt Ltd (2003)

MODEL QUESTION PAPER

19PPH22: Thermodynamics, Statistical Physics and Basic Quantum Mechanics

Time:3 hours **Max.Marks:75**

Part A

Answer any 5 questions .Each question carries 3 marks (5x3=15marks)

I a) Write a note on Dirac's ket and bra notations.
b) Explain commuting and non commuting operators.
c) Prove that eigen values of a Hermitian operator are real.
d) What is the difference between classical and quantum statistics?
e) Distinguish between a boson and a fermion.
f) Define density matrix
g) Show that the ratio of adiabatic and isothermal elasticities of any substance is equal to Cp/Cv.
h) Derive the third Maxwell's relation.

Part B

Answer all questions. Each carries 15 marks (3x15=45marks)

II A) Discuss Bose-Einstein condensation and how it differs from ordinary condensation. Explain the anomalous properties of liquid Helium at its transition temperature.

OR

What is the density matrix in Quantum Statitics. Obtain the density matrix for microcanonical, canonical and grand canonical ensembles.

III A) State and Explain Nernst Heat theorem of thermodynamics. Explain any three consequences of third law of thermodynamics.

OR

B) Obtain the Maxwell Boltzmann distribution law and deduce the distribution law of energies.

IV A) Obtain the eigen values and eigen states of a Harmonic oscillator using operator method.

OR

B) a) Define the energy eigen values of a rigid rotator of two masses separated by a distance.
b) In a stationary state of a rigid rotator, show that the probability density is independent of the angle Φ.

Part C

Answer any 3 Questions. Each carries 5 marks (3x5=15marks)

V a) Show that the ground state of harmonic oscillator corresponds to minimum uncertainty product.
b) Obtain the time independent Schrodinger equation from group velocity equation.
c) Obtain the Claussius Clapeyron equation.
d) Obtain the Gibb's Helmoltz relations.
e) Consider silver with one free electron per atom. Calculate its Fermi energy. Density of silver =10.5gm/cc. ;atomic weight =108; Avagadro number = 6.02 x 10^{23} atom per mol
f) Three particles are to be distributed in four energy states. Write down the possible ways for such a distribution if the particles are (1) fermions (2) bosons and (3) classical particles.

19PPH23: COMPUTER SCIENCE AND NUMERICAL TECHNIQUES (6L, 1T)

Course outcome

Upon completion of the course, students will be able:

CO1: To enrich themselves with deep knowledge about Foundations of computer science, microprocessor and python programming.

CO2: Numerical Techniques (PPH23) on C++ programming will help the student to master using key structured programming constructs: declarations, sequence, selection, repetition, evaluating expressions; arrays, pointers etc.

CO3: To write algorithms and programs in the language to solve physical problems.

Unit I

Foundations of computer science (12 hours)

Introduction to computers-computer architecture-memory (RAM and ROM, cache) and storage- I/O devices-operating systems-data communications, computer networks and topology.

Introduction to microprocessors (12 hours)

Evolution of microprocessors-microcontrollers and digital signal processors- Intel 8085 8 bit microprocessor-pin description-functional description- 8085 instruction format-addressing modes of 8085- interrupts of 8085-memory interfacing- 8085 machine cycles and Bus timings- assembly language programming of 8085.

Introduction to Python Programming (12 hours)

Python - Python shell, number, variables, comparisons and logic, Python objects - strings, lists, tuples, loops , control flow, file input and output functions.

Unit II

Programming with C++ (36 hours)

Features of C++-basic structure of C++ programs-header files-in and out functions compilation and execution-data types-constants and variables , global variables operators and Expressions of C++- flow control-conditional statements-iterative statements-switch statements-conditional operators as an alternative to IF-nested loops-break statements-ext ( ) functions-structured data types-arrays-storage classes-multidimensional arrays-sorting of strings-functions-built in and user defined- accessing function and passing arguments to functions-calling functions with arrays-scope rule for functions and variables-structures in C++-classes and objects –definition class declaration class function definitions-creating objects-use of pointers in the place of arrays-file handling in C+ +-basic file operations-serial and sequential files-reading and writing on to disks.

Unit III

Numerical Techniques (36 hours)

Solution of simultaneous linear algebraic equations-Gauss elimination method-Gauss Jordan method-inverse of a matric using Gauss elimination method-Finite differences-forward and backward differences-central differences-difference of a polynomial-error propagation in difference table-Interpolation with equal intervals-Gregory Newton forward and backward formula- error in polynomial interpolation-central difference interpolation formula-Gauss's forward and backward formula- Stirling's formula-Lagrange interpolation formula-numerical differentiation-numerical integration using general quadrature formula-Trapezoidal rule Simpsons 1/3 and 1/8 rules-numerical solutions to ordinary differential equations-Euler and modified Euler methods-Runge Kutta methods(2^{nd} and 4^{th}order)-numerical solution to partial differential equations-solutions to Poisson and Laplace equations.

Books for study

1. ITL Education Solutions Ltd, Introduction to Computer Science, Second Edition, Dorling Kindersley (India) Pvt Ltd (2011)
2. V.N. Vedamurty and N. Iyengar,Numerical Methods,Vikas Publishing Pvt Ltd (1998)
3. K. Udayakumar, and B.S. Umasankar,The 8085 microprocessor,Dorling Kindersley(India) Pvt Ltd (2008)
4. Christian Hill, Learning Scientific Programming with Python, Cambridge University Press (2015)
5. V. Carl Hamacher, Z.G.Vranesic and S.G. Zaky, Computer Organization, Fourth Edition, McGraw Hill International Edition (1996)
6. Peter Norton etal., Beginning Python, Wiley Publishing (2005)
7. Abishek Yadav, Microprocessor 8085 8086,University Science Press, New Delhi (2008)

8. D.Ravichandran, Programming in C++,Tata McGraw Hill (2011)
9. M.T.Somasekhara, Programming in C++, PHI Pvt Publishing (2005)
(Chapters 4,5,6,7,8,9,11 and 12 of Vedamurty and Iyengar)

References

1. V. Rajaraman, Fundamentals of Computers, Fifth Edition, PHI (2010)
2. R.S.Gaonkar, Microprocessor-Architecture, Programming and Applications with 8085
3. S.S. Sastry, Introductory method of Numerical analysis, Fifth Edition, PHI
4. P. Ghosh, Numerical Methods with computer programs in C++,PHI learning Pvt Ltd
5. Bjorne Stroustrup, The C++ Programming Language ,Fourth Edition, Addison Wesley

MODEL QUESTION PAPER

19PPH23: Computer Science and Numerical Techniques

Time:3 hours **Max.Marks:75**

Part A

Answer any 5 questions .Each question carries 3 marks (5x3=15marks)

I a) Explain the different types of errors in C++ language.
b) What are the differences between break and continue statements.
c) "C++ is the superset of C". Explain.
d) Construct a forward difference table with an error in one entry and list out the features of propagation of error in difference table.
e) Establish the symbolic relation (i) $E \equiv 1+\Delta$ (ii) $\equiv 1-E^{-1}$ and (iii)$\Delta \equiv E$
f) Show that the nth order differences of an nth degree polynomial are constants.
g) Define stack and stack pointers.
h) Describe any three addressing modes of 8085. Give at least one example.

Part B

Answer all questions. Each carries 15 marks (3x15=45marks)

II A) Describe the operators and expressions in C++ with examples.

OR

B) Describe the iterations in C++ with examples.

III A) Obtain Newton-Gregory forward difference interpolation formula for equal interval interpolation.

OR

B) Explain Runge-Kutta methods for obtaining numerical solutions tom ordinary differential equations.

IV A) Describe the memory read and I/O write machine cycles with the help of timing diagram.

OR

B) Describe the various synchronous, asynchronous and DMA data transfer scheme for a microprocessor system.

Part C

Answer any 3 Questions. Each carries 5 marks (3x5=15marks)

V a) Find out (y=4.5) if y(3)=2.7, y(4)=6.4, y(5)=12.5, y(6)=21.6 and y(7)=34.3.
b) Find the inverse of the matrix using Gauss elimination method.

$$\begin{bmatrix} 2 & 1 & 3 \\ 0 & 3 & -1 \\ -2 & 0 & 4 \end{bmatrix}$$

c) Write a program to generate Fibonacci series using function.
d) Write a program to sort a list of numbers in the descending order using array.
e) Write an 8085 program to exchange the constants of memory locations 8000H and 8010H
f) Describe an 8085 program to add two 8-bit numbers.

Semester III

19PPH31: Advanced Quantum Mechanics (6 L, 1 T)

Course outcome

Upon completion of the course, students will be able:

CO1: To analyse and solve advanced problems in quantum mechanics by learning approximate techniques, handling many body problems, etc

CO2: To enhance knowledge about symmetry and conservation laws, quantum theory of scattering, etc.

CO3: To understand the preliminary ideas of relativistic quantum mechanics.

Unit I

Variation method (08 hours)

The variational principle-Rayleigh Ritz method-variation method for excited states-ground state of Helium and Deuteron.

Time Independent Perturbation Theory (12 hours)

Basic concepts of time independent perturbation theory-non-degenerate energy levels- First order correction to anharmonic oscillator-ground state of He atom using perturbation theory- effect of electric field on the ground state of hydrogen- degenerate energy levels- effect of electric field on the n=2 state of hydrogen-spin_orbit interaction.

Time Dependent Perturbation Theory (06 hours)

Time dependent perturbation theory-first order and harmonic perturbation-absorption and emission of radiation-Einstein's A and B coefficients.

WKB approximation (10 hours)

WKB method- Nature of solutions-connection formulae -barrier potential-penetration-alpha particle emission-bound states in a potential well.

Unit II

Symmetry and conservation laws (10 hours)

Symmetry transformations-space translation and conservation of angular momentum-time translation and conservation of energy- rotation in space and conservation of angular momentum-space inversion-time reversal

Quantum theory of scattering (12 hours)

Scattering cross section and scattering amplitude-partial wave analysis and scattering by a central potential-scattering by attractive square well potential-scattering length-expression for phase shifts-Born approximation-scattering by Coulomb potential- Laboratory and center of mass coordinate transformations.

System of identical particles (14 hours)

Identical particles- Pauli's exclusion principle- inclusion of spin-spin function for a two-electron system-Helium atom-central field approximation-Thomas Fermi model of an atom- Hartree and Hartree-Fock equations.

