ST. ALBERTS COLLEGE AUTONOMOUS, ERNAKULAM, KERALA

M.Sc. PROGRAMME IN PHYSICS

UNDER

CREDIT AND SEMESTER SYSTEM

(2016 admissions onwards)

Members of the Board of Studies of Physics

Sl.No:	Name	Designation	Qualification
a) **Chairman:** *(Head of the Department concerned)*			
1	Dr. Nelson Rodrigues	HoD	MSc, PhD
b) Teachers: *(The entire faculty of each specialization)*			
1	Dr Nandakumar Kalarikkal	Hon. Director of International and Inte runiversity Centre for Nanoscience & Nanotechnology, and Associate Professor, School of pure and Applied Physics Mahatma Gandhi University, Kottayam -686560 , Kerala , India.	MSc, PhD.
2	Dr. Pramod Gopinath	Professor, International School of Photonics, CUSAT, Kalamassery	MSc, Ph.D
3	Dr. James Kurian	Professor, Department of Electronics, CUSAT, Kalamassery	M.Tech , Ph.D
4	Dr. Louie Frobel P.G	Asst. Professor, Department of Physics, St.Albert's College Ernakulam	M.Sc , M.Phil, Ph.D
5	Dr. Sajeesh T H	Asst. Professor, Department of Physics, St. Albert's College Ernakulam	M.Sc, Ph.D
6	Dr. Vimala George	Asst. Professor ,Department of Physics , St. Xavier's College for women Aluva	M.Sc, Ph.D
7.	Dr. Ninan Sajith Philip	Associate Professor, Department of Physics, St. Thomas College,Kozhencherri-689641..	MSc, PhD.
8	Dr. Tripti S.warrier	Assistant Professor, Department of Electronics,CUSAT, Kalamassery.	B Tech, M Tech, PhD.
c) Two Subject Experts: *(From outside the Parent University to be nominated by the Academic Council)*			
1	Dr. Anand Narayanan	Associate Professor , Department of Earth and Space Science , Indian Institute of Space Science and Technology, TVM	M.Sc., Ph.D
2	Dr. M. K. Jayaraj	Syndicate member, and Professor Department of Physics , CUSAT ,Kalamassery	M.Sc , Ph.D

d) Nominee of Vice Chancellor: (*one expert to be nominated by the Vice-Chancellor from a panel of six experts recommended by the Principal)*			
1	Dr. Issac Paul	Associate Professor, Department of Physics , S.B.College Changanassery	M.Sc , Ph.D
e) Placement Representative: *(One representative from industry/corporate sector/allied area relating to placement)*			
1	Mr G. Sivaramakrishnan	Consultant Konark Systems Pvt Ltd Kaloor, Ernakulam, Kerala	
2	Rev.Dr.George Peter Pittappillil	Director, Mithradham	
f) Meritorious alumnus: *(One postgraduate meritorious alumnus to be nominated by the Principal)*			
1	Dr. Sasikumar	Principal , Govt.College Thalasseri	M.Sc , Ph.D
g) The Chairman, Board of Studies, **may** *with the approval of the Principal of the college,* **co-opt:**			
a) Co-opted Special Experts from outside (*Experts from outside the college whenever special courses of studies are to be formulated)***:**			
1	Dr. Joe Jacob	Associate Professor and HoD Department of Physics, SB College Changanserri	M.Sc , Ph.D
2	Dr. L. Godfrey	Emeritus professor, Dept. of Physics, CUSAT	M.Sc , Ph.D
b) Other members of staff of the same faculty:			
1	Sri. Shaji Joseph	Associate Professor	M.Sc
2	Sr. Lawrel Gregory	Associate Professor	M.Sc
3	Sri. S. Charles	Associate Professor	M.Sc
4	Sri. Justin Paiva	Associate Professor	M.Sc, M.Phil
5	Sri. Augustine Sumesh C J	Assistant Professor	M.Sc, B.Ed

SEM	Name of the course with course code	No.of Hrs/ week	No. of credit	Total Hrs/ SEM.
I	**PPH1CRT01:**Mathematical Methods in Physics- I	4	4	72
I	**PPH1CRT02**: Classical Mechanics	4	4	72
I	**PPH1CRT03**: Electrodynamics	4	4	72
I	**PPH1CRT04**: Electronics	4	4	72
I	**PPH1CRP01**: General Physics Practicals	9	3	162
II	**PPH2CRT01**:Mathematical MethodsinPhysics- II	4	4	72
II	**PPH2CRT02**: Thermodynamics and Statistical Mechanics	4	4	72
II	**PPH2CRT03**: Condensed Matter Physics	4	4	72
II	**PPH2CRT04**: Quantum Mechanics - I	4	4	72
II	**PPH2CRP01**: Electronics Practicals	9	3	162
III	**PPH3CRT01**: Quantum Mechanics - II	4	4	72
III	**PPH3CRT02**: Computational Physics	4	4	72
III	**PPH3CRT03:** Integrated Electronics & DSP	4	4	72
III	**PPH3CRT04:** Microelectronics & Semiconductors	4	4	72
III	**PPH3CRP01**: Computational Physics Practicals	9	3	162
IV	**PPH4CRT01**: Atomic and Molecular Physics	4	4	72
IV	**PPH4CRT02**: Nuclear and Particle Physics	4	4	72
IV	**PPH4CRT03**: Instrumentation and communication electronics	4	4	72
IV	**PPH4CRT04**: Thin Film and Nanoscience	4	4	72
IV	**PPH4CRP01**: Advanced Electronics Practical	4	4	72
IV	**PPH4CPR01**: Computational Physics Practical	4	4	72
IV	**PPH4CPR01**: Project/Dissertation	Nil	2	Nil
IV	**PPH4CRV01**: Viva Voce	Nil	2	Nil

Table 1.1: Structure of PGCSS Physics M.Sc. Common Courses

The Elective Bunches:

There are four Electives Bunches offered in this PGCSS Programme. Each elective consists of a bunch of **three** theory courses and **one** laboratory course. The first two theory courses of a bunch are placed in the Semester III, while the third theory course and the laboratory course go to the Semester IV. An institution can select only one Elective Bunch in an academic year. The course structure of the Electives Bunches is given in Table 1.2

The Electives Bunches are named,

(i) Bunch A: Electronics

(ii) Bunch B: Informatics

(iii) Bunch C: Material Science

(iv) Bunch D: Theoretical Physics.

Distribution of Credit: The total credit for the programme is fixed at 80. The distribution of credit points in each semester and allocation of the number of credit for theory courses, practicals, project and viva is as follows. The credit of theory courses is 4 per course, while that of laboratory practical course is 3 per course. The project and viva voce will have a credit of 2 each. The distribution of credit is shown in Table 1.2.

Semester	Courses	Credit	Total Credit
I	4 Theory courses	4 x 4 = 16	16
II	4 Theory Course 2 Laboratory Practical	4 x 4 = 16 2 x 3 = 6	22
III	4 Theory courses	4 x 4 = 16	16
IV	4 Theory Course 2 Laboratory Practical 1 Project/dissertation 1 Viva – voce	4 x 4 = 16 2 x 3 = 6 1 x 2 = 2 1 x 2 = 2	26
Total credit of the M.Sc. Programme			80

Table 1.2: Distribution of creditin the PGCSS Programme.

GRADING AND EVALUATION

Examinations

The evaluation of each course shall contain two parts such as Internal or In-Semester Assessment (IA) and External or End-Semester Assessment (EA). The ratio between internal and external examinations shall be 1:3. The Internal and External examinations shall be evaluated using Direct Grading system based on 5-point scale.

Internal or In-Semester Assessment (IA)

Internal evaluation is to be done by continuous assessments of the following components. The components of the internal evaluation for theory and practicals and their weights are as in the Table 2.1. The internal assessment should be fair and transparent. The evaluation of the components should be published and acknowledged by students. All documents of internal assessments are to be kept in the institution for 2 years and shall be made available for verification by the university. The responsibility of evaluating the internal assessment is vested on the teacher(s) who teach the course. The two test papers should be in the same model as the end semester examination question paper, the model of which is discussed in the Section 2.3. The duration and the number of questions in the paper may be adjusted judiciously by the college for the sake of convenience.

THEORY		**PRACTICALS**	
Component	Weights	Component	Weights
Attendance	2	Attendance	2
Assignments	2	Laboratory Involvement	2
Seminar	2	Test [*Best of Two*]	2
Test - I	2	Record	2
Test - II	2	Viva	2
Total Weight of Theory = 10		Total Weight of Practicals = 10	

Table 2.1: Distribution of weights and components of theory and practical

Attendance, Assignment and Seminar

The split up of Attendance grade and different components of Assignment and Seminar is given in the Table 2.2. Monitoring of attendance is very important in the credit and semester system. All the teachers handling the respective courses are to document the attendance in each semester. Students with attendance less than 75% in a course are not eligible to attend external examination of that course. The performance of students in the seminar and assignment should also be documented.

Attendance		Assignments		Seminar	
%of Attendance	Grade	Components	Weig-hts	Components	Weig-hts
≥90%	A	Punctuality	1	Innovation of Topic	1
≥85% and < 90%	B	Review	2	Review/ Reference	1
≥ 80 % and < 85%	C	Content	4	Content	3
≥ 75 % and < 80%	D	Conclusion	2	Presentation	3
<75 %	E	References	1	Conclusion	2

Table 2.2: split up of attendance grade and components of Seminar & Assignment

Project Evaluation

The internal evaluation of the project is done by the supervising guide of the department or the member of the faculty decided by the head of the department. The project work may be started at the beginning of the Semester III. The supervising guide should keenly and sincerely observe the performance of the student during the course of project work. The supervising guide is expected to inculcate in student(s), the research aptitude and aspiration to learn and aim high in the realm of research and development. A maximum of three students may be allowed to perform one project work if the volume of the work demands it.

Project evaluation begins with (i) the selection of problem, (ii) literature survey, (iii) work plan, (iv) experimental / theoretical setup/data collection, (v) characterization techniques/computation/analysis (vi) use of modern software for data analysis/experiments (Origin, LABView, MATLAB, …etc) and (vi) preparation of dissertation. The project internal grades are to be submitted at the end of Semester IV. The internal evaluation is to done as per the following general criteria given in Table 2.3

Component	**Weights**
Literature Survey	3
Experimental/Theoretical setup/Data Collection	4
Result and Discussion	3

Table 2.3: Criteria for internal evaluation of Project

General Instructions

(i) The assignments/ seminars / test papers are to be conducted at regular intervals. The time for conduct of two test papers will be notified by the university from time to time. These should be marked and promptly returned to the students.

