VIVEKANANDHA COLLEGE OF ARTS & SCIENCES FOR WOMEN

(AUTONOMOUS)

SCHEME OF EXAMINATIONS PG

PG AND RESEARCH DEPARTMENT OF PHYSICS

M.Sc., DEGREE – SYLLABUS

2017 – 2018

M.Sc. (Physics)

I. SCOPE OF THE COURSE

M.Sc. (Physics), the recent developments in Physical sciences, has been included in the enriched syllabus to meet out the present day needs of academic and research, institutions and industries**.** The program expects a serious commitment of the student to take up challenging study schedules and assignments. The course involves a blend of theoretical education and practical training which run concurrently for a period of two years and equips a student with knowledge, ability, skills and other qualities required for a professional accountant.

The uniqueness of the program is its content and topic coverage, the teaching methodology and the faculty. The syllabus has been designed at a level equal to that of professional courses. The teaching methodologies include classroom lectures, industrial visits, orientation, internship, case study and research work. Focus is also on developing soft skills of the students. For Core subjects, Outsource Guest Lectures by Industrialists and Professional Men will be arranged to enable the students to get wider exposure.

I. SALIENT FEATURES

- ✓ Course is specially designed for a higher level Career Placement.
- ✓ Special Guest lectures from Industrialists will be arranged.
- ✓ Exclusively caters to students interested in pursuing higher studies.
- ✓ Special Industry Orientations and Training are parts of the Degree Course.
- ✓ Project work is included in the syllabus to enhance conceptual, analytical & deductive skills.

III. OBJECTIVES OF THE COURSE

- ✓ The new syllabus throws light on the recent and emerging areas of Physics.
- ✓ Enable the students understand Physics and make them more relevant to the society.
- ✓ Develop the analytical ability in students so that they are become objective in solving problems.
- ✓ Help the students learn practical skills in a better way.
- ✓ Inculcate research aptitude in students.
- ✓ Enable the students to go to higher levels of learning Physics.
- ✓ Improve the employability of the students.

- ✓ To inspire the students to apply their knowledge gained for the development of society in general.

IV. ELIGIBILITY FOR ADMISSION

Candidates seeking admission to the first year Degree course (M.Sc. Physics) shall be required to have passed an Under Graduate degree, i.e. B.Sc., (Physics or Applied Sciences) of the Periyar University or an examination of some other University accepted by the syndicate as equivalent there to shall be permitted to be eligible.

V. DURATION OF THE COURSE

- ✓ The course shall extend over a period of two academic years consisting of four semesters. Each academic year will be divided into two semesters. The First semester will consist of the period from July to November and the Second semester from December to March.
- ✓ The subjects of the study shall be in accordance with the syllabus prescribed from time to time by the Board of Studies of Vivekanandha College of Arts and Sciences for Women with the approval of Periyar University.
- ✓ Each subject will have five hours of lecture per week apart from practical training at the end of each semester.

VI. CONTINUOUS INTERNAL ASSESSMENT

The performance of the students will be assessed continuously and the

Internal Assessment Marks will be as under:

1. Average of two Tests - 10 Marks
2. Seminar - 5 Marks
3. Assignment - 5 Marks
4. Attendance - 5 Marks

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Total = 25 Marks

The distribution of attendance marks is given as follows,

76-80 % - 1 Mark

81-85 % - 2 Marks

86-90 % - 3 Marks

91-95 % - 4 Marks

96-100 % - 5 Marks

VII. Question Paper Pattern:

Question Paper Pattern for the examinations

Time: 3 Hours, Maximum Marks: 75

Part A Answer all of the following (Either or type) (5 x 5 = 25 Marks)

Part B Answer all questions (Either or type) (5 x 10 = 50 Marks)

VII. PASSING MINIMUM

In the University Examinations, the passing minimum shall be 40 % out of 75 Marks for theory (30 marks) and 40% out of 60 marks for practical. (24 Marks).

VIII. ELIGIBILITY FOR EXAMINATION

A candidate will be permitted to appear for the University Examination only on earning 75 % of attendance and only when her conduct has been satisfactory. It shall be open to grant exemption to a candidate for valid reasons subject to conditions prescribed.

IX. CLASSIFICATION OF SUCCESSFUL CANDIDATES

Successful candidates passing the examination of Core Courses (main and allied subjects) and securing marks

a) 75 % and above shall be declared to have passed the examination in first class with Distinction provided they pass all the examinations prescribed for the course at first appearance itself.
b) 60% and above but below 75 % shall be declared to have passed the examinations in first class without Distinction.
c) 50%and above but below 60% shall be declared to have passed the examinations in second class.
d) All the remaining successful candidates shall be declared to have passed the examinations in third class.
e) Candidates who pass all the examinations prescribed for the course at the first appearance itself and within a period of three consecutive academic years from the year of admission only will be eligible for University rank.

X. COMMENCEMENT OF THESE REGULATIONS

These regulations shall take effect from the academic year 2017 - 2018 (i.e.,) for the students who are to be admitted to the first year of the course during the academic year 2017 - 2018 and thereafter.