Unit III

Angular momentum (12hours)

Angular momentum operators and commutation relations-eigen values and eigen functions of L^2 and L_z – general angular momentum-eigen values of $J^2$and J_z-angular momentum matrices-spin angular momentum –spin vectors for a spin ½ system-addition of angular momentum-Clebsh-Gordan coefficients

Relativistic quantum mechanics(24 hours)

Klein-Gordon equations –plane wave solution-probability density and current density using Klein Gordon equations; Dirac's relativistic theory-Dirac's equation for a free particle-Dirac matrices-covariant form of Dirac's equations-probability density-plane wave solutions-negative energy starts-spin in Dirac's theory-magnetic moment of an electron, Spin orbit interaction from Dirac's equation for an electron in a central filed, Relativistic corrections of Hydrogen atom spectrum (qualitative)-Lamb Shift

Book for study

1. G. Aruldas, *Quantum Mechanics*, Second Edition, PHI learning Pvt Ltd (2009)
2. D.J. Griffiths, *Introduction to Quantum Mechanics*, Second Edition, Pearson Education Inc (2005)

References

1. J.J. Sakurai, Advanced Quantum Mechanics, Pearson Education Inc (2009)
2. P.M. Mathews and K.Venkitesan, A Text Book of Quantum Mechanics, Tata Mc Graw Hill (2010)
3. A. Ghatak and S. Lokanathan, Quantum Mechanics Theory and Applications, Kluwer Academic Publishers (2004)
4. V.K. Thankappan, Quantum Mechanics, Second Edition, New Age International Pvt Ltd (2003)
5. S.Devanarayanan, Quanrtum Mechanics, Sci Tech Publications (India) Pvt Ltd (2005)
6. L.H.Ryder, Quantum Field Theory Second Edition, Cambridge University Press (1996)
7. Steven Weinberg, Quantum Theory of Fields(in Three Volumes), Cambridge University Press (2002)

MODEL QUESTION PAPER

19PPH31: Advanced Quantum Mechanics

Time:3 hours **Max.Marks:75**

Part A

Answer any 5 questions .Each question carries 3 marks (5x3=15marks)

I
- a) Write a note on occupation number representation.
- b) Write down the properties of Dirac matrices.
- c) What is Lamb shift?
- d) Explain the variational principle .
- e) State and explain Fermi's Golden rule.
- f) What are ladder operators? Prove that $L_x{}^2 + L_y{}^2 = L_-L_+ + \hbar L_z$
- g) Define differential scattering cross-section and total scattering cross-section.
- h) Explain the effect of parity operator on the observables r,p and L.

Part B

Answer all the following questions. Each carries 15 marks (3x15=45marks)

II A) Derive the Dirac's equation.

OR

B) What do you mean by second quantization? Obtain the Euler Langrangian field equation

III A) Explain the 'rotation in space' and prove that angular momentum is conserved during rotation.

OR

B) (i) Show that cross-section has the dimension of area.

(ii) Explain how Born approximation is used to compute scattering cross-section from square well potential

IV A) Discuss the time-independent perturbation theory and get an expression for first order correction in energy.

OR

B) (i) Derive the Fermi Golden rule for the transition rate from a given initial state to the final state of continuum.

(ii) What are Einstein's A and B coefficients? State the relation between the two.

Part C

Answer any 3 Questions. Each carries 5 marks (3x5=15marks)

V
- a) Use Dirac's equation to show that the orbital angular momentum is not conserved.
- b) In terms of the creation and annihilation operators, show that the fermions obey the exclusion principle.
- c) If Ψ_+(r) and Ψ_-(r) are eigen functions of the parity operator belonging to even and odd eigen states, show that they are orthogonal.
- d) Find the first order correction to the ground state of an anharmonic oscillator subjected to a potential $V=1/2mw^2x^2+bx^2$.
- e) Assuming that a perturbation H'=CX is applied to a particle in a one dimensional box of side L, show that the first order correction to its energy is CL/2**.**
- f) Evaluate the commutation relations [Lx,Ly],[L^2 ,Lx] where L represents angular momentum

19PPH32: ADVANCED SPECTROSCOPY (6l,1T)

Course outcome

Upon completion of the course, the students will be able

CO1: To analyse the general tools for experimental spectroscopy.

CO2: To identify the basic components of spectroscopic instrumentation,

CO3: To gain knowledge of various spectroscopies in an advanced level

Unit I

General tools of experimental spectroscopy(14 hours)

General components of absorption measurements-dispersing elements-prisms-gratingand interferometers-tools in different regions of the electromagnetic spectrum-atomicabsorption spectroscopy-inductively coupled plasma emission spectroscopy-recordingspectrophotometers for IR,visible and UV regions

Molecular symmetry(10 hours)

Symmetry operators-symmetry elements-algebra of symmetry operationsmultiplicationtools-matrix representation of symmetry operators-molecular pointgroups-reducible and irreducible representations-great orthogonality theoremcharactertables for point groups-symmetry species of point groups-IR and Ramanactivity

Molecular rotational spectroscopy(12 hours)

Classification of molecules-rotational spectra of diatomic molecules-isotope effect andintensity of rotational lines-non rigid rotator-linear polyatomic molecules-symmetricand asymmetric top molecules-microwave spectrometer-analysis of rotational spectra.

Unit II

IR spectroscopy(12 hours)

Vibrational spectra of diatomic molecules-charestrisitic IR spectra-vibrations ofpolyatomic molecules-anharmonicity-Fermi resonance-hydrogen bonding-normalmodes of vibrationin a crystal-interpreation of vibrational spectra-Fourier transform IR spectrometer(Block diagram).

Electronic spectra of molecules(12 hours)

Vibrational coarse structure and analysis of bound systems-Deslanders table-Frankcondon principle-vibrational electronic spectra-rotational fine structure-Fortratparabola-electronic angular momentum in diatomic molecules

Raman spectroscopy(12 hours)

Theory of Raman scattering-rotational and vibrational Raman spectra-Ramanspectrometer-structure determination using Raman and IR spectroscopy-nonlinearRaman effects-Hyper Raman effect-stimuated Raman scattering –coherent antistokesRaman scattering

Unit III

ESR and NMR spectroscopy(12 hours)

Principle of NMR-ESR spectrometer-Hyperfine structure-ESR spectra of Freeradicals-Magnetic properties of nuclei-resonance condition-NMR instrumentationchemicalshift-NMR spectra of solids-NMR imaging-interpretion of NMR spectra,NMR and ESR applications.

Mossabauerspectroscopy(8 hours)

Recoilless emission and absorption-Mossbauer spectrometer-experimental techniquesisomershift-quadrupole interaction-magnetic hyperfine interaction

Photoelectron and Photo-accousticspectroscopy(16 hours)

Photroelectron spectroscopy-experinertal methods-photoelectron spectra and theirinterpretation-Auger electron and X ray Flourescence spectroscopy-Photo-accousticeffect-basic theory-experimental arrangement-applications

Books for study

1. J.M.Hollas,*ModernSpectroscopy*,FourthEdition,John Wiley &Sons (2004)
2. G.Aruldas,*Molecular Structure and Spectrocopy*,PHI learning Pvt Ltd (2007)
3. Suresh Chandra, *Molecular Spectroscopy*,Narosa Publishing Co (2009)

References

1. C.N.Banwell and E.M.McCash,Fundementals of Molecular Spectroscopy,Fourthedn,TataMcGrawHill (1995).

2. D.N.Satyanarayana,Vibrational spectroscopy-Theory and applications,New Age International Pvt Ltd (2004)
3. J.L.McHale,MolecularSpectroscopy,Pearson education Inc (2008).

MODEL QUESTION PAPER

19PPH32: Advanced Spectroscopy

Time:3 hours **Max.Marks:75**

Part A

Answer any 5 questions .Each question carries 3 marks (5x3=15marks)

I a) Discuss the principle of photo acoustic spectroscopy.
b) Write notes on Isomer shift in Mossbauer spectroscopy.
c) Explain the hyperfine structure of ESR spectroscopy.
d) Explain the classification of symmetric top, asymmetric top and spherical top molecule
e) Explain the great orthogonality theorem.
f) What are the factors effecting the relative intensity of rotational spectral lines?
g) Explain the quantum mechanical theory of Raman Scattering?
h) Give the selection rules for vibrational spectra?

Part B

Answer all the following questions. Each carries 15 marks (3x15=45 marks)

II A) With the help of block diagram, describe a Mossbauer spectrometer. Explain recoilless emission and absorption of gamma rays.

OR

B) Explain the principle of ESR spectrum and describe ESR spectrometer.

III A) Explain with necessary theory the spectrum of a non-rigid rotator.

OR

B) Explain the theory of a diatomic vibrating rotator. Obtain the equation for the energy level.

IV A) i) Discuss the different modes of normal infra red absorption spectra of H_2O and CO_2 molecules.
ii) With the help of a schematic diagram, describe a IR spectrometer

OR

B) i) Describe with necessary theory the main features of the vibrational and rotational Raman spectra of diatomic molecules.
ii)How far dose it help us to determine the structure of the molecules?

Part C

Answer any 3 Questions. Each carries 5 marks (3x5=15marks)

V a) Free Mossbauer nucleus Sn^{119}emits a γ radiation of frequency $5.76X10^{18}$ Hz. Calculate the recoil velocity and energy of the nucleus. What is the Doppler shift of γ-radiation frequency observed by an outside observer? Given Avagadro number=$6.02X10^{23}$ mol^{-1}.
b) A free electron is placed on a magnetic field of strength 1.3T. Find out the resonance frequency when g=2.0023 and Bohr magneton M_B=$9.273X10^{-24}$ J/T.
c) The first line in the rotational spectrum of a carbon monoxide molecule has a frequency of 3.8424cm^{-1}. Calculate the rotational constant and hence the CO bond length in carbon monoxide. (Given Avagadro number =6.022x1023/mol.m_C=$19.927x10^{-27}$Kg, m_O=$26.561x10^{-27}$Kg)
d) Write the matrices for the following symmetry operations: rotation about the z-axis, inversion,reflection in the xy,yzand xz planes.
e) With which type of spectroscopy would one observe the pure rotational spectra of H_2? If the bond length of H_2 is 0.07414nm, what would be the spacing of the line in the spectrum.
f) The Raman line associated with a vibrational mode is found at 4600 Å when excited by light of wavelength 4358 Å.Calculate the wavelength of the vibrational mode.

19PPH33: Basic Nuclear and Particle Physics (6 L, 1 T)

Course outcome

Upon completion of the course, the students will be able

CO1: To understand the theoretical ideas of nuclear interactions, models, decay process and particle physics.

CO2: To enrich the student with a vast knowledge on nuclear forces, fission, fusion etc

CO3: To identify the basic components of nuclear detectors, particle accelerators etc

Unit I: Nuclear Properties, Forces and Models(36 hours)

Nuclear Proprties (14 hours)

Charge, mass, shape, size, spin, parity, electric and magnetic moments; mass defect; packing fraction; binding energy curve and stability of nuclei; Experimental determination of nuclear mass-Aston's mass spectrograph; Measurement of nuclear spin (using Zeeman effect) and magnetic moment (using NMR); Determination of electric quadrupole moments of nuclei.

Nuclear forces(10 hours)

Types of nuclear forces; Properties of nuclear forces-attractive central potential, spin dependence, non-central behaviour(tensor potential), charge symmetry, charge independence, repulsive nature and momentum dependence; Nuclear exchange force; Meson theory of nuclear forces; Nature of two nucleon potential; Deuteron - ground and excited states.

Nuclear models (12 hours)

Fermi gas model; Liquid drop model: Bethe-Weizsacker formula and its applications; Shell model - evidences of shell model, nuclear spin-orbit coupling, single particle shell model, predictions of shell model, limitations of shell model.

Unit II: Nuclear fission and Fusion(36 hours)

Nuclear fission(20 hours)

Mechanism of nuclear fission; calculation of critical energy based on liquid drop model; fission products and energy release; energetic of fission process; Bohr-Wheeler theory of fission; fission chain reactions; neutron cycle and four factor formula; nuclear reactor; breeding of fuel; classification of nuclear reactors.