(ii) One teacher appointed by the Head of the Department will act as a coordinator for consolidating grade sheet for internal evaluation in the department in the format supplied by the University. The consolidated grade sheets are to be published in the department notice board, one week before the closing of the classes for end semester examinations. The grade sheet should be signed by the coordinator and counter signed by the Head of the Department and the college Principal.

(iii) The consolidated grades in specific format supplied by the university are to be kept in the college for future references. The consolidated grades in each course should be uploaded to the University Portal at the end of each semester as directed by the University.

(iv) A candidate who fails to register for the examination in a particular semester is not eligible to continue in the subsequent semester.

(v) Grievance Redress Mechanism for Internal evaluation: There will be provision for grievance redress at four levels, viz,

a) at the level of teacher concerned,

b) at the level of departmental committee consisting of Head of the Department, Coordinator and teacher concerned,

c) at the level of college committee consisting of the Principal, Head of the Department and one member of the college council, nominated by the principal each year,

d) at the university level committee consisting of Pro-Vice Chancellor / Dean of the Faculty, the controller of examinations and the Convener of the Standing Committee on Academic Affairs of the Syndicate.

College level complaints should be filed within one week of the publication of results and decisions taken within two the next two weeks. University level complaints will be made within the time stipulated by the University and decisions will be taken within one month of the last date fixed for filing complaints.

External Evaluation (EA)

The external examination of all semesters shall be conducted by the university on the close of each semester. There will be no supplementary examinations.

Question Paper Pattern for Theory Courses.

All the theory question papers are of three hour duration. All question papers will have three parts.

Part A: Questions from this part are very short answer type. Six questions have to be answered from among ten questions. Each question will have weight one and the Part A will have a total weight of six. A minimum of two questions must be asked from each unit of the course.

Part B: Part B is fully dedicated to solving problems from the course concerned. Four problems out of six given have to be answered. Each question has a weight two making the Part B to have total weight eight. A minimum of one problem from each unit is required. The problems need not always be of numerical in nature.

Part C: Part C will have four questions. Two questions of equal standard must be asked from each unit with internal option. Each question will have a weight four making the total weight sixteen in Part C

Practical, Project and Viva Voce Examinations

Practical Examination: First and second semester practical examinations are conducted at the end of Semester II and third and fourth semester practical examinations are conducted at the end of Semester IV. The practical examinations are conducted immediately after the second and fourth semester theory examinations respectively. There will be two practical examination boards every year to conduct these practical exams. All practical examinations will be of five hours duration. Two examiners from the panel of examiners of the university will be deputed by the board chairman to each of the examination centers for the fair and transparent conduct of examinations. Practical examination is conducted in batches having a maximum of eight students. The board enjoys the right to decide on the components of practical and the respective weights.

Project Evaluation: The project is evaluated by the two external examiners deputed from the board of practical examination. The dissertation of the project is examined along with the oral presentation of the project by the candidate. The examiners should ascertain that the project and report are genuine. Innovative projects or the results/findings of the project presented in national seminars may be given maximum advantage. The supervising guide or the faculty appointed by the head of the department may be allowed to be present at the time of project evaluation. This is only to facilitate proper evaluation of the project. The different weight for assessment of different components is shown in Table 2.5.

Viva Voce Examination: Viva voce examination is conducted only by the two external examiners of the board of practical examinations. The viva voce examination is given a credit two. The examination should be conducted in the following format shown in Table 2.6 below.

Component	**Weights**
Quality of project under study	1
Presentation of the project	3

Experimental/Theoretical setup/Data Collection	4
Result and Dissertation layout	2

Type of Questions	Percentage	Weightage to Difficulty Level	
B.Sc/ + 2 level	20	Level of Difficulty	%
M.Sc. Syllabus Based	40	Easy	30
Subject of Interest	20	Average	50
Advanced Level	20	Difficult	20

Table 2.6: Format for viva voce Examination

Both project evaluation and viva voce examination are to be conducted in batches of students formed for the practical examinations.

Reappearance/Improvement: For reappearance / improvement as per university rules, students can appear along with the next regular batch of students of their particular semester. A maximum of two chances will be given for each failed paper. Only those papers in which candidate have failed need be repeated. Chances of reappearance will be available only during eight continuous semesters starting with the semester in which admission/readmission is given to the candidate.

M. Sc. PHYSICS SYLLABUS

Introduction:

This chapter deals with the Syllabi of all Core courses, Elective courses and Open Elective courses of the M.Sc. Physics Programme under Credit and Semester System. The semester wise distribution of the courses is given. In Semester III and Semester IV, the courses from Elective Bunches and Open Elective Bunch will come as opted by the colleges concerned. The titles of the courses with course codes of all categories of courses are discussed in the Chapter – I.

CORE COURSES

SEMESTER - I

PPH1CRT01 MATHEMATICAL METHODS IN PHYSICS – I

Unit I

Vectors and Vector Spaces (18 Hrs)

Integral forms of gradient, divergence and curl, Line, surface and volume integrals – Stoke's, Gauss's and Green's theorems - Potential theory - scalar, gravitational and centrifugal potentials. Orthogonal curvilinear coordinates - gradient, divergence and curl in Cartesian, spherical and cylindrical coordinates. Equation of continuity - Linear vector spaces - Hermitian, unitary and projection operators with their properties- inner product space - Schmidt orthogonalization - Hilbert space - Schwartz inequality.

Text Books

1. Mathematical Methods for Physicists, G.B. Arfken &H.J. Weber 4th Edition, Academic Press (Chapter 1 & 2)
2. Mathematical Physics, P.K Chattopadhyay, New Age International (chapter 7)
3. Theory and problems of vector analysis, Murray R. Spiegel (Schaum's outline series)

Unit II

Matrices (12 Hrs)

Direct sum and direct product of matrices, diagonal matrices, Matrix inversion (Gauss-Jordan inversion method) orthoganal, unitary and Hermitian matrices, normal matrices, Pauli spin matrices, Cayley-Hamilton theorem. Similarity transformation - unitary and orthogonal transformation. Eigen values and eigenvectors – Diagonalisation using normalized eigenvectors. Solution of linear equation-Gauss elimination method. Normal modes of vibrations.

Text Books

1. Mathematical Methods for Physicists, G.B. Arfken &H.J. Weber 4th
2. Mathematical Physics, P.K Chattopadhyay, New Age International (Chapter 7)

Probability theory and distributions (6 Hrs)

Elementary probability theory, Random variables, Binomial, Poisson and Gaussian distributions-central limit theorem. Text Books

1. Mathematical methods for Physics and Engineering, K.F. Riley, M.P Hobson, S. J. Bence, Cambridge University Press (Chapter 24)

2. Mathematical Methods for Physicists, G.B. Arfken &H.J. Weber 4th Edition, Academic Press. (Chapter 19)

Unit III

Differential Geometry (16 Hrs)

Definition of tensors, basic properties of tensors. Covariant, contravariant and mixed tensors. Levi-Civita tensor, Metric tensor and its properties, Tensor algebra, Christoffel symbols and their transformation laws, covariant differentiation, geodesic equation, Riemann-Christoffel tensor, Ricci tensor and Ricci scalar.

Text Books

1. Introduction to Mathematical Physics, Charlie Harper, PHI
2. Vector analysis and tensors, Schaum's outline series, M.R. Spiegel, Seymour Lipschutz, Dennis Spellman, McGraw Hill
3. Mathematical Physics, B.S. Rajput, Y. Prakash 9th Ed, Pragati Prakashan (Chapter 10)
4. Tensor Calculus: Theory and problems, A. N. Srivastava, Universities Press

Unit IV

Special functions and Differential equations (20 Hrs)

Gamma and Beta functions, different forms of beta and gamma functions, evaluation of standard integrals. Dirac delta function, Kronecker Delta - properties and applications.

Bessel's differential equation – Bessel and Neumann functions – Legendre differential equation - Associated Legendre functions- Hermite differential equation - Laguerre differential equation – Associated Laguerre polynomials. (Generating function, recurrence relations, and orthogonality condition for all functions), Rodrigue's formula

Text Books

1. Mathematical Methods for Physicists, G.B. Arfken &H.J. Weber 4th

2. Mathematical Physics, B.S Rajput, Pragati Prakashan

Reference Books:

1. Mathematical Physics, B.D. Gupta, Vikas Pub.House, New Delhi
2. Advanced Engineering Mathematics, E. Kreyszig, 7^{th} Ed., John Wiley
3. Introduction to mathematical methods in physics, G.Fletcher, Tata McGraw Hill
4. Advanced engineering mathematics, C.R. Wylie, & L C Barrett, Tata McGraw Hill
5. Advanced Mathematics for Engineering and Physics, L.A. Pipes & L.R. Harvill, Tata McGraw Hill
6. Mathematical Methods in Physics, J. Mathew & R.L. Walker, India Book House.
7. Mathematical Physics, H.K. Dass, S. Chand & Co. New Delhi.

PPH1CRT02 CLASSICAL MECHANICS

Unit I

Hamiltonian Mechanics (10 Hrs)

Review of Newtonian and Lagrangian formalisms - cyclic co-ordinates - conservation theorems and symmetry properties - velocity dependent potentials and dissipation function - Hamilton’s equations of motion - Least action principle - physical significance.

Text Book:

1. Classical Mechanics, H. Goldstein, C.P. Poole & J.L. Safko, Pearson, 3^{rd} Ed., (Chap. 1, 2 & 8)

Variational Principle and Lagrange’s equations (6 Hrs)

Hamilton’s principle - calculus of variations – examples - Lagrange’s equations from Hamilton’s principle.

Text Book:

1. Classical Mechanics, H. Goldstein, C.P. Poole & J.L. Safko, Pearson, 3rd Ed., (Chapter 2)

Unit II

Mechanics of Small Oscillations (6 Hrs)

Stable and unstable equilibrium - two-coupled oscillators – Lagrange's equations of motion for small oscillations - normal co-ordinates and normal modes - oscillations of linear tri-atomic molecules.

Text Book:

1. Classical Mechanics, S.L. Gupta, V. Kumar & H.V. Sharma, Pragati Prakashan, 2007. (Chapter 8)

Canonical Transformations (7 Hrs)

Equations of canonical transformation- examples of canonical transformation - harmonic oscillator.

Text Book:

1. Classical Mechanics, H. Goldstein, C.P. Poole & J.L. Safko, Pearson, 3rd Ed. (Chapter 9)

Poisson brackets - Lagrange brackets - properties- equations of motion in Poisson bracket form - angular momentum Poisson brackets - invariance under canonical transformations.

Text Book:

1. Classical Mechanics, J.C. Upadhyaya, Himalaya, 2010. (Chapter 7)

Hamilton-Jacobi Theory (7 Hrs)

Hamilton-Jacobi equation for Hamilton's principal function - harmonic oscillator problem - Hamilton - Jacobi equation for Hamilton's characteristic function- action angle variables in systems of one degree of freedom - Hamilton-Jacobi equation as the short wavelength limit of Schroedinger equation.

Text Books:

1. Classical Mechanics, H. Goldstein, C.P. Poole & J.L. Safko, Pearson, 3rd Edn. (Chapter 10)
2. Classical Mechanics, J.C. Upadhyaya, Himalaya, 2010. (Chapter 8)

Unit III

Central Force Problem (9 Hrs)

Reduction to the equivalent one body problem - equations of motion and first integrals - equivalent one-dimensional problem and classification of orbits - differential equation for the orbits – virial theorem - Kepler problem. Text Book:

1. Classical Mechanics, H. Goldstein, C.P. Poole & J.L. Safko, Pearson, 3rd Ed.. (Chapter 3)

Rigid Body Dynamics (9 Hrs)

Angular momentum - kinetic energy - inertia tensor - principal axes - Euler's angles- infinitesimal rotations - rate of change of a vector - Coriolis force - Euler's equations of motion of a symmetric top - heavy symmetric top with one point fixed.

Text Book:

1. Classical Mechanics, G. Aruldhas, Prentice Hall 2009, (Chapter 8)

Unit IV

General Theory of Relativity (9 Hrs)

Principle of equivalence - principle of general covariance - motion of a mass point in a gravitational field - the Newtonian approximation - time dilation - rates of clocks in a gravitational field - shift in the spectral lines – energy-momentum tensor- Einstein's field equations and the Poisson approximation.

Text Book:

1. The Theory of Relativity, R.K. Pathria, Dover Pub. Inc. NY,2003 (Chap 6,7& 8)

Classical Chaos (9 Hrs)

Linear and non-linear systems - integration of linear equation: Quadrature method - the pendulum equation – phase plane analysis of dynamical systems

– phase curve of simple harmonic oscillator and damped oscillator- phase portrait of the pendulum - bifurcation - logistic map – attractors - universality of chaos - Lyapunov exponent - fractals - fractal dimension.

Text Book:

1. Classical Mechanics, G. Aruldhas, Prentice Hall 2009, (Chap.11& 12)

Reference Books:

1. Classical Mechanics, N.C. Rana and P.S. Joag, Tata Mc Graw Hill
2. Introduction to Classical Mechanics, R.G. Takwale and P.S. Puranik, TMGH.
3. Langrangian and Hamiltonian Mechanics, M.G. Calkin, World Scientific Pub.Co Ltd
4. Introduction to General Relativity, R. Adler, M. Bazin, M. Schiffer, TMGH.
5. An introduction to general relativity, S. K. Bose, Wiley Eastern.
6. Relativistic Mechanics, Satya Prakash, Pragathi prakashan Pub.
7. Chaos in Classical and Quantum Mechanics, M.C.Gutzwiller, Springer, 1990.
8. Deterministic Chaos, N. Kumar, University Press,
9. Chaotic Dynamics, G.L.Baker & J.P.Gollub, Cambridge Uni. Press, 1996
10. Mathematical Methods for Physicists, G.B. Arfken &H.J. Weber 4th Edition

PPH1CRT03 ELECTRODYNAMICS

Unit I

Electrostatic fields in matter and Electrodynamics (10 Hrs)

Review of Electrostatics and Magnetostatics, Time varying fields and Maxwell’s equations, Potential formulations, Gauge transformations, boundary conditions, wave equations and their solutions, Poynting theorem, Maxwell's stress tensor.

Electromagnetic waves (8 Hrs)

Maxwell's equations in phasor notation. Plane waves in conducting and non-conducting medium, Polarization, Reflection and transmission (Normal and Oblique incidence), Dispersion in Dielectrics, Superposition of waves, Group velocity.

Text Book:

1. Introduction to Electrodynamics, David J. Griffiths, PHI.

Unit II

Relativistic Electrodynamics (18 Hrs)

Structure of space time: Four vectors, Proper time and proper velocity, Relativistic dynamics - Minkowiski force, Magnetism as a relativistic phenomenon, Lorentz transformation of electromagnetic field, electromagnetic field tensor, electrodynamics in tensor notation, Potential formulation of relativistic electrodynamics.

Text Book:

1. Introduction to Electrodynamics, David J. Griffiths, PHI

Unit III

Electromagnetic Radiation (20 Hrs)

Retarded potentials, Jefimenkos equations, Point charges, Lienard-Wiechert potential, Fields of a moving point charge, Electric dipole radiation, Magnetic dipole radiation, Power radiated by point charge in motion. Radiation reaction, Physical basis of radiation reaction. Text Book:

1. Introduction to Electrodynamics, David J. Griffiths, PHI

Unit IV

Antenna, Wave Guides and Transmission Lines (16 Hrs)

Radiation resistance of a short dipole, Radiation from quarter wave monopole or half wave dipole. Antenna parameters. Waves between parallel conducting plane TE, TM and TEM waves, TE and TM waves in Rectangular wave guides, Impossibility of TEM waves in rectangular wave guides. Transmission Lines-Principles-Characteristic impedance, standing waves-quarter and half wavelength lines

Text Books:

1. Electromagnetic waves and radiating systems, E.C. Jordan & K.G. Balmain PHI, 1968
2. Antenna and wave guide propagation, K. D Prasad, Satya Prakashan.

Reference Books:

1. Antennas, J.D Kraus, Tata Mc-Graw Hill.
2. Classical Electrodynamics, J. D. Jackson, Wiley Eastern Ltd.
3. Electromagnetic fields, S. Sivanagaraju, C. Srinivasa Rao, New Age International.
4. Introduction to Classical electrodynamics, Y. K. Lim, World Scientific, 1986.
5. Electromagnetic Waves and Fields, V.V. Sarwate, Wiley Eastern Ltd, New Age Inernational
6. The Feymann Lectures in Physics, Vol. 2, R.P. Feymann, R.B. Leighton & M. Sands.
7. Electronic Communication Systems, G. Kennedy & B. Davis, TMH.

PPH1CRT04 ELECTRONICS

Unit I

Semiconductor Devices (**5 Hrs**)

FET devices - structure, characteristics, frequency dependence and applications

Text Book:

1. Fundamentals of Semiconductor Devices, Betty Anderson,

Richard Anderson, TMH. (Chapter 7, 8 and 9)

Op-amp with Negative Feedback (13 Hrs)

Differential amplifier – Inverting amplifier – Non-inverting amplifier -Block diagram representations – Voltage series feedback: Negative feedback – closed loop voltage gain – Difference input voltage ideally zero – Input and output resistance with feedback – Bandwidth with feedback – Total output offset voltage with feedback – Voltage follower. Voltage shunt feedback amplifier: Closed loop voltage gain – inverting input terminal and virtual ground - input and output resistance with feedback – Bandwidth with feedback - Total output offset voltage with feedback – Current to voltage converter- Inverter. Differential amplifier with one op-amp and two op-amps. Text Book:

1. Op-amps and linear integrated circuits, R.A. Gayakwad 4th Edn. PHI, (Chapter 2 & 3)

Unit II

The Practical Op-amp (6 Hrs)

Input offset voltage –Input bias current – input offset current – Total output offset voltage- Thermal drift – Effect of variation in power supply voltage on offset voltage – Change in input offset voltage and input offset current with time - Noise – Common mode configuration and CMRR. Text Book:

1. Op-amp and linear integrated circuits, R.A. Gayakwad 4th Ed. PHI. (Chapter 4)

General Linear Applications (with design) (12 Hrs)

DC and AC amplifiers – AC amplifier with single supply voltage – Peaking amplifier – Summing , Scaling, averaging amplifiers – Instrumentation amplifier using transducer bridge – Differential input and differential output amplifier – Low voltage DC and AC voltmeter - Voltage to current converter with grounded load – Current to voltage converter – Very high input impedance circuit – integrator and differentiator.

Text Book:

1 Op-amps and linear integrated circuits, R.A. Gayakwad 4th Ed. PHI. (Chap. 6)

Unit III

Frequency Response of an Op-amp (6 Hrs)

Frequency response –Compensating networks – Frequency response of internally compensated and non compensated op-amps – High frequency op-amp equivalent circuit – Open loop gain as a function of frequency – Closed loop frequency response – Circuit stability - slew rate**.** Text Book:

1. Op-amps and linear integrated circuits, R.A. Gayakwad 4th Edn.PHI, (Chap.5)

Active Filters and Oscillators. (with design) (12 Hrs)

Active filters – First order and second order low pass Butterworth filter - First order and second order high pass Butterworth filter- wide and narrow band pass filter - wide and narrow band reject filter- All pass filter – Oscillators: Phase shift and Wien-bridge oscillators – square, triangular and sawtooth wave generators- Voltage controlled oscillator. Text Book:

1. Op-amps and linear integrated circuits, R.A. Gayakwad 4th Ed. PHI, (Chap. 7)

Unit IV

Comparators and Converters (8 Hrs)

Basic comparator- Zero crossing detector- Schmitt Trigger – Comparator characteristics- Limitations of op-amp as comparators- Voltage to frequency and frequency to voltage converters - D/A and A/D converters- Peak detector – Sample and Hold
circuit. Text Book:

1. Op-amps and linear integrated circuits R.A. Gayakwad 4th Edn. PHI. (Chap. 8)

IC555 Internal architecture, Applications IC565-PLL, Voltage regulator ICs

78XX and 79XX

Text Book:

1. Op-amps and linear integrated circuits R.A. Gayakwad 4th Edn. PHI. (Chap. 10)

Review of analog modulation – Radio receivers – AM receivers – superhetrodyne receiver – detection and automatic gain control – communication receiver – FM receiver – phase discriminators – ratio detector – stereo FM reception.