Nuclear fusion (16 hours)

Nuclear fusion in stellar interiors; proton-proton cycle; carbon-nitrogen cycle; thermo- nuclear reactions in the laboratory; conditions for the construction of nuclear fusion reactor; critical ignition temperature; Lawson criterion; plasma confinement in fusion; principles of pinch ,magnetic and inertial confinements.

Unit III: Particle Accelerators, Detectors and Nuclear Reactions(36 hours)

Particle Accelerators(10 hours)

Electrostatic accelerators; Cyclotron; Synchrotron; Linear Accelerators; Colliding Beam Accelerators.

Particle Detectors (10 hours)

Gas filled detectors; Ionization chamber; Proportional counter; GM counter; Scintillation detectors; Semiconductor detectors; Cerenkov detector; Cloud chamber; Bubble chamber; Nuclear emulsion techniques.

Nuclear Reactions (16 hours)

Types of nuclear reactions; conservation laws; energetic of nuclear reactions; non-relativistic Q-value equation; threshold energy; nuclear transmutations; compound nucleus hypothesis; cross section of nuclear reaction; level width; resonance reactions; Breit-Wigner one level formula; direct reactions; stripping and pick up reactions; heavy ion induced reactions.

Books for study

1. D.C.Tayal, *Nuclear Physics*, 5thEdition, Himalaya Publishing Co (2008)
2. S.N.Ghoshal, NuclearPhysics, S,Chand Ltd (1997)
3. J.Verma, R.C.Bhandari, D.R.S.Somayajulu*, Fundementals of Nuclear Physics*, CBS Publishers and Distributors (2005)
4. K.S.Krane, Introductory*NuclearPhysics*, Wiley India Pvt Ltd (1988)
5. Satya Prakash, Nuclear Physics and Particle Physics, Sultan Chand & Sons(2005).

References

1. S.B.Patel,Nuclear Physics-An Introduction,New Age International Pvt Ltd (1996).
2. B.R.Marhu,Nuclae and Particle Physics- an Introducion,SecondEdition,Wiley (2012)

3. M.P.Khanna,Introduction to Particle Physics,PHI (2011)
4. J.Freidberg,Plasma Physics and Fusion Energy,Cambridge University Press (2007)
5. FF.Chen,Introduction to Plasma Physics,Springer,London (2002).

MODEL QUESTION PAPER

19PPH33: Nuclear and Particle Physics

Time:3 hours **Max.Marks:75**

Part A

Answer any 5 questions .Each question carries 3 marks (5x3=15marks)

I a) Describe briefly the colliding beam accelerators.
b) What are semiconductor detectors.
c) Explain Linac.
d) Write a short note on nuclear exchange forces. What are exchange operators?
e) What are the experimental evidence for the existence of non-central forces
f) What are the similarities between (nn)and (pp)forces?
g) Distinguish between prompt and delayed neutrons.
h) Give the four factor formula and very briefly explain the terms.

Part B

Answer all the following questions. Each carries 15 marks (3x15=45 marks)

II A) Describe ionization chamber and proportional counters.

OR

B) Explain quark model of elementary particles and ideas of GUT of fundamental forces

III A) Explain the liquid drop model of a nucleus. Write down the limitations of this model in describing nuclear properties.

OR

B) Obtain the semi-empirical mass formula by considering the different energy terms involved.

IV A) Describe the neutron cycle. Derive the four factor formula.

OR

B) Write a note on pinch, magnetic and inertial confinements.

Part C

Answer any 3 Questions. Each carries 5 marks (3x5=15marks)

V a) An α particle of energy 5.48MeV is completely stopped in an ionization chamber. What is the pulse height in an external resistance of 1MΩ. Energy required to produce an ion –pair is 35 eV and the capacitance of the chamber is 50pF
b) Which of the following reactions are possible.
(1) $\pi^+ + n \rightarrow \Lambda^0 + K^+$ (2) $\pi^+ + n \rightarrow K^0 + K^+$
(3) $\nu_e + p \rightarrow n + \mu^+$. (4) $\nu_e + p \rightarrow n + e^+$.
c) Show that for square well of depth V_o and range b,the scattering length for a spinless neutron is given by the relation $K\cot Kb=(b-a)^{-1}$, where $K=(mVo)^{1/2}/h$
d) If, in a certain fission process, the mass loss is 0.1%, then calculate the energy liberated by the fission of 1 kg of the substance. How much kilowatt-hour energy can be generated from it?
e) Calculate the energy released by the fission of 1 kg of U^{235} in kilowatt hour. Assume that, the average energy released per fission is 200 MeV and Avogadro number $N=6.023\times10^{26}$ per kg-atom.
f) Discuss the various concepts in optical model.

Semester IV

19PPH41: CONDENSED MATTER PHYSICS

Course outcome

Upon completion of the course, the students will be able

CO1: To gain deep knowledge of crystal physics, lattice vibrations and thermal properties, free electron and band theory

CO2: To understand the theoretical ideas of semiconductors, dielectric and magnetic properties of materials,

CO3: To have a vast knowledge on superconductivity, fundamentals of nano technology, nanomaterial preparation techniques, characterization methods etc.

Unit I

Crystal physics (10 hours)

Lattice points and space lattice-basis and crystal structure-unit cells and lattice parameters symmetry elements in crystals –space groups-Bravais lattice-density and lattice constant relation-crystal directions, planes and Miller indices-reciprocal lattice-allotropy and polymorphism in crystals imperfections in crystals.

Lattice vibrations and thermal properties (10 hours)

Dynamics of identical atoms in crystal lattice- dynamics of linear chain-experimental measurement of dispersion relation-anharmonicity and thermal expansion-specific heat of solids-classical model-Einstein's model-Debye model-thermal conductivity of solids-role of electrons and phonons-thermal resistance of solids.

Free electron and band theory (16 hours)

Electrons moving in one dimensional potential well-Fermi-Dirac statistics-effect of temperature on Fermi distribution-electronic specific heat-electrical conductivity of metals- Wiedmann- Franz- Lorentz law-electrical resistivity of metals-Hall effect-energy bands in solids-Kronig Penny model construction of Brillouin zones-nearly free electron model-conductors, semiconductors and insulators -elementary ideas of Fermi surfaces.

Unit II

Semiconductors (12 hours)

Free carrier concentration in semiconductors-mobility of charge carriers temperature effects- electrical conductivity of semiconductors-Hall effect in semiconductors-semiconductor junction properties

Dielectric and magnetic properties of materials(24 hours)

Dipole moment-polarisation-local electric field in an atom-dielectric constant and its measurement-polarizability-classical theory-Peizo,Pyro and Ferro electric properties of Crystals -Ferreoelectric domains-classification of magnetic materials-atomic theory of magnetism-Langevins theory-paramagnetism and quantum theory-Weiss molecular exchange field-ferromagnetic domains-anti ferromagnetism-Ferrites

Unit III

Superconductivity(20 hours)

Introduction-superconductivity, sources of superconductivity-critical temperature, critical current and critical magnetic field of superconductors-effects of magnetic field on superconductors-Meissner effect-Type I and II superconductors- intermediate and vortex states-Thermodynamics of superconducting transitions-entropy difference, specific heat, thermal conductivity and energy gap in superconductors- -coherence length-Theories of superconductivity-London equations-Elements of BCS theory-AC and DC Josephson effects in superconductors- Examples and properties of High Temperature superconductors-applications of superconductors (qualitative)

Introduction to nano science and technology(16 hours)

Introduction to nanomaterials-properties-classification of nanomaterials-quantum confinement effects-nano material preparation techniques (non-lithographic)-sputtering-chemical vapour deposition-pulsed laser deposition-sol-gel technique-characterization of nano materials-X-ray diffraction- single crystal and powder xrd methods,scanning probe microscopy-atomic force microscopy-SEM and TEM techniques -carbon nanostructures –molecular machines using nanotechnology

Books for study

1. S.O.Pillai,*Solid State Physics*,Third Edition New Age International Pvt Ltd (1999)
2. M.A.Wahab,*Solid State Physics*,Narosa Publishing House (1999)

3. R.J.Singh,Solid State Physics ,Dorling Kindersley (India) Pvt Ltd (2012)
4. K.K.Chattopahyay,A.N.Banerjee,Introduction to Nano Science and NanoTechnology,Prentice Hall of India (2009)

References

1. N.W.Ashcroft and N.D.Merwin,Solid State Physics,Cenage Learning India (2001)
2. Charles.C.Kittel,Introduction to Solid State Physics,wiley Student Edition (2007)
3. M.AliOmar,elementary Solid State Physics,Pearson Education Inc (1999)
4. P.Phillips,Advanced Solid State Physics,SecondEdn,Cambridege University Press (2012)

MODEL QUESTION PAPER

19PPH41: Condensed Matter Physics

Time:3 Hrs **Max.Marks:75**

Part A

Answer any 5 questions .Each question carries 3 marks (5x3=15marks)

I. a) What are type I and type II superconductors? Give examples.
b) Explain the photolithographic process.
c) What are miller indices?
d) Name the Bravais lattices.
e) Define APF.
f) Differentiate top down and bottom up approaches of material fabrication.
g) What is electronic polarizability? Derive an expression for electronic polarizability.
h) Explain the following terms: a) polarization, b) polarizability and c) dielectric constant.

Part B

Answer all questions. Each carries 15 marks (3x15=45marks)

II A) Discuss the vibrations of a one dimensional mono atomic lattice.

OR

B) Discuss the Kronig-Penney model for a linear lattice. How does it lead to the formation of energy bands in solids? What happens to the width of the allowed and forbidden bands with the change in the strength of the periodic potential

III A) Derive the London equations for superconductors.

OR

B) Explain the following process (1) Chemical Vapour Deposition (2) Sol-Gel technique and (3) Pulsed laser deposition technique.

IV A) Distinguish clearly between diamagnetism, paramagnetism and ferromagnetism. Derive an expression for diamagnetic susceptibility on the basis of classical theory.

OR

B) Derive the expression for free carrier concentration in semiconductors in terms of impurity density. Discuss the result for n-type and p-type semiconductors.

Part C

Answer any 3 Questions. Each carries 5 marks (3x5=15marks)

V a) Lead in the superconducting state has critical temperature of 6.2K at zero magnetic field and a critical field of 0.064Am^{-1} at 0K. Determine the critical field at 4K.
b) Copper has fcc structure with lattice constant 0.361nm. Calculate the interplanar spacing for (1 1 2) and (1 2 0) planes.
c) Write down the coordination number, lattice constant and hence find the APF of fcc structure.
d) A specimen of germanium is doped with 0.1 atomic percent of arsenic. Assuming that at room temperature, all the arsenic atoms are ionized. Find the electron and hole densities in germanium. The intrinsic carrier density at room temperature in germanium is $2.37 \times 10^{19}/m^3$. The atomic weight of Ge is 72.59 g mol-1 and density is 5400 kg/m^3
e) With proper diagram, explain the steps involved in the process of electron lithography.
f) Discuss the working of a transmission electron microscope.

SYLLABUS FOR SPECIAL PAPERS (SPECIAL PAPER I)

19PPH42E: ADVANCED ELECTRONICS -I (6L,1T)

Course Outcome

Upon completion of the course, the students will be able

CO1: To gain knowledge about communication technology.

CO2: To understand the theoretical ideas of Digital communications

CO3: To acquire deep knowledge about Digital Signal processing

Unit I

Analog radio frequency communications (16 hours)

Different types of analogcontinous wave modulation-analog baseband signal transmission-signal distortions and equilization-linear continous wave modulation schemes-amplitude modulation-DSB and SSB schemes-frequency conversion-angle modulation-spectra of angle modulated signals-power and bandwidth of FM signals-generation and demodulation of FM signals-commercial radio broadcasting techniques-AM and FM radio broadcasting and reception

(Chapter 5 of Sam Shanmugam)

Microwave radio communications (10 hours)

Advantages and disadvantages of microwave radio communications-digital and analog systems-frequency and amplitude modulation techniques-FM microwave radio system-FM microwave repeaters-FM microwave radio stations-line of sight path characteristics

(Chapter 24 of Tomasi)

Pulse modulation (10 hours)

Different types of pulse modulation-pulse amplitude modulation (PAM)-PAM spectrum-pulse code modulation(PCM)-sampling and quantization of analog signals-quantization error-signal to noise ratio-differential PCM_ delta modulation-other pulse modulation schemes-applications of pulse modulation

(Chapter 13 of Kennedy and Davis and Chapter 11 Roody and Coolen)

Unit II

Digital communications (16 hours)

Basics of information theory-ideas of digital codes –noise in information carrying channel-Digital carrier modulation -binary ASK,PSK and FSK schemes-bandwidth and power requirements-synchronization methods-ideas of error control coding and error corrections-digital transmission of analog signals-transmission using PCM – frequency and time division multiplexing (TDM) –TDM in PCM telephone system.

(Chapter 13 &14 of Kennedy and Davis, and 10 of Sam Shanmugam and Chapter 12 of Roody and Coolen))

Optical fiber communications (20hrs)

Overview of the optical communication system and its components-optical communication receiver and its equivalent circuit-direct and coherent detection systems- digital modulation and demodulation schemes for coherent optical communication receivers-heterodyne and homodyne detection – principles of wavelength division and code division multiplexing in potical communication- - optical solitons-soliton based optical communication systems

(Chapters 1,7-10 of Keiser and Chapters 1,3,6-10 of Agrawal)

Unit III

Mobile cellular communications (12 hours)

Mobile telephone services-cellular telephone-frequency reuse-cell splitting-sectoring,segmentation and dualisation-cellular system topology-roaming and handoffs-cellular telephone nework components and call processing-first and second generation cellular telephone services-digital cellular telephone system-global system for mobile communicartion-personnal satellite communication system

(Chapters 19 and 20 of Tomasi)

Digital Signal processing (24 hours)

Basics of signals and systems (6 hours)

Classification of signals-amplitude and phase spectra-classification of system-simple manipulations of discrete time signals-representation of systems-analog to digital conversion of signals

(Chapter 1 of Salivahananetal)

Fourier analysis of signals and systems (12 hours)

Triganometric Fourier series-exponential form-Parseval's idendity-power spectrum of period function-Fourier transform-properties of Fourier transform-Fourier transform of important signals-Fourier transform of power and energy signals-Discrete time fourier transform - Fast Fourier transform (FFT) (Chapter 2 of Salivahanan et al)

z-transofrms (8 hours)

Definition of z transform-properties of z-transform-evaluation of the inverse z-transform (Chapter 4 of Salivahanan et al)

Digital Filters (10 hours)

Magnitude and phase response of Digital filters- Finite Impulse Response (FIR) digital filters-frequency response of linear phase FIR filters-design techniques of FIR filters-ideas of Infinite Impulse Response filters. (Chapter 7 of Salivahanan et al)

Books for study

1. K.SamShanmugam,Digital and Analog communication systems,JohnWileya& Sons (2006)
2. W.Tomasi,Electroniccommunicationsystems:Findementals through advanced, DorlingKinderley (India) Pvt Ltd (2009)
3. G.Kenndy and B.Davis,Elecrinuic communication systems,FourthEdiion,Tata Mc Graw Hill (2003)
4. G.Keiser,*Optical Fibre Communication*,3rdedition,McGraw Pub (2000)
5. G.P.Agrawal,Fibre optic communication systems,John Wiley& Sons (1993)
6. S.Salivahanan and G.Ganapriya,Digital Signal Processing,Tata Mc Graw Hill (2011)

References

1. H.Taub,D,Schilling and G.Saha,Principle of Communiation systems,3rdEdition,Tata Mc Graw Hill (2008)
2. W.C.Y.Lee,Mobile Communications-design,Fundementals,SecondEdition,John Wiley & Sons (1993)
3. J.S.Chitode,DigitalCommunications,Technical Publications Pune (2008)
4. J.M.Senior,Optical Fibre Communications-Principles and Practice,SecondEdition,Pearson Education (2006).
5. J.J.Carr ,Microwave and Wireless communications Technology,Butterworth-Heinemann (1996)

19PPH42M: MATERIALS SCIENCE- I (6L,1T)

Course Outcome

Upon completion of this course, the students will be able:
CO1: To gain a deep knowledge about crystal structure
CO2: To understand the theoretical ideas of Formation of crystalline materials
CO3: To acquire deep knowledge about Mechanical and Thermal properties of crystals

Unit I

Introduction to Crystals (36 Hrs)

Crystals

Lattice –Unit cells-Basis- and crystal structures-Periodicity in crystals-Combination of symmetry elements – Symmetry groups-point groups. Structure of crystals**-** l-Determination of crystal structures-Diffraction theory-Scherrer formula-Calculation of particle size-line broadening Determination of unit cell content-. Atomic packing in crystals**:** Rules governing the packing of atoms-Pauling's rules-applications in crystal structures-complex ions-polymorphism-solid solutions. Electronic Structure of atoms-Atomic and ionic arrangements in materials-Short range and long range order-Liquid crystals-Amorphous materials-Softmaterials

Classification of materials,-Functional classification of materials

Materials for Aerospace, Biomedical, Electronic, Energy technology, Environmental technology, Magnetic, Photonic and Structural Applications- Smart materials. Struc-turalclassification of Materials- Crystalline-Single crystals-polycrystalline materials-Grains and grain boundaries. **Crystal structures of ionic** materials-Cesium chloride, Fluorite, Perovskite and Corundum type structures-Covalent structures.

Imperfections in crystals

Types of imperfections in crystals -Point defects-Interstitial defects-Substitutional defects-Frenkel and Schottky defects-Line Kronger-Vink notation for defect chemical reaction- Dislocations and Diffusion in crystals -

Dislocations- Burgers vectors – edge and screw dislocations –slip-significance of dislocations-Schmid's law-Surface defects-Domain boundaries- Importance of defects –Diffusion**-** Applications of Diffusion-Stability of atoms and ions-Mechanism for diffusion-Activation energy for diffusion- Permeability of polymers-Composition profile-Diffusion and materials processing.

Unit II

Formation of crystalline materials (36 hrs)

Growth from the melt - the Bridgmann technique – crystal pulling -Czochralski method- liquid solid interface shape -crystal growth by zone melting - Verneuil flame
fusion technique. Low temperature solution growth - methods of crystallization - slow cooling, solvent evaporation, temperature gradient methods - crystal growth system - growth of KDP, ADP and KTP crystals - high temperature solution growth, gel growth.

Unit III

<u>Properties of materials -Mechanical and Thermal properties - (36 hrs)</u>

Mechanical properties

Stress-strain relation and tensile test-True stress and true strain-Bend test for brittle materials-Hardness of materials-Knoop test-Strain rate effects-Ductile -brittle transition temperature.-Fracture mechanics-Micro-structural features of fractures in ceramics and compounds-Fatigue

Thermal properties

Heat capacity and specific heat-thermal expansion-thermal conductivity-Thermal diffusivity-thermal shock in materials. **Transformation in crystals-**Elements of thermodynamics-Free energy-First order and second order transformations-order-disorder transitions-Equilibrium diagrams-phase rules-solid solutions

Reference Books

1. Introduction to solids –L.V.Azaroff Tata Mc Graw Hill
2. The Science and Engineering of Materials: Donald R Askeland and Pradeep P Phule 6 Edition-Thomson Brooks/Cole.
3. Principles of Electronic Materials and Devices , S.O.Kasap .Tata Mc Graw Hill
4. Crystallography and crystal defects, A. Kelley, G.W. Groves & P. WileyKidd,
5. Crystallography applied to Solid State Physics, A.R. Verma, O.N. Srivastava, NAI
6. Solid State Physics, A.J.Dekker, Macmillan, (1967).
7. Solid State Physics, S.L. Gupta and V.Kumar, Pragati Prakashan.
8. Introduction to Theory of Solids, H.M. Rosenberg, Prentice Hall.
9. Solid State Physics,J.S. Blakemore, W.B.Saunders & Co. Philadelphia.
10. 10. Solid State Physics, N.W. Ashcroft & N.D. Mermin, Brooks/ Cole (1976).
11. Crystal Defects and Crystal Interfaces, W. Bollmann, Springer Verlag.
12. Elementary solid State physics M.Ali Omar-Pearson
13. Solid State Physics R.J.singh-Pearson
14. Thermal Analysis, Wesley W.M. Wendlandt , Wiley.

19PPH42N: ADVANCED NUCLEAR PHYSICS (6 L, 1 T)

Course outcome

Upon completion of this course, the students will be able:

CO1: To understand the theoretical ideas of Nuclear Models Forces, Two-Body problem

CO2: To acquire deep knowledge about Radioactivity and the decay process.

CO3: To understand the theoretical ideas of Relativistic Nuclear Reaction, Particle Physics

<u>Unit I: Nuclear Models & Forces (36 hours)</u>

<u>Nuclear models(16 hours)</u>

Collective model - vibrational & rotational states; Nilsson model; Optical model; More relativistic models - many-particle shell model, single-particle states in deformed nuclei.

<u>Two-Body problem and nuclear forces(20 hours)</u>:

Nucleon-nucleon scattering - basic concepts; laboratory & centre of mass coordinate systems; scattering cross section; low energy n-p scattering; partial wave analysis of n-p scattering; spin dependence of nuclear forces;

effective range theory; coherent scattering of slow neutrons; proton-proton scattering at low energies; non-central forces(tensor forces).

Unit II: Radioactivity (36 hours)

Alpha Decay(12 hours)

Determination of energy of alpha particles; Alpha ray spectra and nuclear energy levels; Range of alpha particles & Geiger-Nuttall law; Long range alpha particles; Theory of alpha emission from radioactive nuclei; Gamow's theory of alpha decay.

Beta Decay(12 hours)

Beta decay processes; measurement of beta ray energies; beta ray spectra & its explanation; Energy balance in beta decay; Fermi theory of beta decay; Life time of beta decay; selection rules in beta decay; Theory of electron capture; Parity violation in beta decay; Helicity.

Gamma Transitions(12 hours)

Absorption of gamma rays by matter; absorption cross section; measurement of gamma ray energies; Multiple order of gamma radiations; internal conversion; $0 \rightarrow 0$ transitions; Internal pair creation; Nuclear isomers; Angular correlation in gamma emission; Coulomb excitation; nuclear resonance absorption; Mössbauer effect & applications.