Text Book:

1. Electronic Communication Systems, Kennedy & Davis 4thEd.TMH, (Chap. 6)

Reference Books:

1. Electronic Devices (Electron Flow Version), 9/E Thomas L. Floyd, Pearson
2. Fundamentals of Electronic Devices and Circuits 5th Ed. David A. Bell, Cambridge.
3. Electronic Communications Dennis Roddy and John Coolen, 4th Ed. Pearson.
4. Modern digital and analog communication systems, B.P. Lathi & Zhi Ding 4th Ed., Oxford University Press.
5. Linear Integrated Circuits and Op Amps, S Bali, TMH

PPH1CRP01 GENERAL PHYSICS PRACTICALS

(Minimum of 12 Experiments with Error analysis of the experiment is to be done)

1. Y, n, σ Cornu's method (a) Elliptical fringes and (b) Hyperbolic fringes.
2. Absorption spectrum –$KMnO_4$ solution / Iodine vapour – telescope and scale arrangement – Hartmann's formula or photographic method

3. Frank and Hertz Experiment – determination of ionization potential.
4. Hall Effect (a) carrier concentration (b) Mobility & (c) Hall coefficient.
5. Resistivity of semiconductor specimen–Four Probe Method.
6. Band gap energy measurement of silicon.
7. Magnetic Susceptibility-Guoy's method / Quincke's method.
8. Michelson Interferometer - λ and $d\lambda$ / thickness of mica.
9. Ultrasonic-Acousto-optic technique-elastic property of a liquid.
10. B - H Curve-Hysteresis.
11. Oscillating Disc-Viscosity of a liquid.
12. e/m of the electron-Thomson's method.

15. Characteristic of a thermistor - Determination of the relevant parameters.
16. Dielectric constant of a non-polar liquid.
17. Dipole moment of an organic molecule (acetone).
18. Young's modulus of steel using the flexural vibrations of a bar.
19. Verification of Stefan's law and determination of Stefan's constant of radiation
20. Temperature dependence of a ceramic capacitor and verification of Curie-Wiess law
21. Experiments using GM counter- absorption co-efficient of beta rays in materials.
22. Multichannel analyzer for alpha energy determination.
23. Zeemann effect setup – measurement of Bohr magnetron
24. Photoelectric effect – determination of Plank's constant using excel or origin.
25. Magneto-optic effect (Faraday effect)- rotation of plane of polarization as a function of magnetic flux density.

26. Linear electro-optic effect (Pockels effect) – half wave voltage and variation of intensity with electric field.
27. Silicon diode as a temperature sensor.
29. Electrical and thermal conductivity of copper and determination of Lorentz number.

SEMESTER – II

PPH2CRT01: MATHEMATICAL METHODS IN PHYSICS – II

Unit I

Complex Analysis (18 Hrs)

Functions of a complex variable - Analytic functions - Cauchy-Riemann equation - integration in a complex plane – Cauchy's theorem-deformation of contours - Cauchy's integral formula - Taylor and Laurent expansion-poles, residue and residue theorem – Cauchy's Principle value theorem - Evaluation of integrals.

Text Books:

1. Mathematical Physics, B.D. Gupta, Vikas Pub.House, New Delhi
2. Mathematical methods in Classical and Quantum Physics, T. Dass & S. K. Sharma, Universities Press (2009)
3. Introduction to Mathematical physics, Charlie Harper, PHI

Unit II

Integral Transforms (18 Hrs)

Introduction to Fourier series and Fourier integral form - Fourier transform - square wave, full wave rectifier and finite wave train – momentum representation of hydrogen atom ground state and harmonic oscillator.

Laplace transform –inverse Laplace transform-properties and applications – Earth's nutation, LCR circuit, wave equation in a dispersive medium, damped, driven oscillator, solution of differential equations.

Text Books:

1. Mathematical Methods for Physicists, G.B. Arfken &H.J. Weber 4th Edition, Academic Press.
2. Mathematical Physics, H.K Dass & Dr. Rama Verma, S. Chand &Co.

Unit III

Group theory (18 Hrs)

Introductory definition and concepts of group - point group, cyclic group, homomorphism and isomorphism-classes, reducible and irreducible representations- Schur's Lemmas and Great Orthogonality theorem. Group character table- C2V, C3V and C4V groups, Lie group, concept of generators- rotation group SO(2), SO(3), Unitary Group SU(2) and SU(3) Homomorphism between SU(2) and SO(3) – Irreducible Representation of SU(2).

Text Books:

1. Elements of Group Theory for Physicists, A.W. Joshi, New Age India
2. Mathematical Physics, Sathyaprakash, Sultan Chand & Sons, New Delhi.
3. Group theory- Schaum's series, Benjamin Baumslag & Bruce Chandler, MGH.

Unit IV

Partial Differential Equations (18 Hrs)

Characteristics and boundary conditions for partial differential equations. Nonlinear partial differential equations – separation of variables in Cartesian, cylindrical and spherical polar coordinates. Heat equation, Laplace's equation and Poisson's equation. Nonhomogeneous equation - Green's function - symmetry of Green's function - Green's function for Poisson equation, Laplace equation and Helmholtz equation - Application of Green's function in scattering problem

Text Books:

1. Mathematical Methods for Physicists, G.B. Arfken & H.J. Weber 4th Edition, Academic Press.
2. Mathematical Physics, B.S Rajput, Pragati Prakashan

Reference Books:

(Given Under **PH1C01**)

PPH2CRT02 THERMODYNAMICS AND STATISTICAL MECHANICS

Unit I

Fundamental of Thermodynamics (10 Hrs)

Fundamental definitions – different aspects of equilibrium – functions of state – internal energy – reversible changes – enthalpy – heat capacities – reversible adiabatic changes in an ideal gas – second law of thermodynamics – the Carnot cycle - equivalence of the absolute and the perfect gas scale of temperature – definition of entropy- measuring the entropy – law of increase of entropy – calculations of the increase in the entropy in irreversible processes – the approach to equilibrium.

Text Book:

1. Introductory Statistical Mechanics, R. Bowley & M. Sanchez, 2nd Edn. 2007, Oxford University Press, Indian Edition, (Chapter 1 and 2)

Foundations of Statistical Mechanics (8 Hrs)

Ideas of probability – classical probability – statistical probability – the axioms of probability theory – independent events – counting the number of events – statistics and distributions – basic ideas of statistical mechanics - definition of the quantum state of the system – simple model of spins on lattice sites – equations of state – the second law of thermodynamics. Text Book:

1. Introductory Statistical Mechanics, R. Bowley & M.Sanchez, 2nd Edn. 2007, Oxford University Press, Indian Edition, (Chapter 3 and 4)

Unit II

The Canonical Ensemble (12 Hrs)

A system in contact with a heat bath – the partition function – definition of the entropy in the canonical ensemble – the bridge to thermodynamics through partition function – condition for thermal equilibrium – thermodynamic quantities from partition function – case of a two level system – single particle in a one dimensional box – single particle in a three dimensional box – expression for heat and work – rotational energy levels for diatomic molecules – vibrational energy levels for diatomic molecules – factorizing the partition function – equipartition theorem – minimizing the free energy.

Text Book:

1. Introductory Statistical Mechanics, R. Bowley & M.Sanchez, 2nd Edn. 2007, Oxford University Press, Indian Edition, (Chapter 5)

Statistics of Identical Particles (4 Hrs)

Identical particles – symmetric and antisymmetric wavefunctions - bosons – fermions – calculating the partition function for identical particles – spin – identical particles localized on lattice sites.

Text Book:

1. Introductory Statistical Mechanics, R. Bowley & M.Sanchez, 2nd Edn. 2007, Oxford University Press, Indian Edition, (Chapter 6)

Unit III

Maxwell Distribution and Planck's Distribution (12 Hrs)

The probability that a particle is in a quantum state – density of states in k space – single particle density of states in energy – distribution of speeds of particles in a classical gas – blackbody radiation – Rayleigh-Jeans theory – Planck's distribution – derivation of the Planck's distribution – the free energy – Einstein's model vibrations in a solid – Debye's model of vibrations in a solid.

Text Book:

1. Introductory Statistical Mechanics, R. Bowley & M.Sanchez, 2nd Edn. 2007, Oxford University Press, Indian Edition. (Chapter 7 and 8)

Grand Canonical Ensemble (8 Hrs)

Systems with variable number of particles – the condition for chemical equilibrium – the approach to chemical equilibrium – chemical potential – reactions – external chemical potential – grand canonical ensemble – partition function – adsorption of atoms on surface sites – grand potential.

Text Book:

1. Introductory Statistical Mechanics, R. Bowley & M. Sanchez, 2nd Edn. 2007, Oxford University Press, Indian Edition, (Chapter 9)

Unit IV

Fermi and Bose Particles (6 Hrs)

Statistical mechanics of identical particles – thermodynamic properties of a Fermi gas – examples of Fermi systems – non-interacting Bose gas.

Text Book:

1. Introductory Statistical Mechanics, R. Bowley & M.Sanchez, 2nd Edn. 2007, Oxford University Press, Indian Edition, (Chapter 10)

Phase Transitions (12 Hrs)

Phases – thermodynamic potential – approximation – first order phase transition - Clapeyron equation – phase separation – phase separation in mixtures – liquid gas system – Ising model – order parameter – Landau theory- symmetry breaking field – critical exponents.

Text Book:

1. Introductory Statistical Mechanics, R. Bowley & M.Sanchez, 2nd Edn. 2007, Oxford University Press, Indian Edition, (Chaptr 11& 12)

Reference Books:

1. Statistical Mechanics, R.K. Pathria, & P.D. Beale, 2nd Edn, B-H (Elsevier) (2004).
2. Introductory Statistical Physics, S.R.A. Salinas, Springer (2000).

3. Fundamentals of Statistical and Thermal Physics, F. Rief, McGraw Hill (1986).
4. Statistical Mechanics, Kerson Huang, John Wiley and Sons (2003).
5. Statistical Mechanics, Satyaprakash & Agarwal, Kedar Nath Ram Nath Pub. (2004).
6. Problems and solutions on Thermodynamics and Statistical mechanics, Yung Kuo Lim, World Scientific Pub. (1990)
7. Fundamentals of Statistical Mechanics, A.K. Dasgupta, New Central Book Agency Pub. (2005)
8. Statistical Mechanics: a survival guide, A.M. Glazer and J.S. Wark, Oxford University Press. (2001).

PPH2CRT03 CONDENSED MATTER PHYSICS

Unit I

Elements of Crystal Structure (6 Hrs)

Review of crystal lattice fundamentals and interpretation of Bragg's equation, Ewald construction, the reciprocal lattice, reciprocal lattice to SC, BCC and FCC lattices, properties of reciprocal lattice, diffraction intensity - atomic, geometrical and crystal structure factors- physical significance. Text Book:

1. Solid State Physics: Structure and properties of materials, M.A. Wahab, Narosa 2nd Edn. 2010, (Chapter 8**)**

Free Electron Theory of Metals (12 Hrs)

Review of Drude-Lorentz model - electrons moving in a one dimensional potential well - three dimensional well - quantum state and degeneracy - density of states - Fermi-Dirac statistics - effect of temperature on Fermi-Dirac distribution - electronic specific heat - electrical conductivity of metals - relaxation time and mean free path - electrical conductivity and Ohm's law - Widemann-Franz-Lorentz law - electrical resistivity of metals.

Text Book:

1. Solid State Physics: Structure and properties of materials, M.A. Wahab, Narosa 2^{nd} Edn. 2010, (Chapter 10**)**

Unit II

Band Theory of Metals (6 Hrs)

Bloch theorem - Kronig-Penney model - Brillouin zone construction of Brillouin zone in one and two dimensions – extended, reduced and periodic zone scheme of Brillouin zone (qualitative idea only) - effective mass of electron - nearly free electron model – conductors - semiconductors - insulators.

Text Book:

1. Solid State Physics: Structure and properties of materials, M.A. Wahab, Narosa 2^{nd} Edn. 2010, (Chapter 11**)**

Band theory of semiconductors (10 Hrs)

Generation and recombination - minority carrier life-time - mobility of current carriers - drift and diffusion - general study of excess carrier movement- diffusion length.

Text Book:

1. Solid State Physics, S.O. Pillai, New Age International 6^{th} Edn. 2010,(Chapter 10).

Free carrier concentration in semiconductors - Fermi level and carrier concentration in semiconductors - mobility of charge carriers - effect of temperature on mobility - electrical conductivity of semiconductors - Hall effect in semiconductors - junction properties- metal-metal, metal-semiconductor and semiconductor-semiconductor junctions. Ref. Text:

1. Solid State Physics: Structure and properties of materials, M.A. Wahab, Narosa 2^{nd} Edn. 2010, (Chapter 13**)**

Unit III

Lattice Dynamics (14 Hrs)

Vibrations of crystals with monatomic basis – diatomic lattice – quantization of elastic waves – phonon momentum.

Text Book:

1. Introduction to Solid State Physics, C. Kittel, 3rd Edn. Wiley India. (Chapter 4).

Anharmonicity and thermal expansion - specific heat of a solid - classical model - Einstein model - density of states - Debye model - thermal conductivity of solids - thermal conductivity due to electrons and phonons - thermal resistance of solids.

Text Book:

1. Solid State Physics: Structure and properties of materials, M.A. Wahab, Narosa 2nd Edn. 2010, (Chapter 7 &9**)**

Dielectric Properties of Solids (6 Hrs)

Review of basic terms and relations, ferroelectricity, hysteresis, dipole theory - Curie-Weiss law, classification of ferroelectric materials and piezoelectricity.

Text Book:

1. Solid State Physics, S.O. Pillai, New Age International 6th Edn. 2010, (Chapter 11).

Ferroelectric domain, antiferroelectricity and ferrielectricity.

Text Book:

1. Solid State Physics: Structure and properties of materials, M.A. Wahab, Narosa 2nd Edn. 2010, (Chapter 14**)**

Unit IV

Magnetic properties of solids (10 hrs)

Review of basic terms and relations, Quantum theory of paramagnetism - cooling by adiabatic demagnetization – Hund's rule – ferromagnetism - spontaneous magnetization in ferromagnetic materials - Quantum theory of ferromagnetism –Weiss molecular field - Curie- Weiss law- spontaneous magnetism - internal field and exchange interaction – magnetization curve – saturation magnetization - domain model. Text Book:

1. Solid State Physics, S.O. Pillai, New Age International 6th Edn. 2010, (Chapter 9).

Superconductivity (4 Hrs)

Thermodynamics and electrodynamics of superconductors- BCS theory- flux quantization-single particle tunneling- Josephson superconductor tunneling- macroscopic quantum interference

Text Book:

1. Introduction to Solid State Physics, C. Kittel, 3rd Edn. Wiley India. (Chapter 12).
2. Solid State Physics, S.O. Pillai, New Age International 6th Edn. 2010, (Chapter 8).

Nanotechnology and Metamaterials (Qualitative) (4 Hrs)

Properties of metal, semiconductor, rare gas and molecular nanoclusters- superconducting fullerene- quantum confined materials-quantum wells, wires, dots and rings- metamaterials- graphene Text Book:

1.Introduction to Nanotechnology, Charles P Poole and Frank J Owens, Wiley India (Chapter 4, 5, 9)

Reference Books:

1. Solid State Physics, N.W. Ashcroft & N.D. Mermin, Cengage Learning Pub.11th Indian Reprint (2011).
2. Solid State Physics, R.L. Singhal, Kedar Nath Ram Nath & Co (1981)
3. Elementary Solid State Physics, M. Ali Omar, Pearson, 4th Indian Reprint (2004).
4. Solid State Physics, C.M. Kachhava, Tata McGraw-Hill (1990).
5. Elements of Solid State Physics, J. P. Srivastava, PHI (2004)
6. Solid State Physics, Dan Wei, Cengage Learning (2008)
7. Solid State Physics, A.J. Dekker, Macmillan & Co Ltd. (1967)

PPH2CRT04 QUANTUM MECHANICS – I

Unit I

Basics of Quantum Mechanics (14 Hrs)

Stern - Gerlach experiment leading to vector space concept, Dirac notation for state vectors- ket space, bra space, inner products - algebraic manipulation of operators – unitary operators, eigenkets and eigenvalues – Hermitian operators-concept of complete set-representation of an operator by square matrix – matrix elements of an operator - expectation values of Hermitian and anti-Hermitian operators – generalized uncertainty product — change of basis-orthonormal basis and unitary matrix, transformation matrix-unitary equivalent observables-eigenkets of position-infinitesimal operator and its properties – linear momentum as generator of translation – canonical commutation relations – properties of wave function in position space and

momentum space - relations between operator formalism and wave function formalism-momentum operator in position basis – momentum space wave function – computation of expectation values x, x^2, p and p^2 for a Gaussian wave packet.

Text Book:

1. Modern Quantum Mechanics, J. J. Sakurai, Pearson Education (Chapter 1)

Unit II

Quantum Dynamics (18Hrs)

Time evolution operator and its properties-Schrodinger equation for the time evolution operator - energy eigenkets - time dependence of expectation values - time energy uncertainty relation - Schrodinger picture and Heisenberg picture - behaviour of state kets and observables in Schrodinger picture and Heisenberg picture - Heisenberg equation of motion - Ehrenfest's theorem - time evolution of base kets - transition amplitude - energy eigenket and eigen values of a simple harmonic oscillator using creation and annihilation operators

Text Book:

1.Modern Quantum Mechanics, J.J. Sakurai, Pearson Education (Chapter 2)

Identical particles

Identity of particles - spin and statistics-Pauli's exclusion principle - Helium atom

Text Book:

1. Quantum Mechanics, V. K. Thankappan, New Age International, 1996, (Chapter 9)

Unit III

Angular momentum (20 Hrs)

Commutation relation between infinitesimal and rotation-infinitesimal rotations in quantum mechanics-fundamental commutation relations of angular momentum - rotation operator for spin ½ system - Pauli two component formalism - Pauli spin matrices - 2x2 matrix representation of rotation operator – commutation relations for J^2, J_x – eigenvalues of J^2 and J_x - matrix elements of angular momentum operators - representation of the rotation operator – rotation matrix-properties of the rotation matrix-orbital angular momentum as a rotation generator - addition of angular momentum and spin angular momentum - addition of spin angular momenta and Clebsch-Gordon coefficients for two spin ½ particles

Text Book:

1. Modern Quantum Mechanics, J.J. Sakurai, Pearson Education,

Unit IV

Solutions of Schrodinger equation and Approximation Methods (20 Hrs)

Motion in a central potential - Hydrogen atom WKB approximation - WKB wave function –validity of the approximation - connection formula (proof not needed) potential well - barrier penetration variational methods - bound states – hydrogen molecule ion - stationary state perturbation theory - non degenerate case - anharmonic oscillator - degenerate case -applications - first order Stark effect and Zeeman effect in hydrogen Text Book:

1. Quantum mechanics, V.K. Thankappan New Age International 1996 (Chapter 4, 8)
2. Quantum Mechanics, G Aruldhas, PHI, 2002, (Chapter 10)

Reference Books:

1. A Modern approach to quantum mechanics, John S. Townsend, Viva Books MGH.
2. Basic Quantum Mechanics, A. Ghatak, Macmillan India 1996
3. Quantum Mechanics, an Introduction, W Greiner, Springer Verlag
4. Quantum Mechanics, E. Merzbacher, John Wiley, 1996
5. Introduction to Quantum Mechanics, D.J. Griffiths, Pearson.
6. Quantum Mechanics, L.I. Schiff, Tata McGraw Hill
7. A Text Book of Quantum Mechanics, P.M. Mathews & K. Venkatesan, TMGH.
8. Quantum Mechanics, Concepts and Applications, N. Zettily, John Wiley & Sons.
9. Fundamentals of Quantum Mechanics Y.R. Waghmare, S Chand & Co.

PPH2CRP01 ELECTRONICS PRACTICALS

(Minimum of 12 experiments should be done)

1. R C Coupled CE amplifier - Two stages with feedback - Frequency response and voltage gain.
2. Differential amplifiers using transistors and constant current source - Frequency response, CMRR.
3. Push-pull amplifier using complementary - symmetry transistors- power gain and frequency response.