Unit III: Relativistic Nuclear Reaction, Particle Physics & Quark Model (36 hours)

Relativistic Nuclear Reaction(8 hours)

Physics of neutrons; Relativistic Q-value equation; Kinematics in high energy collisions; Particles in high energy reactions.

Particle Physics (16 hours)

Classification of elementary particles; fundamental interactions among particles; states of particles in terms of quantum numbers; conservation of quantum numbers; Resonant particles; symmetries and conservation laws; CPT invariance; Gellmann-Nishijima formula; Gellmann & Neeman classification.

Quark Model(12 hours):

Quarks and their properties; quark combinations of hadrons; Gluons; Colour of quarks and their combinations - Quantum Chromo Dynamics (QCD); symmetry classifications of elementary particles; particle interactions and Feynman diagrams; weak interactions; Grand Unification Theory (GUT).

Books for Study

1. S.N. Goshal, Atomic and Nuclear Physics, S Chand & Company Ltd. 1998
2. Kenneth S Krane, Introductory Nuclear Physics, John Wiley & Sons, 1987
3. Sathya Prakash, Nuclear Physics & particle Physics, S Chand 2005
4. John S Liley, Nuclear physics, Wiley India, 2007

References

1. Irving Kaplan, "Nuclear Physics", Narosa Book Distributors, 2002.
2. R.D. Evans, "The atomic Nucleus", McGraw-Hill, 1955.
3. D.C.Tayal, Nuclear Physics, Himalayan Publication house, Bombay, 1980
4. R.R. Roy & B P Nigam, Nuclear Physics Theory and Experiments, Wiley Eastern, 2000.
5. D.J. Griffiths, Harper & Row, Introduction to elementary particles, Wiley Eastern, 1987

MODEL QUESTION PAPER

19PPH42N: Advanced Nuclear Physics

Time:3 hours **Max.Marks:75**

Part A

Answer any 5 questions .Each question carries 3 marks (5x3=15marks)

I a) Distinguish between isomeric nuclei and mirror nuclei.
b) Write down the properties of nuclear forces.
c) Show that the density of nucleus is independent of its volume.
d) Write short notes on any six types of nuclear reactions.
e) State any six conservation laws obeyed in nuclear reactions.

f) Obtain an expression for the threshold energy of a nuclear reaction by considering the formation of a compound nucleus.
g) What is meant by Gas Amplification?
h) What are the basic methods of radiation detection?

Part B

Answer all questions. Each carries 15 marks (3x15=45marks)

II A) Discuss about the various energy terms involved in the semi-empirical nuclear binding energy formula for a nucleus and hence write down the Weizacker's semi-empirical mass formula.

OR

B) i) Explain the evidences and limitations of shell model.
ii) Discuss the single particle shell model.

III A) i) Explain the principle, construction and working of a Geiger Muller counter.
ii) Write a note on neutron detectors.

OR

B) Discuss the response of gas filled tubes at different applied potentials. Briefly explain the working of ionization chamber.

IV) A) i) Explain the Bohr-Wheeler theory of nuclear fission.
ii) Write a note on stripping and pick up reactions.

OR

B) i) Explain the Quark model of hadrons
ii) Explain the Gellmann Nishijima Formula with example.

Part C

Answer any three Questions. Each carries 5 marks (3x5=15marks)

V a) The radius of Ho^{165} is 7.731F. Deduce the radius of He^4.
b) Show that the coulomb energy experienced by the nucleus is proportional to $Z^2/A^{1/3}$.
c) Find the Q-value and identify the type of the reaction:
$_7N^{14} + {_2He^4} \rightarrow {_8O^{17}} + {_1H^1} + Q$
The atomic masses of the reactant and products are:
$_7N^{14}$=14.00755amu, $_2He^4$=4.00388amu, $_8O^{17}$=17.00453amu and $_1H^1$=1.00815amu.
d) The Q-value of $Na^{23}(n_1\alpha)F^{20}$ reaction is -5.4MeV.Determine the threshold energy of the neutrons for this reaction. Given mass of $_0n^1$=1.008665amu and mass of Na^{23}=22.9898amu.
e) Find the driving force on an electron at a distance 2mm from the axis of a cylindrical gas filled tube held at a potential difference 1000V between the electrodes. Radius of the cathode is 0.5 cm and that of anode is 0.5 mm.
f) Calculate the potential to be applied just to produce secondary ionization in a cylindrical gas filled with a gas of ionization potential 0.4 eV. Radius of the cathode is 1 cm and that of anode is 0.1 mm.

19PPH42S: SPACE PHYSICS AND PLASMA PHYSICS (6L,1T)

Course Outcome

Upon completion of this course, the students will be able:
CO1: To gain knowledge about Basic Plasma Phenomena
CO2: To understand the theoretical ideas of solar wind, Cosmic rays and energetic particles
CO3: To acquire deep knowledge about Observational technique in astrophysics

Unit I

Basic Plasma Phenomena (6h)

Plasma Concepts – Debye shielding – plasma parameters – Plasma as a fluid - Fluid equations – Fluid drift perpendicular to B – Fluid drift parallel to B.

[Ref. 1,Ch 1, 2&3].

Waves in plasma (20h)

Plasma oscillations –Electron plasma waves – sound waves – ion waves – Electrostatic electron oscillations perpendicular to B - Electrostatic ion waves perpendicular to B – Lower hybrid frequency – Electromagnetic

waves perpendicular to B_0 – cut offs and resonances - Electromagnetic waves parallel to B_0 – Hydromagnetic waves – Magneto-sonic waves.
Diffusion and Resistivity- Decay of plasma by diffusion – steady state solutions – Re-combinations – Diffusion across a magnetic field – Collisions in fully ionized plasma – Single fluid MHD equations.
[Ref. 1, Ch. 4 and 5].
Magnetohydrodynamics (10h)
Maxwell's equations in MHD – MHD Induction equation – Magnetic Reynold's num-ber – Momentum equation, Pressure force – Magnetic tension force – Magnetic Buoy-ancy – Acoustic waves – Alfven waves – Internal gravity waves – MHD waves – Whistlers. [**Ref. 3, Ch. 9].**

UNIT II
Solar Physics (16h)
Solar interior and energy production – Neutrino problem – Helioseismology – solar activity – sunspot cycle - Sun's magnetic field – solar rotation - Photosphere – Chromosphere – Corona – Coronal heating – Solar flares – Solar wind – importance of solar terrestrial studies.
[Ref. 3; Ch. 6].
Solar wind Physics (16h)
Coronal expansion – Parker's hydrodynamic theory – solar wind parameters – interplanetary magnetic field – sector structure – solar wind variations and its relationship with solar phenomena**. [Ref.5].**
Cosmic rays and energetic particles (4h) Galactic cosmic rays – solar cycle modulation of galactic cosmic rays – solar energetic particles – Interstellar pick up ions – Anomalous cosmic rays – Cosmic ray detectors**. [Ref.5].**

UNIT III
Neutral atmosphere (8h) Neutral atmosphere – scale height – Variation of temperature with altitude – Troposphere – Stratosphere – Mesosphere – Thermosphere – Heat balance equation – Exosphere. [Ref.7].
Ionosphere and Magnetosphere (16h) Ion composition and chemistry – D, E, F_1 and F_2 regions – Ionospheric conductivities and currents – Equatorial anomaly. Magnetosphere, intrinsic magnetic field – Interaction of solar wind with magnetosphere – Bow shock and magnetopause – Magnetospheric current systems – Magnetic diffusion – Magnetic reconnection – magnetic activity and substorms – magnetic storms – geomagnetic activity indices**. [Ref.6].**
Observational technique (12h) Upper atmosphere sensing – direct, indirect and remote – Direct methods for neutral atmosphere – Direct methods for ionized component – Langmuir probe – Impedance and resonance probes – Mass spectrometers – Detectors for energetic particles and radiation environment – Satellite drag and related methods – Remote sensing of the neutral atmosphere – Remote
sensing by radio propagation – Experimental technique for ionospheric studies – Ionosonde technique – Incoherent scatter technique. **[Ref 4 ,6 & 10.]**

References

1. Chen F. F.: Introduction to Plasma Physics and Controlled Fusion, Plenum Press.
2. Dendy R. O. : Plasma Dynamics (Clarendon Press, 1990).
3. Press,Tamas1998)I.Gombosi: Physics of the Space Environment (Cambridge University
4. Harra L. K. and Mason K. O.: Space Science (Imperial College Press)
5. Peter Foukal: Solar Astrophysics (Wiley, 1990)
6. Ratcliffe: Introducion to ionosphere and magnetosphere (CUP,1972)
7. AcademicRobertG. FleaglePress,London,aJoost1971A. .Businger: An Introduction to Atmospheric Physics,
8. Banks P. M. and G. Kocharts: Aeronomy, Academic Press, London, 1973.
9. Savindra Singh: Climatology, Prayag Pustak Bhavan, 2005.
10. BreachMichaelScienceD.Pappagiannis:PublsherLtdSpace.,1972Physics. and Space Astronomy, Gordon and

19PPH42T: THEORETICAL PHYSICS-I (6L,1T)

Course Outcome

Upon completion of this course, the students will be able:

CO1: To enrich their knowledge about Linear vector space, Relativistic quantum mechanics Lorentz group and field theory

CO2: To understand the theoretical ideas of Special topics in non-equilibrium systems

CO3: To acquire deep knowledge about General relativity

Unit I

• Formalism

Linear vector space, linear operators, normed spaces, Hilbert spaces, self-adjoint operators, representation of operators and states in suitable basis, spectral properties of self-adjoint operators - spectral theorem. [Ref 1, 2, 3, 4]

• Groups and Symmetry

Review of groups: Irreducible representations of groups, discrete and continuous groups, Lie groups, Lie algebra.

how symmetries form a group, unitary and anti-unitary symmetry operators, Rotation and O(3) group, SU(2) group, angular momentum

algebra, vector operators, Tensor operators, Wigner-Eckart theorem Discrete symmetries - space and time inversion symmetries. Ref [5, 6, 7, 8, 9, 10]

Relativistic quantum mechanics Lorentz group - generators, representation of Lorentz group extended by parity and Dirac equation, hydrogen atom [Ref 5, 7, 10, 11]

Field theory

Lagrangian formalism, Noether's theorem, Hamiltonian density, quantisation of fields, second-quantization, quantisation of EM field. [Ref 10]

Unit II

Statistical Physics(36 hours)

Stochastic processes

Review of probability and measure, equilibrium vs non-equilibrium,

Brownian motion, Langevin equation, Ito vs Stratanovic, Markov processes,

Fokker-Planck equation, Fluctuation-Dissipation theorem. [Ref 13, 14, 16, 15]

Special topics in non-equilibrium systems

Einstein diffusion equation - derivation and boundary conditions, free diffusion in one-dimensional half-space, flourescencemicrophotolysis [Ref 13]

Unit III - General relativity (36 hrs)

Differential geometry

Tensors, diffentiable manifolds, geodesics, curvature, Riemannian tensor [Ref 3, 4, 17, 18]

Relativity

Principle of equivalence, Einstein equations, centrally symmetric gravitational fields, Schwaarzchild solution, singularities [Ref 17, 18]

References

1. F. Scheck, *Quantum Physics*, Springer (2007).
2. G. Teschl, *Mathematical Methods in Quantum Mechanics*, American Mathematical Society (2009).
3. P. Szekeres, *Modern Mathematical Physics*, Cambridge University Press (2004).
4. M. T. Vaughn, *Introduction to Mathematical Physics*, Wiley - VCH Verlag (2007).
5. Arfken, *Mathematical Physics for Physicists*, Academic Press (2013).
6. J. J. Sakurai, *Modern Quantum Mechanics*, Addison-Wesley Publishing Company (1994).
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8. R. Shankar, *Principles of Quantum Mechanics*, Springer (1994).
9. L. E. Ballentine, *Quantum Mechanics*, World Scientific Publishing Co. (2000).
10. L. H. Ryder, *Quantum Field Theory*, Cambridge University Press (2008).
11. J. J. Sakurai, *Advanced Quantum Mechanics*, Addison-Wesley (1967).