4. R F amplifier - frequency response & band width - Effect of damping.
5. Voltage controlled oscillator using transistors.
6. Voltage controlled oscillator using IC 555
7. R F Oscillator - above 1 MHz frequency measurement.
8. Differential amplifier - using op-amp.
9. Active filters – low pass and high pass-first and second order-frequency response and rolloff rate.
10. Band pass filter using single op-amp-frequency response and bandwidth.
11. Wein-bridge Oscillator – using op-amp with amplitude stabilization.
12. Op-amp-measurement of parameters such as open loop gain - offset voltage – open loop response.
13. Crystal Oscillator
14. RC phase shift oscillator
15. AM generation and demodulation
16. Solving differential equation using IC 741
17. Solving simultaneous equation using IC 741
18. Current to voltage and voltage to current converter (IC 741)
19. Temperature measurement using ADC and microprocessor.
20. Op-amp-triangular wave generator with specified amplitude.
21. µp - stepper motor control.
22. µp- measurement of analog voltage.
23. µp-Digital synthesis of wave form using D/A Converter.
24. Analog to digital and digital to analog converter ADC0800 & DAC0800

SEMESTER – III

PPH3CRT01 QUANTUM MECHANICS – II

Unit I

Time Dependent Perturbation Theory (16 hrs)

Time dependent potentials - interaction picture - time evolution operator in interaction picture - time dependent perturbation theory - Dyson series – transition probability - constant perturbation - Fermi-Golden rule - harmonic perturbation - interaction with classical radiation field - absorption and stimulated emission - electric dipole approximation - photo electric effect – energy shift and decay width - sudden and adiabatic approximation Text Book:

1. Advanced Quantum Mechanics, J.J. Sakurai, Pearson Education (Chapter 5)
2. Quantum mechanics – V. K. Thankappan New Age Int. Pub 1996 (Chapter 8)

Unit II

Scattering (18 hrs) Asymptotic wave function and differential cross section, Born approximation, Yukawa potential, Rutherford scattering. The partial wave expansion, hard sphere scattering, S-wave scattering for the finite potential well, resonances - Ramsaur- Townsend effect Text Book:

1. A Modern Approach to Quantum Mechanics, John S. Townsend, Viva Books Pvt Ltd, MGH (Chapter 13)**Unit III**

Relativistic Quantum Mechanics (18 hrs)

Need for relativistic wave equation - Klein-Gordon equation - Probability conservation - covariant notation - derivation of Dirac equation - conserved current representation - large and small components - approximate Hamiltonian for electrostatic problem - free particle at rest -plane wave solutions - gamma matrices - bilinear covariant – relativistic covariance of Dirac equation - angular momentum as constant of motion. Text Book:

1. Advanced Quantum Mechanics, J.J. Sakurai, Pearson Education (Chapter 3)

Unit IV

Elements of Field Theory (20 hrs)

Euler-Lagrange equation for fields - Hamiltonian formulation – functional derivatives -conservation laws for classical field theory - Noether's theorem - Non relativistic quantum field theory - quantization rules for Bose particles, Fermi particles - relativistic quantum field theory - quantization of neutral Klein Gordon field - canonical quantization of Dirac field – plane wave expansion of field operator - positive definite Hamiltonian Text Book:

1. Field Quantization, W Greiner , J Reinhardt, Springer, (Chapter 2, 3, 4&5)
2. Quantum mechanics - V.K. Thankappan, New Age Int. Publishers

Reference Books:

(In addition to books given under PH2C06, the following books are also recommended)

1. Quantum Field Theory, Lewis H. Ryder, Academic Publishers, Calcutta,1989
2. Quantum Field Theory, Claude Itzykson & Jean Bernard Zuber, MGH, 1986
3. Introduction to Quantum Field Theory, S.J. Chang, World Scientific, 1990
4. Quantum Field Theory, Franz Mandl & Graham. Shaw, Wiley 1990

PPH3CRT02 COMPUTATIONAL PHYSICS

Unit I

Curve Fitting and Interpolation (20Hrs)

The least squares method for fitting a straight line, parabola, power and exponential curves with the help of principle of least square fit. Interpolation

- Introduction to finite difference operators, Newton's forward and backward difference interpolation formulae, Lagrange’s interpolation formula, Newton's divided difference formula with error term, interpolation in two dimensions. Cubic spline interpolation end conditions. Statistical tests - Ψ^{2-} test and T-test.

Unit II

Numerical Differentiation and Integration (16 Hrs)

Numerical differentiation, errors in numerical differentiation, cubic spline method - finding maxima and minima of a tabulated function - Integration of a function with Trapezoidal Rule, Simpson's 1/3 and 3/8 Rule and error associated with each. Romberg's integration, Gaussian integration method, Monte Carlo evaluation of integrals - numerical double integration

Unit III

Numerical Solution of Ordinary Differential Equations (20Hrs)

Euler method - modified Euler method and Runge - Kutta 4^{th} order methods - adaptive step size R-K method, predictor - corrector methods - Milne's method, Adam-Mouton method.

Numerical Solution of System of Equations

Gauss-Jordan elimination Method, Gauss-Seidel iteration method, Gauss elimination method and Gauss-Jordan method to find inverse of a matrix. Power method and Jacobi's method to solve eigenvalue problems.

Unit IV

Numerical solutions of partial differential equations (16Hrs)

Elementary ideas and basic concepts in finite difference method, Schmidt Method, Crank - Nicholson method, Weighted average implicit method.

Concept of stability.

Text Books:

1. Mathematical Methods, G. Shanker Rao, K. Keshava Reddy, I.K. International Publishing House, Pvt. Ltd.
2. Introductory Methods of Numerical Analysis, S.S. Sastry, PHI Pvt. Ltd.

Reference Books:

1. An Introduction to Computational Physics, Tao Pang, Cambridge University Press
2. Numerical methods for scientific and Engineering computation M.K Jain,S.R.K Iyengar, R.K. Jain, New Age International Publishers
3. Computer Oriented Numerical Methods, V. Rajaraman, PHI, 2004.
4. Numerical Methods, E. Balagurusami, Tata McGraw Hill, 2009.
5. Numerical Mathematical Analysis, J.B. Scarborough, 4^{th} Edn, 1958

ELECTIVES : BUNCH – A: ELECTRONICS

PPH3CRT03 : INTEGRATED ELECTRONICS AND DIGITAL SIGNAL PROCESSING

Unit I

Integrated Circuit Fabrication and Characteristics (16 Hrs)

Integrated circuit technology – basic monolithic IC – epitaxial growth – marking and etching – diffusion of impurities – transistor for monolithic circuit – monolithic diodes – integrated resisters, capacitors and inductors – monolithic circuit layout - additional isolation methods – MSI, LSI, VLSI (basic ideas) – the metal semiconductor contact.

Unit II

Basics of Digital Signal Processing (18 Hours)

Signals and representation – classification - continuous time (CT) and discrete time (DT) signals - standard CT and DT signals - Fourier Analysis of periodic and aperiodic continuous time signals - convolution and correlation of DT and CT Signals – classification of systems CT – DT - causal, noncausal, static and dynamic systems - stable systems - FIR and IIR systems -frequency domain representation of systems

Unit III

DSP Techniques (18 Hrs)

Frequency analysis of DT signals - discrete Fourier Transform - Fast Fourier Transform (FFT) - Decimation in time and decimation in frequency algorithm - Z-Transform regional convergence and properties - relation to Fourier Transform - Poles and Zeros of system function - Gibb's phenomenon

Unit IV

Digital Filters (20 Hrs)

FIR and IIR Filters - IIR Filter design techniques - Approximation of derivatives -Impulse invariant method - Bilinear transformation - FIR filter design techniques - Fourier Series method - Window techniques - FIR filter using rectangular window - Realisation of IIR systems - Direct form I & form II realization - Direct form and cascade form realization of FIR systems - Finite word length affecting digital signal processing. Text Books

1. Integrated Electronics – Analog and Digital Circuits and Systems, J. Millmann & C.C. Halkias, TMGH
2. Digital Signal Processing: Theor, Analysis and Digital-Filter Design, B. Somanathan Nair, PHI (2004)
3. Digital Signal Processing, P. Ramesh Babu, Scitech
4. Digital Signal Processing, Alan V. Oppenheim & R.W. Schafer, PHI

Reference Books:

1. Computer applications in physics, Suresh Chandra, Alpha Science International (2006)
2. Digital Signal Processing, S. Salivahanan, A. Vallavaraj, C. Gnanapriya, TMH
3. Signals and Systems, Allan V. Oppenheim, Alan S. Willsky, S.H. Nawab, PHI
4. Digital Signal Processing, John G. Proakis, Dimitris G. Manolakis, PHI
5. Digital signal processing, Sanjay Sharma, S.K. Kataria & Sons, 2010
6. Mathematical Methods for Physicists, G.B. Arfken & H.J. Weber.Elsavier, Academic Press

PPH3CRT04 MICROELECTRONICS AND SEMICONDUCTOR DEVICES

Unit I

Basics of Digital Techniques (18 Hrs)

Review of 8085 microprocessor - General organization of a microprocessor based microcomputer system – memory organization – main memory array – memory management – cache memory – virtual memory - input/output - standard I/O – memory mapped I/O – microcomputer I/O circuits – interrupt driven I/O –DMA – RAM - hard disk - CD – Flash memory.

Unit II

8086 Microprocessor (19 Hrs)

The Intel 8086 - architecture - MN/MX modes - 8086 addressing modes - instruction set- instruction format - assembler directives and operators - Programming with 8086 - interfacing memory and I/O ports - Comparison of 8086 and 8088 - Coprocessors - Intel 8087 - Familiarisation with Debug utility.

Unit III

Microcontrollers (19 Hrs)

Introduction to microcontrollers and Embedded systems - comparison of microprocessors and microcontrollers - The 8051 architecture - Register set of 8051 - important operational features - I/O pins, ports and circuits - external memory - counters and timers – interrupts - Instruction set of 8051 - Basic programming concepts - Applications of microcontrollers - (basic ideas) – Embedded systems(basic ideas)

Unit IV

Semiconductor Devices (16 hrs)

Schottky barrier diode - qualitative characteristics – ideal junction properties – nonlinear effects on barrier height – current voltage relationship – comparison with junction diode – metal semiconductor ohmic contact – ideal non rectifying barriers – tunnelling barrier – specific contact resistances – hetro-junctions – hetro junction materials – energy band diagram – two dimensional electron gas – equilibrium electrostatics – current voltage characteristics

Text Books

1. Microprocessors and Microcomputer based system design, H. Rafiquizzaman, Universal Book stall, New Delhi
2. Microprocessor and Peripherals, S.P. Chowdhury & S. Chowdhury- SCITECH Publications
3. Microprocessor Architecture Programming and Applications with 8085, R.S. Gaonkar – Penram int. Pub. Mumbai
4. The 8051 microcontroller, Architecture Programming and Applications, Kenneth J Ayala- Penram Int. Pub. Mumbai.
5. Semiconductor Physics and Devices, Donald A. Neamen, McGraw Hill

Reference Books:

1. 0000 to 8085 Introduction to Microprocessors for Engineers and Scientists.- P.K. Gosh & P.R. Sridhar, PHI
2. Advanced microprocessors and peripherals, A.K. Ray & K.M. Burchandi –TMH.
3. Microprocessor and microcontroller, R. Theagarajan- SCITECH Publications India Pvt. Ltd.
4. Operating system Principles, Abraham Silberschatz & Peter Baer Galvin & Greg Gagne, John Wiley

PPH3CRP01 COMPUTATIONAL PHYSICS PRACTICALS

(Minimum of 12 Experiments should be done with C++ as the programming language)

1. Study the motion of a spherical body falling through a viscous medium and observe the changes in critical velocity with radius, viscosity of the medium.
2. Study the path of a projectile for different angles of projection. From graph find the variation in range and maximum height with angle of projection.
3. Study graphically the variation of magnetic field B(T) with critical temperature in superconductivity using the relationship $B(T) = B_0 [1 - (T/T_c)^2]$, for different substances.
4. Discuss the charging /discharging of a capacitor through an inductor and resistor, by plotting time –charge graphs for a) non oscillatory, b) critical) oscillatory charging.
5. Analyze a Wheatstone's bridge with three known resistances. Find the voltage across the galvanometer when the bridge is balanced.
6. Study the variation in phase relation between applied voltage and current of a series L.C.R circuit with given values of L C Find the resonant frequency and maximum current.
7. A set of observations of π meson disintegration is given. Fit the values to a graph based on appropriate theory and hence calculate life time τ of π mesons.
8. Draw graphs for radioactive disintegrations with different decay rates for different substances. Also calculate the half-life's in each case.
9. Half-life period of a Radium sample is 1620 years. Analytically calculate amount of radium remaining in a sample of 5gm after 1000 years.Varify your answer by plotting a graph between time of decay and amount of substance of the same sample.
10. Plot the trajectory of a α-particle in Rutherford scattering and ditermine the values of the impact parameter.
11. Draw the phase plots for the following systems.

(i) A conservative case (simple pendulum)
(ii) A dissipative case (damped pendulum)
(iii) A nonlinear case (coupled pendulums).

12. Two masses m_1 and m_2 are connected to each other by a spring of spring constant k and the system is made to oscillate as a two coupled pendulum. . Plot the positions of the masses as a function of time.
13. Plot the motion of an electron in (i) in uniform electric field perpendicular to initial velocity (ii) uniform magnetic field at an angle with the velocity. and (iii) simultaneous electric and magnetic fields in perpendicular directions with different field strengths.
14. A proton is incident on a rectangular barrier, calculate the probability of transmission for fixed values of V_0 and E ($V_0 > E$) for the width of barrier ranges from 5 to 10 Fermi, and plot the same.
15. Generate the interference pattern in Young's double slit-interference and study the variation of intensity with variation of distance of the screen from the slit.
16. Analyze the Elliptically and circularly polarized light based on two vibrations emerging out of a polarizer represented by two simple harmonic motions at right angles to each other and having a phase difference. Plot the nature of vibrations of the emergent light for different values of phase difference
17. Generate the pattern of electric field due to a point charge
18. Sketch the ground state wave function and corresponding probability distribution function for different values of dispalcements of the harmonic oscillator.
19. Gauss elimination method for solving a system of linear equations.

20. Solving a second order differential equation using 4^{th} order Runge- Kutta method.
21. Finding the roots of a nonlinear equation by bisection method.

Reference Books:

1. Computational physics, An Introduction, R.C. Verma, P.K. Ahluwalia & K.C. Sharma, New Age India, Pvt. Ltd.
2. An Introduction to computational Physics, Tao Pang, Cambridge University Press.
3. Simulations for Solid State Physics: An Interactive Resource for Students and Teachers, R.H. Silsbee & J. Drager, Cambridge University Press.
4. Numerical Recipes: the Art of Scientific Computing, W.H. Press, B.P. Flannery, S.A. Teukolsky & W.T.Vettering, Cambridge University Press.

SEMESTER - IV

PPH4CRT01 ATOMIC AND MOLECULAR PHYSICS

Unit I

Atomic Spectra (18 Hrs)

The hydrogen atom and the three quantum numbers n, l and $m_{l.}$ - electron spin - spectroscopic terms. Spin-orbit interaction, derivation of spin-orbit interaction energy, fine structure in sodium atom, selection rules. Lande g-factor, normal and anomalous Zeeman effects, Paschen–Back effect and Stark effect in one electron system. L S and j j coupling schemes (vector diagram) - examples, derivation of interaction energy, Hund's rule, Lande interval rule. Hyperfine structure and width of spectral lines.(qualitative ideas only).

Text Book:

1. Spectroscopy, B.P. Straughan & S. Walker, Vol. 1, John Wiley & Sons

Unit II

Microwave and Infra Red Spectroscopy (18 Hrs)

Microwave Spectroscopy: Rotational spectra of diatomic molecules - intensity of spectral
lines - effect of isotopic substitution. Non–rigid rotor - rotational spectra of polyatomic molecules - linear and symmetric top - Interpretation of rotational spectra.

IR Spectroscopy: Vibrating diatomic molecule as anharmonic oscillator, diatomic vibrating rotor – break down of Born-Oppenheimer approximation - vibrations of polyatomic molecules - overtone and combination frequencies - influence of rotation on the spectra of polyatomic molecules - linear and symmetric top - analysis by IR technique - Fourier transform IR spectroscopy.

Text Books:

1. Fundamentals of molecular spectroscopy, C.N. Banwell, Tata McGraw Hill
2. Molecular structure and spectroscopy, G. Aruldhas, PHI Learning Pvt. Ltd.

Unit III

Raman and Electronic Spectroscopy. (18 Hrs)

Raman Spectroscopy: Pure rotational Raman spectra - linear and symmetric top molecules - vibrational Raman spectra – Raman activity of vibrations - mutual exclusion principle - rotational fine structure - structure determination from Raman and IR spectroscopy.

Non- linear Raman effects - hyper Raman effect - classical treatment - stimulated Raman effect - CARS, PARS - inverse Raman effect

Electronic Spectroscopy: Electronic spectra of diatomic molecules - progressions and sequences - intensity of spectral lines. Franck – Condon principle - dissociation energy and dissociation products - Rotational fine structure of electronic-vibrational transition - Fortrat parabola - Pre-dissociation.

Text books:

1. Fundamentals of molecular spectroscopy, C.N. Banwell, MGH
2. Molecular structure and spectroscopy, G. Aruldhas, PHI Learning Pvt. Ltd.
3. Lasers and Non-Linear Optics, B.B Laud, Wiley Eastern

Unit IV

Spin Resonance Spectroscopy (18 Hrs)

NMR: Quantum mechanical and classical descriptions - Bloch equations - relaxation processes - chemical shift - spin–spin coupling - CW spectrometer - applications of NMR.

ESR: Theory of ESR - thermal equilibrium and relaxation - g- factor - hyperfine structure -applications.

Mossbauer spectroscopy: Mossbauer effect - recoilless emission and absorption - hyperfine interactions – chemical isomer shift - magnetic hyperfine and electronic quadrupole interactions - applications. Text Book:

1. Molecular structure and spectroscopy, G. Aruldhas, PHI Learning Pvt. Ltd.
2. Spectroscopy, B.P. Straughan & S. Walker, Vol. 1, John Wiley & Sons

Reference Books:

1. Introduction of Atomic Spectra, H.E. White, Mc Graw Hill
2. Spectroscopy (Vol. 2 & 3), B.P. Straughan & S. Walker, Science paperbacks 1976
3. Raman Spectroscopy, D.A. Long, Mc Graw Hill international, 1977
4. Introduction to Molecular Spectroscopy, G.M. Barrow, Mc Graw Hill
5. Molecular Spectra and Molecular Structure, Vol. 1, 2 & 3. G.

6. Elements of Spectroscopy, Gupta, Kumar & Sharma, Pragathi Prakshan
7. The Infra Red Spectra of Complex Molecules, L.J. Bellamy, Chapman & Hall. Vol. 1 & 2.
8. Laser Spectroscopy techniques and applications, E.R. Menzel, CRC Press, India

PPH4CRT02 NUCLEAR AND PARTICLE PHYSICS

Unit I

Nuclear Properties and Force between Nucleons (18 Hrs)

Nuclear radius, mass and abundance of nuclides, nuclear binding energy, nuclear angular momentum and parity, nuclear electromagnetic moments, nuclear excited states

Duetron, nucleon-nucleon scattering, proton-proton and neutron-neutron interactions, properties of nuclear forces, exchange force model Text Book:

1. Introductory Nuclear Physics, K. S. Krane Wiley, (Chapter 3&4)

Unit II

Nuclear Decay and Nuclear Reactions (18 Hrs)

Beta decay, energy release, Fermi theory, experimental tests, angular momentum and parity selection rules, Comparative half lives and forbidden decays, neutrino physics, non conservation of parity

Types of reactions and conservation laws, energetics of nuclear reactions, isospin, Reaction cross sections, Coulomb scattering, nuclear scattering, scattering and reaction cross sections, compound-nucleus reactions, direct reactions, heavy ion reactions.

Text Book:

1. Introductory Nuclear Physics, K. S. Krane Wiley, (Chapter 9&11)

Unit III

Nuclear Models, Fission and Fusion (18 Hrs)

Shell model potential, Spin-orbit potential, Magnetic dipole moments, Electric quadrupole moments, Valence Nucleons, Collective structure,

Nuclear vibrations, Nuclear rotations, Liquid drop Model, Semi-empirical Mass formula

Characteristics of fission - energy in fission - fission and nuclear structure, Controlled fission reactions - Fission reactors.

Fusion processes, Characteristics of fusion, Controlled fusion reactors

Text Book:

1. Introductory Nuclear Physics, K. S. Krane Wiley, (Chapter 5, 13 &14)

Unit IV

Particle Physics (18 Hrs)

Types of interactions between elementary particles, Hadrons and leptons-masses, spin, parity and decay structure. Quark model, confined quarks, coloured quarks, experimental evidences for quark model, quark-gluon interaction. Gell-Mann-Nishijima formula, symmetries and conservation laws, C, P and T invariance, applications of symmetry arguments to particle reactions, parity non-conservation in weak interactions. Grand unified theories.