12. M. Le Bellac, *Quantum and Statistical Field Theory*, Oxford University Press (2001).
13. K. Schulten and I. Kosztin, *Lectures in Theoretical Biophysics*, University of Illinois at Urbana-Champaign (2000).
14. R. Kubo, M. Toda and N. Hashitsume, *Statistical Physics II: None quilibrium Statistical Mechanics*, Springer-Verlag (1985).
15. G. F. Mazenko, *Nonequilibrium Statistical Mechanics*, Wiley-VCH Verlag (2006).
16. V. Balakrishnan, *Elements of Nonequilibrium Statistical Mechanics*, CRC Press (2008).
17. B. F. Schutz, *A First Fourse in General Relativity*, Cambridge University Press (2009).
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21. E. Fradkin, *Field Theories of Condensed Matter Systems*, Levant Books (2006).
22. P. M. Chaikin and T. C. Lubensky, *Principles of Condensed Matter Physics*, Cambridge University Press (2004).
23. A. M. Tsvelik, *Quantum Field Theory in Condensed Matter Physics*, Cambridge University Press (2003).

SPECIAL PAPER SYLLABUS : SPECIAL PAPER -I I

19PPH43E: ADVANCED ELECTRONICS-II (6L,1T)

Course Outcome

Upon completion of this course, the students will be able:

CO1: To gain knowledge about Microprocessor interfacing devices and advanced microprocessors

CO2: To understand the theoretical ideas of artificial intelligence and expert systems

CO3: To acquire deep knowledge about television, radar and satellite communications

Unit I

Microprocessor 8086 : Introduction and Programming (18 hours)

Internal architecture of 8086-pin configuration of 8086-memory organization of 8086-addressing modes of 8086-minimum and maximum mode configurations-instructions set of 8086-data movment instructions-arithematic and logic instructions-programming of 8086-flow charts and programming steps

(Chapter 2,3,4 of Sunil Mathur)

Microprocessor interfacing devices and advanced microprocessors(12 hours)

Programmed I/O –direct memory access-micro controllers-8251A USART-8257 DMA controller-8259A programmable interrupt controller-8279 programmable keyboard/display interface-analog to digital and digital to analog converters-advanced microprocessors-80186/80188 high integration 16-bit microprocessors-80386 and 80386 processors-RISC processors.

(Chapter 6 and 7 of Abishek Yadav)

Elements of embedded systems (6hours)

Example of an embedded system-processor chips for embedded applications-a simple micro controller using embedded systems-embedded processor families

(Chapter 10 of Hamacher et al)

Unit II

Introduction to artificial intelligence and expert systems (20 hours)

Overview of artificial intelligence (AI)-knowledge representation in AI-problem solving in AI-search methods-predicate and propositional logic-Formal symbolic logic-LISP and PROLOG basics-network representations of knowledge-natural language study in AI-Fuzzy sets and Fuzzy logic- Expert systems-rule based expert systems-nonproduction system architectures-examples of expert systems.

(Chapters 1,2,4,5,7,9,12 & 15 of Patterson; Chapter 1-5 and 8 of Rich and Knight)

Adsvanced artificial intelligence systems (16 hours)

Introduction to robotics-artifical intelligence machines-language based and knowledge based machines-Fuzzy expert systems-fuzzy quantifiers-fuzzy inference-fuzzy rule based systems-engineering applications of fuzzy logic-applications in power plants,datamining,image processing and control instrumentation-basic concepts of artificial neural networks-neural network architectures-learning methods-neural network systems-ADALINE

and MADALINE networks –neural network application domains.
(Chapter 21 of Rich and Knight,Chapter 16 of Janakiramanetal,Chapters 1 and 7 of Rajasekaran and Pai,,Chapter 8 of Sivanandan et al)

Unit III

Television (14 hours)

Television broadcasting fundementals-scanning,blanking and synchronizing pulses-video bandwidth-video signal charecterisitcs-TV broadcasting channels-TV camera tubes-monochrome TV transmission and reception-color camera tube-color TV system-advanced TV systems-satellite TV techniques-cable TV system-Digital colorTV system
(Chapter 1 to 5 of Veera Lakshmi and Srivel)

Radar(12 hours)

Basic principles of radar-Radar equation-MTI,Pulse and Doppler Radars-Radar signal analysis-ideas of Radar transomiters and receivers-hyperbolic systems for navigation-LORAN and DECCA systems.
(Relevant chapters of Skolni,Chapter 4 of Nagaraja)

Satellite communications(10 hours)

Satellite orbits-Geosynchronous satellites-antenna look angles-satellite classifications-spacing and frequency allocations-satellite antenna radiation patterns-satellite system link models –satellite system parameters and link equations (Chapter 25 of Tomasi)

Books for study

1. Sunil Mathur,*Microprocessor 8086-Architecture,Programming and Interfacing*,PHI learning Pvt Ltd (2011)
2. AbishekYadav,*Microprocessor 8085 8086*,University Science Press,New Delhi (2008)
3. Carl Hamacher,Z.G.Vranesic,S.G.Zaky,*Compter organization*,5th Edition,McGraw Hill Education (2002)
4. V.S.Janakiraman,K.Sarukesi and P.Gopalakrishnan,*Foundations of Artificial Intelligenceand Expert systems*,Macmillan Publishers India Ltd (2011).
5. E.Rich and K.Knight,*ArtificialIntelligence*,SecondEdition,Tata McGraw Hill Pub Co (2006),
6. D.W.Patterson,Introduction to *Artificial Intelligence and Expert Systems*,Prentice Hall of India Pvt Ltd (2001)
7. S.Rajasekharan and G.A.VijalekshmiPai,*Neural NetworksFuzzy logic and Geneticalgorithms*,PHI learning PVt Ltd (2010).
8. 8.S.N.Sivanandan,S.Sumathi and S.N.Deepa,*Introduction to Fuzzy logic usingMATLAB*,Springer (2007).\
9. A.Veera Lakshmi and R.Srivel,*Television and Radio engineering*,AnnBookd Pvt Ltd(2010)
10. Skolini.M.I,*Introducion to Radar systems*,Thirdediton,Tata Mc GrawHill (2001)
11. Nagaraja,*Elements of Electronic navigation*,Second Edition, Tata Mc GrawHill (2006).

19PPH43M: MATERIALS SCIENCE –II (6L,1T)

Course Outcome

Upon completion of this course, the students will be able:
CO1: To gain Knowledge about Electronic, Magnetic and photonic materials and properties
CO2: To understand the theoretical ideas of Nanostructured materials and properties
CO3: To acquire deep knowledge about Nano-electronics

Unit I Functional materials and properties (36 hrs)

Electronic, Magnetic and photonic materials and properties

Electronic materials and properties- Electrical conductivity-Conductivity of metals and alloys-superconductivity-conduction in ionic materials-semiconductors-Insulators-dielectrics-polarisation in dielectrics-Electrostriction-piezoelectricity-piezoelectricity and ferroelectricity-Magnetic materials and properties-Classification of magnetic materials- -magnetisation-permeability and the magnetic field-Diamagnetic-paramagnetic-ferromagnetic-ferrimagnetic and super-paramagnetic materials-Domain structure and the hysteris loop-Curie temperature-Applications of magnetic materials-Metallic and ceramic magnetic materials-**Photonic materials and properties**- Electromagnetic spectrum-Reflection, refraction, absorption and transmission-Selective absorption and transmission-Emission phenomenon-luminescent and phosphorescent materials-Fibre optic communication system.

Unit-II-Nanostructured materials and properties (36 Hrs)

Size and dimensionality effects - size effects - potential wells - partial confinement - conduction electrons and dimensionality – quantum well-quantum wires-quantum dots-Fermi gas and density of states - Carbon based nano-materials-Fullerenes-carbon nanotubes- nanoshells- graphene- biological and smart nanomaterials. Properties of nanomaterials- elctrical-optical-mechanical-and thermo dynamical properties. Synthesis of nanomaterials- CVD-Sol-gel-Combustion-hydrothermal- Colloidal growth-nanotube synthesis-Lithographic process-: Lithography, Nanolithography, split gate technology, self assembly, limitation of lithographic process. Non-lithographic techniques: Plasma arc discharge, sputtering, evaporation.Tools of nanomaterials: X-ray diffraction-FTIR spectroscopy-Raman spectroscopy-Band assignments-UV-Vis spectroscopy-Determination of band gap-Tauc's plot –

For qualitative study only(Non evaluative) *:* Scanning probe microscopy-STM-AFM- NSOM- Electron Microscopies-TEM-HRTEM and SEM.

Unit III-Nano-electronics (36 Hrs)

Introduction to Nanoelectronics

Properties dependent on density of states - excitons - single-electron tunnelling - applications infrared detectors - quantum dot lasers-Tunnel junction and application of tunnelling-Tunneling through a potential barrier, potential energy profiles of material interfaces, applications of tunnelling. Micro-electromechanical systems (MEMSs) and Nano-electro-mechanical systems (NEMSs), Intrduction to Spintronics-History and overview of spin electronics; Classes of magnetic materials; Quantum Mechanics of spin; Spin relaxation mechanisms; spin relaxation in a quantum dots.

Qualitative studyonly(Non evaluative)

Resonant Tunnelling Diode, Quantum Cascade lasersSingle electron transistor-: Coulomb Blockade, single electron transistor, other SET and FET structures. Molecular Machines, Nano-biometrics- Molecular and Nano-electronics-Microbial Fuel Cells-Hydrogen storage-Nano medicine-Biological applications-Photonic nano crystals and integrated circuits-Quantum computers Intrduction to Spintronics- :Spin Galvanic effect; Spin LEDs: Fundamental and applications, Spin photoelectronic devices, Electron spin filtering, Materials for spin electronics,. Spin-Valve and spin-tunneling devices: Read Heads, MRAMS, Field Sensors, Spintronic Biosensors, Spin transistors, Quantum Computing with spins.

Reference Books

1. The Science and Engineering of Materials: Donald R Askeland and Pradeep P Phule 6 Edition-Thomson Brooks/Cole.
2. Principles of Electronic Materials and Devices , S.O.Kasap .Tata Mc Graw Hill
3. Crystallography and crystal defects, A. Kelley, G.W. Groves & P. Kidd, Wiley
4. Crystallography applied to Solid State Physics, A.R. Verma, O.N. Srivastava, NAI
5. Solid State Physics, A.J.Dekker, Macmillan, (1967).
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7. Introduction to Theory of Solids, H.M. Rosenberg, Prentice Hall.
8. Solid State Physics,J.S. Blakemore, W.B.Saunders & Co. Philadelphia.
9. Solid State Physics, N.W. Ashcroft & N.D. Mermin, Brooks/ Cole (1976).
10. Crystal Defects and Crystal Interfaces, W. Bollmann, Springer Verlag.
11. Elementary solid State physics M.Ali Omar-Pearson
12. Solid State Physics R.J.singh-Pearson
13. Introduction to Nanotechnology, Charles P. Poole, Jr. and Frank J.Owens, Wiley, (2003) 92
14. Nano The Essential-T Pradeep; Mc Graw Hill Education
15. Nanotechnology An Introduction to Synthesis properties and Applications of Nanomaterials: Thomas Varghese and K.M.Balakrishna-Atlantic Publishers.
16. MEMS/NEMS: micro electro mechanical systems/nano electro mechanical systems Volume1, Design Methods, Cornelius T.Leondes, Springer, (2006).
17. Mick Wilson, Kamali Kannangara, Geoff Smith, Michelle Simmons and Burkhard Raguse "Nanotechnology", Overseas Press New Delhi 2005
18. W. R. Fahrner (Ed.) "Nanotechnology and Nanoelectronics", Springer 2006. S. Bandyopadhyay, M. Cahay

19PPH43N: (Special Paper II) RADIATION PHYSICS (6 L, 1 T)

Course outcome

Upon completion of this course, the students will be able:

CO1: To gain deep knowledge about Interaction of radiation with matter

CO2: To enable the students to adopt the Dosimetry methods in radiation physics

CO3: To give awareness about radiation exposure and biological effects of radiation

Unit –I Interaction of radiation with matter (36 hours)

Ionizing radiations, terrestrial sources, extraterrestrial sources, non-ionizing radiations, natural and man-made sources, interaction of radiation with matter, energy loss rate, bremsstrahlung, range energy relation, stopping power, photoelectric absorption, Compton scattering, pair production, properties of gamma rays and neutrons. Particle flux and fluence, Energy flux and fluence , Cross section, Linear and mass attenuation coefficients , Mass-energy transfer and mass energy absorption coefficients, Stopping power –Linear Energy Transfer (LET) - Weighing Factors(W-values), Radiation and tissue weighting factors, absorbed dose- equivalent dose, effective dose, committed equivalent dose, committed effective dose – Concept of KERMA (Kinetic Energy Released per unit Mass)

Unit II Radioactivity, Detection & Dosimetry (36 hours)

Law of radioactive decay, half life, mean life, specific activity, successive disintegration, radioactive equilibriums, age of mineral and rocks, alpha decay: barrier penetration, range-energy relationship, beta decay: Fermi theory, parity violation, Curie plot, gamma decay, radioactive transitions in nuclei, selection rules.

Thermo luminescent Dosimeters (TLD) – Optically stimulated Luminescence dosimeters (OSLD) –Neutron Detectors – Nuclear track emulsions for fast neutrons – Solid State Nuclear track (SSNTD) detectors, Instruments for personnel monitoring –Digital pocket dosimeters using solid state devices and GM counters - Contamination monitors for alpha, beta and gamma radiation – Scintillation monitors for X and gamma radiations - Neutron Monitors, Tissue equivalent survey meters – Flux meter and dose equivalent monitors – Pocket neutron monitors.

Unit III Radiation Exposure and Biological effects (36 hours)

Natural exposure pathways – exposure through manmade source – X-ray, Ultra sound, CT, MRI scans (elementary ideas only). Somatic and genetic damage factors-Somatic effects, early deterministic somatic effects, Symptoms of acute radiation syndrome-hematopoietic syndrome, gastrointestinal syndrome, cerebrovascular syndrome-Radiation dose-response relationship,Threshold and non-threshold relationships, Late somatic effects-carcinogenesis, cataractogenisis, embryologic effects,Genetic effects-cause of genetic mutations,natural spontaneous mutation, mutagens responsible for genetic mutations,radiation interaction with DNA macromolecules, cellular damage repair by enzymes, incapacities of mutant genes, dominant or recessive point mutations, ionizing radiation as a cause of genetic effects, doubling dose concept.

Books for study

1. G.F. Knoll, Radiation detection and Measurement, John Wiley & Sons, 2000
2. K. Thayalan, Basic Radiological Physics, Jaypee brothers medical publishers, New Delhi,2003
3. Alan Martin and Samuel A. Harbison, An Introduction to radiation Protection Third edition, Chapman and Hall, New York 1986

References

1. R.R. Roy & B P Nigam, Nuclear Physics Theory and Experiments, Wiley Eastern, 2000
2. UNSCEAR Report United Nations Scientific Committee on the Effects of Atomic Radiation, 2008.

MODEL QUESTION PAPER
19PPH43N: Radiation Physics

Time:3 hours **Max.Marks:75**

Part A

Answer any 5 questions .Each question carries 3 marks (5x3=15marks)

I a) Write notes on linear and mass attenuation coefficient.

b) Explain the variation of cross section for photoelectric absorption, Compton Scattering and pair production with energy of the incident photon.

c) Explain the terms absorbed dose, equivalent dose and effective dose?

d) What is the basic principle of TLD?

e) What is meant by transient equilibrium?

f) Write a brief note on parity violation in beta decay.

g) What is meant by short time recoverable effects of radiation?

h) Mention three characteristics of Gamma ray.

Part B

Answer all the following questions. Each carries 15 marks (3x15=45 marks)

II A) What is mean by interaction of radiation with matter? Explain in detail, the interaction processes-photoelectric absorption, Compton scattering, pair production and bremsstrahlung. .

OR

B) What is mean by stopping power? Write its equation and explain the terms. Explain the dependence of stopping power with (i) energy of the beam, (ii) nature of the medium and (iii) projectile.

III A) Briefly sketch Gamow's theory of Alpha decay.

OR

B) Explain the basic idea behind the use of Solid State Nuclear Track Detectors (SSNTDs) for the radiation dosimetry.

IV A) Explain i)acute radiation sickness ii) chronic radiation sickness.

OR

B) What is meant by radiation carcinogenesis? What are the risk of carcinogenesis.

Part C

Answer any 3 Questions. Each carries 5 marks (3x5=15marks)

V a) A mono energetic photon beam of wavelength 0.018 A is Compton scattered in a direction 30^0 from its line of incidence. Calculate the i) Compton shift, ii)kinetic energy given to the recoiled electron and iii)percentage of incident energy lost by the photon.

b) In an event of pair production, the electron and positron are released with kinetic energies of 0.25 MeV and 0.28 MeV respectively. Find the energy of the photon involved in the process?

c) Ten gram of radium (Ra^{226}) was kept in a medium of specific heat 1.4 J / Kg/ ^oC and mass 100 gm. Calculate the rate of rise in temperature of the medium if the half life of the sample is 1620 years and the energy of alpha particle emitted is 5.8 MeV.

d) 8 MeV Alpha particles from a sample were found to deposit 10% of its energy in skin cells with a specific density 1.6 mg/ cm^2. Calculate the dose imparted by the radiation?

e) What are the factors affecting frequency of radiation induced mutation.

f) Explain the genetic effect of radiation.

19PPH43S: ADVANCED ASTROPHYSICS (6L,1T)

Course Outcome

Upon completion of this course, the students will be able:

CO1: To gain advanced knowledge on the general features of observational astronomy

CO2: To understand the theoretical ideas of Stellar evolution

CO3: To acquire deep knowledge about Galactic Physics and elements of Cosmology

UNIT I

General features of observational astronomy (36 hours)

Emergence of modern astronomy - Astronomy in different bands of electromagnetic radiation.Celestial co-ordinates – Spherical coordinates – Altazimuth system – Local equatori-al system – universal equatorial system – Ecliptic system – Galactic coordinates – conversion of coordinates.Apparent luminosity of stars – measurement of apparent luminosity –various magnitude systems – correction for apparent magnitude.Stellar distances and absolute lumin-osities – measurement of distances within the solar system – trigonometric parallaxes of stars– method of measurement of luminosity -.surface temperature of stars – spectral classification of stars-stellar magnetic fields.**[Ref. 1]**

UNIT II

Stellar physics and Stellat evolution (36 hours)

Theory of radiative transfer – Radiative transfer equation – Thermodynamic equilibrium – ra-diative transfer through stellar atmosphere – formation of spectral lines-Basic equation of stel-lar structure – Hydrostatic equilibrium in stars – Virial theorem – energy transport inside stars – convection inside stars – stellar models – some relations among stellar quantities – determination of stellar parameters – main sequence– red giants and white dwarfs Nucleosynthesis and Nuclear reactions in stars – calculation of nuclear reaction rates – Im-portant nuclear reactions in stellar interiors – Helioseismology – solar neutrino experiments – Stellar evolution – Evolution of binary systems – mass loss from stars – stellar winds-Stellar collapse – Degeneracy pressure of Fermi gas – structure of white dwarfs – Chandrasekhar limit – neutron stars – pulsars – binary X – ray sources. accretion disks.[**Ref. 2]**

UNIT III

Galactic Physics and elements of Cosmology (36 hours)

Normal galaxies – morphological classification - physical characteristics and kinematics – expansion of the universe – active galaxies – super luminal motion in quasars – black hole as central engine – unification scheme – cluster of galaxies – large scale distribution of galaxies – gamma ray bursts.

Space time dynamics of the universe – general relativity – the metric of the universe – Friedman equation for the scale factor – cosmic background radiation – evolution of matter dominated universe – evolution of radiation dominated universe.Primordial nucleosynthesis – cosmic neutrino background – nature of dark matter. **[Ref. 2,3 &4]**

References

1. Abhyankar K. D. - *Astrophysics Stars and Galaxies*,Universities Press.
2. Arnab Rai Choudhuri - *Astrophysics for Physicists*, Cambridge University Press.
3. Padmanabhan T. – *Theoretical Astrophysics*, Cambridge University Press.
4. Narlikar J. B.- *Introduction to Cosmology*, Cambridge University Press.

19PPH43T: THEORETICAL PHYSICS – II (6L,1T)

Course Outcome

Upon completion of this course, the students will be able:

CO1: To have a deep knowledge in functional Integrals in Physics

CO2: To understand the theoretical ideas of Many particle physics

CO3: To acquire deep knowledge about Critical phenomena

Unit I

Functional Integrals in Physics(36 hours)

• Functionals

Function vs functional, functional derivatives, functional integration, Guassian integrals [Ref 19, 20, 21, 22]

Path integrals in quantum mechanics

– Single particle systems- Feynman path integral, propagator as a functional integral, Born approximation, Coulomb scattering,

– Many particle systems - Second quantization, coherent states and many-body path integrals, field integral for the quantum partition function.