Text Book:

1.Introductory Nuclear Physics, K. S. Krane Wiley, (Chapter 18)

2. Nuclear Physics, D. C. Tayal, Himalaya Publishing House (Chapter 16)

Reference Books:

1. Introduction to Elementary Particle, D.J. Griffiths, Harper and Row, NY,(1987)
2. Nuclear Physics, R.R. Roy and B.P. Nigam, New Age International, NewDelhi, (1983).
3. The particle Hunters - Yuval Ne’eman & Yoram kirsh CUP, (1996)

4. Concepts of Nuclear Physics, B.L. Cohen, TMH, New Delhi, (1971).
5. Theory of Nuclear Structure, M.K. Pal, East-West, Chennai, (1982).
6. Atomic Nucleus, R.D. Evans, McGraw-Hill, New York.
7. Nuclear Physics, I. Kaplan, 2nd Edn, Narosa, New Delhi, (1989).
8. Introduction to Nuclear Physics, H.A. Enge, Addison Wesley, London, (1975).
9. Introductory Nuclear Physics, Y.R. Waghmare,Oxford-IBH, New Delhi, (1981).
10. Atomic and Nuclear Physics, Ghoshal,Vol. 2, S. Chand & Company
11. Fundamentals of Elementary Particle Physics, J.M. Longo, MGH, New York, (1971).
12. Nuclear and Particle Physics, W.E. Burcham and M. Jobes, Addison-
13. Subatomic Physics, Frauenfelder and Henley, Prentice-Hall.
14. Particles and Nuclei: An Introduction to Physical Concepts, B. Povh, K. Rith, C. Scholz and Zetche, Springer (2002)
15. Elementary Particles and Symmetries, L.H. Ryder, Gordon and Breach, Science Publishers, NY, 1986

PPH4CRT03 INSTRUMENTATION AND COMMUNICATION ELECTRONICS

Unit I

Transducers and Digital Instrumentation (20 Hrs)

Transducers: Classification of transducers - electrical transducer - resistive transducer - strain gauges- piezo-electric and magnetostrictive transducers - Hall effect transducers -thermistor inductive transducer - differential output transducers - pressure transducers - pressure cell - photoelectric transducers - photo voltaic cell – semi conductor photo diode – thermo electric transducers – mechanical transducers – ionization transducers – digital transducers - electro chemical transducers.

Digital Instrumentation: Digital counters and timers - digital voltmeter – RAMP - voltage to time conversion - voltage to frequency conversion - frequency to voltage conversion - digital multimeter - digital phase meter - digital frequency meter - time and frequency measurement – tachometer - pH meter.

Unit II

Measurement of Basic Parameters and Recorders (18 Hrs)

Transistor Voltmeter - amplified DC meter – A.C voltmeters using rectifiers – precision rectifier – true RMS responding voltmeter – chopper type DC amplifier voltmeter - milli voltmeter using operational amplifier – differential voltmeter – Ohm meter – electronic multimeter – commercial multimeter – output power meters - stroboscope – phase meter – vector impedance meter – Q meter – RF measurement – transistor testers – CRO (Basic ideas)

Recorders: Strip chart recorders - XY recorders - digital XY plotters - magnetic recorders -digital data recording - Storage oscilloscope – Digital storage oscilloscope

Unit III

Introduction to Communication (18 Hrs)

Bandwidth requirements – SSB technique – radio wave propagation – Ionosphere – Ionosphere variations – Space waves – Extraterrestrial communication - Transmission lines – Basic principles – Characteristic impedance – Losses – Standing waves – Quarter and half wavelength lines.

Television fundamentals – Monochrome transmission – Scanning – Composite TV video wave form – Monochrome reception – Deflection circuits – Colour Television. Basic ideas of high definition TV – LCD & LED TV

Unit IV

Digital Communication (16 hrs)

Pulse Communication – Information theory – Coding – Noise – Pulse modulation – PAM – PTM – PCM – PPM. Digital communication – Data Communication – Digital codes – Data Sets and interconnection requirements.

Multiplexing techniques – Frequency division and time division multiplexing. Microwave generators – Klystron and Magnetron – Satellite communication. Digital cellular systems GSM, TDMA and CDMA – basic ideas of GPS

Text Books:

1. Electronic Instrumentation, H.S. Kalsi, TMH (1995)
2. Transducers and instrumentation, D.V.S. Murty, PHI (1995)
3. Monochrome and Colour Television R.R. Gulati, New Age India
4. Electronic communication systems, George Kennedy, TMH
5. Mobile Cellular Telecommunication Systems, William C.Y. Lee, MGH

Reference Books:

1. Modern electronic Instrumentation and Measurement Techniques, A.D. Helfric & W.D. Cooper,PHI, (1997)
2. Instrumentation-Devices and Systems 2nd Edn. C.S. Rangan, G.R. Sarma, V.S.V. Mani, TMH, (1998)
3. Electronic Measurements and Instrumentation, M.B. Olive & J.M. Cage, MGH, (1975)
4. Digital Instrumentation, A.J. Bouwens,TMH, (1998)
5. Elements of Electronic Instrumentation, J. Jha, M. Puri, K.R. Sukesh, & M.Kovar., Narosa, (1996)
6. Instrumentation Measurement and Analysis, B.C. Nakra & K.K. Chaudhry, TMH, (1998)
7. Op-amps and Linear Integrated Circuits, R.A. Gaykward, PHI, (1989)
8. Electronic fundamentals and Applications, John D. Ryder, PHI.
9. Satellite communication, Robert M.Gagliardi, CBS Publishers, Delhi.
10. Electric and electronic measurements and instrumentation 10th Edn. A.K. Sawhney, Dhanpath Rai & Company.

3.3.3 BUNCH - C: MATERIAL SCIENCE

PPH4CRT04 THIN FILM AND NANO SCIENCE

Unit I

Thin Film (18 Hrs)

Nucleation – Langmuir theory of condensation – Theories of nucleation – Liquid like coalescence and growth process – Epitaxial growth – Structural defects in thin films – Electrical conduction in metallic, semiconducting and insulator films. Optical properties of thin films.

Unit II

Deposition of Films (18 Hrs)

Production of Vacuum, Different types of vacuum pumps, Measurement of Vacuum Gauges, Working principle, Deposition of thin films, Various deposition techniques, Thickness measurement – optical methods, thickness monitors - Thin film applications.

Unit III

Nano materials and Applications (18 hours)

Nano structured Crystals -Natural Nano crystals -Crystals of Metal-Nano particles –Nano particle Lattices in Colloidal Suspensions -Photonic Crystals.

Synthesis and purification of carbon nanotubes, Single-walled carbon nanotubes and multiwalled carbon nanotubes, Structure-property relationships, physical properties, applications.

Overview of different nano materials available, Potential uses of nano materials in electronics, robotics, computers, sensors in textiles, sports equipment, mobile electronic devices, vehicles and transportation. Medical applications of nano materials.

Unit IV

Synthesis of Nano materials (18hrs)

Top-down techniques: photolithography, other optical lithography (EUV, X-Ray, LIL), particle-beam lithographies (e-beam, focused ion beam, shadow mask evaporation), probe lithographies, Bottom-up techniques: self-assembly, self-assembled mono layers, directed assembly, layer-by-layer assembly. Combination of Top-Down and Bottom-up techniques: current state-of-the-art.

Pattern replication techniques: soft lithography, nano imprint lithography. Pattern transfer and enhancement techniques: dry etching, wet etching, pattern growth techniques (polymerization, directed assembly).

Reference Books:

1. Thin film phenomena, K.L Chopra, McGraw Hill, New York
2. Thin film fundamentals, A. Goswami, New Age International
3. Vacuumm deposition of Thin films, L. Holland, Chapman Hall, London
4. Handbook of thin film Technology, L.I Maissel and R. Glang, McGraw Hill
5. Optical Properties of Thin Films, O. S. Heaven, Dover Publications
6. Nano: the essentials, T. Pradeep, TMH, 2007
7. Nanoscale Materials, L.M. Liz-Marzán & P.V. Kamat, Kluwer Academic Pub. (2003)
8. Nanoscience, Nanotechnologies and Nanophysics, C. Dupas, P. Houdy & M. Lahmani, Springer-Verlag , (2007).
9. Nanotechnology 101, John Mongillo, Greenwood Press, (2007).
10. What is What in the Nanoworld A Handbook on Nanoscience and Nanotechnology, Victor E. Borisenko and Stefano Ossicini , WILEY-VCH Verlag, (2008).

11. Introduction to Nanotechnology, Charles P. Poole, Jr. and Frank J. Owens, Wiley
12. Semiconductor Nanostructures for Optoelectronic Applications, Todd Steiner, ARTECH HOUSE, (2004).
13. Nanotechnology and Nano-Interface Controlled Electronic Devices, M. Iwamoto, K. Kaneto, S. Mashiko Elsevier Science, Elsevier Science, (2003).
14. Semiconductors for Micro and Nanotechnology—An Introduction for Engineers Jan G. Korvink and Andreas Greiner, WILEY-VCH Verlag, (2002).

PPH4CRP01 ADVANCED ELECTRONICS PRACTICALS

(Minimum of 12 Experiments should be done choosing at least 2 experiments from each group)

[A] Microprocessors and Micro Controllers (use a PC or 8086-µp kit)

1. Sorting of numbers in ascending/descending order.
2. Find the largest and smallest of numbers in array of memory.
3. Conversion of Hexadecimal number to ASCII and ASCII to Hexadecimal number.
4. Multi channel analog voltage measurements using AC card.

5. Generation of square wave of different periods using a microcontroller.
6. Measurement of frequency, current and voltage using microprocessors.

[B] Communication Electronics

7. Generation PAM and PWM
8. Frequency modulation and demodulation using IC –CD4046.
9. Multiplexer and demultiplexer using digital IC 7432.
10. Radiation characteristics of a horn antenna.
11. Measurement of characteristic impedance and transmission line parameters of a coaxial cable.

[C] Electronic Instrumentation

12. DC and AC milli-voltmeter construction and calibration.
13. Amplified DC voltmeter using FET.
14. Instrumentation amplifier using a transducer.
15. Generation of BH curve and diode characteristics on CRO.
16. Voltage to frequency and frequency to voltage conversion.
17. Construction of digital frequency meter.
18. Characterization of PLL and frequency multiplier and FM detector.

[D] Optoelectronics

19. Characteristic of a photo diode - Determination of the relevant parameters.
20. Beam Profile of laser, spot size and divergence.
21. Temperature co-efficient of resistance of copper.
22. Data transmission and reception through optical fiber link.