– Quantum Fields - Path integrals for fields, functionals for bosonic andfermionic fields, generating functions for free and interacting fields, Wick's theorem, Perturbation theory. [Ref 8,13,14,17,10, 20, 21, 23]

Unit II

Many particle physics(36 hours)

Broken symmetry and collective phenomena

Mean field theory, Bose-Einstein condensation and superfluidity, superconductivity, interacting electron gas and disorder

Response functions

Linear response theory, analytic structure of correlation functions, electromagnetic linear response

Unit III

Critical phenomena (36 hrs)

Continuous phase transitions, critical behaviour, scaling, renormalization group, Ising model, RG analysis of ferromagnetic transition. [Ref 19, 22]

References

1. F. Scheck, *Quantum Physics*, Springer (2007).
2. G. Teschl, *Mathematical Methods in Quantum Mechanics*, American Mathematical Society (2009).
3. P. Szekeres, *Modern Mathematical Physics*, Cambridge University Press (2004).
4. M. T. Vaughn, *Introduction to Mathematical Physics*, Wiley - VCH Verlag (2007).
5. Arfken, *Mathematical Physics for Physicists*, Academic Press (2013).
6. J. J. Sakurai, *Modern Quantum Mechanics*, Addison-Wesley Publishing Company (1994).
7. L. I. Schiff, *Quantum Mechanics*, McGraw-Hill Book Co. (1968).
8. R. Shankar, *Principles of Quantum Mechanics*, Springer (1994).
9. L. E. Ballentine, *Quantum Mechanics*, World Scientific Publishing Co. (2000).
10. L. H. Ryder, *Quantum Field Theory*, Cambridge University Press (2008).
11. J. J. Sakurai, *Advanced Quantum Mechanics*, Addison-Wesley (1967).
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14. R. Kubo, M. Toda and N. Hashitsume, *Statistical Physics II: None quilibrium Statistical Mechanics*, Springer-Verlag (1985).
15. G. F. Mazenko, *Nonequilibrium Statistical Mechanics*, Wiley-VCH Verlag (2006).
16. V. Balakrishnan, *Elements of Nonequilibrium Statistical Mechanics*, CRC Press (2008).
17. B. F. Schutz, *A First Fourse in General Relativity*, Cambridge University Press (2009).
18. S. Caroll, *Spacetime and Geometry: An Introduction to General Relativity*, Addison-Wesley (2004).
19. A. Altland and B. Simons, *Condensed Matter Field Theory*, Cambridge University Press (2008).
20. J. W. Negele and H. Orland, *Quantum Many-particle Systems*, Levant Books (2006).
21. E. Fradkin, *Field Theories of Condensed Matter Systems*, Levant Books (2006).
22. P. M. Chaikin and T. C. Lubensky, *Principles of Condensed Matter Physics*, Cambridge University Press (2004).
23. A. M. Tsvelik, *Quantum Field Theory in Condensed Matter Physics*, Cambridge University Press (2003).

19PPH51: GENERAL PHYSICS PRACTICALS

Course outcome

Upon completion of this course, the students will be able:

CO1: To have a familiarization of the usage of scientific equipments accurately.

CO2: To enhance knowledge about Error analysis of various general physics experiments is also done.

CO3: Will demonstrate the ability to think critically and to use appropriate concepts to analyze qualitatively problems or situations involving the fundamental principles of physics

CO4: Will demonstrate the ability to use appropriate mathematical techniques and concepts to obtain quantitative solutions to problems in physics.

(Total of 10 experiments to be done from Section A and B)

Section A(at least 5 experiments to be done in this section)

1. Determination of elastic constants by Cornu’s method (elliptical and hyperbolic fringes)
2. Analysis of absorption spectra of liquids using spectrometer
3. Study of ultrasonic waves in liquids
4. Determination of e/k using Ge and Si transistors
5. Anderson Bridge –determination of self and mutual inductance
6. Michelson Interferometer experiments
7. Identification of Fraunhofer lines in solar spectra
8. Verification of Richardson’s equation using diode valve

9. LED experiments (a) wavelength determination (b) I-V characteristics (c) output power variations with applied voltage etc.
10. Thermal diffusivity of brass

Section B(at least 2 experiments to be done from this section)

1. BH curve-anchor ring
2. Study of photoelectric effect and determination of of Planck's constant
3. Determination of Stefan's constant
4. Experiments using Laser: (a) Laser beam characteristics (b) Diffraction grating (c) Diffraction at different types of slits and apertures (d) refractive index of liquids (e) particle size determination
5. Youngs modulus of different materials using strain gauge
6. Determination of magnetic force in a current carrying conductor
7. Optical fibre characteristics
8. Cauchy's constants of liquids and liquid mixtures using hollow prism and spectrometer
9. Dielectric constant of non-polar liquid.
10. Variation of dielectric constant with temperature of ferroelectric material.
11. Surface tension of a liquid using Jaeger's method
12. Experiments using Phoenix Kit (a) Capacitor charging/discharging experiments (b) Dielctric constant of glass

19PPH52: Electronics and Computer Science Practicals

Course outcome

Upon completion of this course, the students will be able:
CO1: To acquire a practical knowledge about basic electronic components ,
CO2: To study and analyze various theoretical aspects through experiments.
CO3: To gain the Fundamentals of algorithm development, program design and structured programming using an object-oriented language.
CO4: Will demonstrate basic experimental skills by the practice of setting up and conducting an experiment with due regards to minimizing measurement error.

Unit I – Electronics Experiments (A total of 10 experiments to be done)
Secion A(atleast 5 experiments to be done)

1. RC integrator and RC differentiator and its response.
2. Single stage CE amplifier –Design and study of frequency response
3. Study of RC Phase shift oscillator circuits using Transistors
4. Construction and study of Astable multivibrator and VCO circuits using Transistors
5. Study of OP Amp circuits (a) summing amplifier (b)difference amplifier
6. OP Amp as an integrator and differentiator
7. Differential Amplifier-using transistors –to measure CMRR
8. Characteristics of JFET and MOSFET
9. Characteristics of SCR
10. Design and study of negative feedback amplifier circuits
11. Study of Clipping and Clamping circuits
12. UJT Characteristics and UJT relaxation Oscillator

Section B(at least 3 experiments to be done)

1. Emitter follower and source follower circuits
2. Weinberg oscillator using OP Amp
3. SR and JK Flip Flops -construction using Logic Gates and study of truth tables
4. Study of the frequency response of a tuned amplifier
5. Study of power amplifier circuits
6. Frequency multiplier using PLL
7. Study of Schmitt trigger circuits using transistors
8. Construction and study of cascade amplifier circuit using transistors.
9. Simple electronics experiments using Phoenix and Python based Kits.

Unit II Comptuter Programming
(A minimum of 8 experiments to be done,programs should be written in C++ language)
1. Least square fitting
2. First derivative of tabulated function by difference table
3. Numerical integration (Trapezoidal rule and Simson method)
4. Solution of algebraic and transcendental equations using Newton-Ralphson method
5. Solution of algebraic equations using bisection method
6. Numerical interpolation using Newton and Lagrangian methods
7. Monte Carlo simulation
8. Evaluation of Bessel and Legendre functions
9. Matrix addition,multiplication ,trace,transpose and inverse
10. Fourier series analysis
11. Study of motion of projectile in a central force field
12. Study of Planetary motion and Kepler's laws

19PPH 61: Advanced Physics Practicals

Course outcome
Upon completion of this course, the students will be able:
CO1: To acquire a practical knowledge about the application and demonstration of advanced experiments in Physics.
CO2: Will demonstrate basic experimental skills by the practice of setting up and conducting an experiment with due regards to minimizing measurement error.
CO3: To recognize and explain aspects of the application of the topics covered in this module in everyday life.

(*A total of 10 experiments to be done*)
Unit I: Physics experiments
Section A(***atleast 5 experiments to be done*****)**
1. e/m of an electron-Thompson's method
2. Charge of an electron-Millikan's method
3. Determination of Fermi energy of Copper
4. Study of variation of resistance of a semiconductor with temperature and determination of band gap
5. Magnetic Suceptibility of a liquid using Quincke's method
6. Ferromagnetic studies using Guoy's method
7. Hall effect in a semiconductor
8. Rydberg constant deterimination using grating,spectrometer and discharge tubes.
9. Thermo-emf of bulk samples like Al,Cu.Brass etc.

Section B (*at least two experiments to be done*)
1. Electrical characteristics of a solar cell
2. Studies usingUV visible spectrophotometer
3. Refractive index of liquids and liquid mixtures using Abbe's refractometer
4. Optical activity studies using Polarimeters
5. Determination of temperature characteristics of a Flame
   a. Candle flame using digital photography and image analysis
   b. sodium flame in comparison with incandescent lamp using a spectrometer
6. LDR and photodiode characteristics
7. Simple experiments using GM counter
8. Determination of dielectric constant of materials
9. Experimental determination of Avogadro's number using an electrochemical cell
10. Study of arc spectra and hydrogen spectra using an imager (CCD) and photoelectric/electronic recorder.

Unit II: Data Anaysis(*Five experiments to be done*)
1. Analysis of the given band spectrum
2. Analysis of given rotation-vibration spectrum

3. Interpretation vibration spectra of simple molecules using Raman and IR spectra
4. Dissociation energy of diatomic molecules
5. Analysis of powder XRD data
6. Study of stellar spectral classification from low dispersion stellar spectra
7. Study of HR diagram of stars
8. Radioactive material counting statistics
9. Interpretation of UV- visible spectra of materials
10. Weather and astronomy related image processing

19PPH62E: Advanced Electronics Paracticals

Course outcome

Upon completion of this course, the students will be able:

CO1: To apply and demonstrate the theoretical knowledge to design, construct and operate electronic circuits like Amplifiers, voltage regulators, astable & monostable vibrators etc

CO2: To analyze, specify, design, write and test assembly language programs of moderate complexity and hence to perform microprocessor based experiments

Unit I-ELECTRONICS(*a total of seven experiments to be done***)**

Section A (***at least 5 experiments to be done*****)**

1. Study of active filters using OP amps (a) low pass (b) high pass (c) band pass for both first order and second order-gain/ roll off determination
2. Wave form generation using OP amp circuits:
   (a) astable and monostablemultivibrators (b) square,triangular and saw-tooth wave generation
3. IC 555 timer experiments (a) monsostable and astablemultivibrators(b) VCO
4. D/A convertor circuits using OP Amp 741
5. Differential amplifier circuits using transistors
6. Design of series pass voltage regulators using (a) transistors with load and line regulation (b) OP Amp Negative feedback –non inverting amplifier, upper cut off frequency, constant gain-bandwidth product

Section B(at least 2 experiments to be done)

1. Study of IF tuned amplifier and Amplitude modulation (generation and detection) using transistor,diode etc.
2. Frequency modulator and detector circuits.
3. Pulse modulation circuits using 555 timer (a) PAM (b) PWM
4. Digital modulation circuits (a) BFSK generation using 555 timer (b) BFSK detector using 555 timer and PLL (c) BPSK generation
5. Shift register and ring counter circuits using flip flops
6. Miscellaneous transistor applications (a) automatic night light with LDR (b) invertor circuit (transistors as a switch) (c) time delay circuit using SCR
7. BCD to decimal decoder and seven segment display using IC
8. Design of Electronic counters (up and down counters)

Unit II: Micorprocessor Based Experiments

(*Five experiments to be done*)

1. 8085 /8086 program to find out largest from a group of 8bit/16 bit numbers
2. Square wave generation using 8255A interface using 8085/8086
3. 8086 program for block additions
4. Interfacing LED display board with 8085/8086
5. 8086 program to convert binary to ASII and ASII to BCD
6. 8086 program to arrange a given data in ascending and decending order
7. 8086-simple traffic light controller
8. 8086 program for binary to BCD conversion and vice versa
9. Program of Fibonacci series using 8086