SCHEME OF CURRICULUM – M.Sc. IN PHYSICS

(For the candidates admitted during the academic year 2017-2018 onwards)

Sem	Subject code	Course	Subject title	Hrs/ week	Credit	Int. marks	Ext. marks	Tot. marks
I	17P1PH01	Core-I	Mathematical Physics	6	5	25	75	100
	17P1PH02	Core-II	Classical and Statistical Mechanics	6	5	25	75	100
	17P1PH03	Core-III	Advanced Electronics	6	5	25	75	100
	17P1PHE01	Elective-I	Elective-I Nano Science	4	3	25	75	100
	17P2PHP01	Core Practical	Practical I – Advanced Electronics Experiments	4	-	-	-	-
	17P2PHP02	Core Practical	Practical II – Advanced physics Experiments-I	4	-	-	-	-
			Total	30	18	100	300	400
II	17P2PH04	Core-IV	Electromagnetic Theory	6	5	25	75	100
	17P2PH05	Core-V	Quantum Mechanics-I	6	5	25	75	100
	17P2PH06	Core-VI	Spectroscopy	6	5	25	75	100
	17P2PHE02	Elective-II	Crystal Physics	4	3	25	75	100
	17P2PHP01	Core Practical-I	Practical I – Advanced Electronics Experiments	4	4	40	60	100
	17P2PHP02	Core Practical-II	Practical II – Advanced physics Experiments-I	4	4	40	60	100
			Total	30	26	180	420	600
III	17P3PH07	Core-VII	Condensed Matter Physics	5	5	25	75	100
	17P3PHO8	Core-VIII	Quantum Mechanics-II	6	5	25	75	100
	17P3PH09	Core-IX	Microprocessor and Microcontroller	5	5	25	75	100
	17P3CHED01	EDC	Industrial Chemistry	4	4	25	75	100
	17P4PHP03	Core Practical-III	Practical III – Microprocessor Experiments	4	-	-	-	-

	17P4PHP04	Core Practical-IV	Practical IV – Advanced physics Experiments-II	4	-	-	-	-
	17P3HR01		Human Rights	2	1	25	75	100
			Total	30	20	125	375	500
IV	17P4PH10	Core-X	Nuclear and Particle Physics	6	5	25	75	100
	17P4PH11	Core-XI	Communication Systems	6	5	25	75	100
	17P4PHE03	Elective - III	Thin Film Technology	4	3	25	75	100
	17P4PHP03	Core Practical	Practical III – Microprocessor Experiments	4	4	40	60	100
	17P4PHP04	Core Practical	Practical IV – Advanced physics Experiments-II	4	4	40	60	100
	17P4PHPR01	Core-XI	Project work	6	5	80	120	200
			Total	30	26	235	465	700
Overall Total				**120**	**90**	**640**	**1560**	**2200**

LIST OF ELECTIVES

S.No	Code	Course Title
1.	17P1PHE01	Nano Science
2.	17P2PHE02	Crystal Physics
3.	17P4PHE03	Thin Film Technology
4.	17P1PHE04	Bio Physics
5.	17P2PHE05	Non Linear Dynamics
6.	17P4PHE06	Sensors and Actuators

Credit: 5

Max. Hours: 60

MATHEMATICAL PHYSICS

Paper Code: 17P1PH01

Subject Description: This course covers a broad spectrum of mathematical techniques essential to the solution of advanced problems in physics.

Goal & Objectives

- To apply advanced mathematical and computational techniques to complex physics problems.
- The main objective of this course is to provide the student with the repertoire of mathematical methods that are essential to the solution of advanced problems encountered in the fields of applied physics.

Unit-I Complex Analysis **10**

Functions of complex variable, Cauchy–Riemann condition, differential equation, Cayley integral theorem, Cauchy integral theorem, Cauchy integral formulas, Taylor's series, Laurents's series, Residue theorem, evaluation of definite integrals, Contour integration.

Unit-II Vectors, Matrices and Tensors **12**

Linear vector spaces – subspaces - linear independants and orthogonality of vectors, Hilbert's space - Transformation of coordinates, Summation convention, contravariant, covariant and mixed tensors, Rank of tensor, Kronecker delta, Symmetric and antisymmetric tensors, Contraction of tensor, Characteristic equation of a matrix, Eigen values and eigen vectors, Cayley-Hamilton theorem, Reduction of a matrix to diagonal form, Jacobi method, Sylvester's Theorem.

Unit-III Fourier series and Laplace Transforms **14**

Fourier transform, properties of fourier transform, fourier transform of derivative, Fourier's sine and cosine transform of derivative complex representation of fourier series, Fourier's integral, different forms of fourier integrals.

Laplace transform, properties of Laplace transform, Laplace transform of derivative function, Laplace transform of integrals, Laplace transform of periodic function, Inverse Laplace transform, properties of inverse Laplace transform, Laplace transform of some special functions,

Evaluation of integral using Inverse Laplace Transform, Convolution theorem, Applications of Laplace transform.

Unit-IV Special Functions and differential Equations **14**

Beta function, symmetry property of beta function, evaluation of beta function, transformation of beta function, different forms of beta function, evaluation of gamma function, transformation of gamma function, reduction of definite integrals to gamma function, relation between beta and gamma functions, Dirac delta function.

Liouville problem, solution for Bessel –Legendre-Lagure and Hermite differential equations-properties, Generating functions, Rodrigue's formula, orthogonal properties, Recurrence relation.

Unit-V Group Theory **10**

Basic Definition, Multiplication Table, Sub groups, Cosets and Classes, Direct Product groups, Point group, Space groups, Symmetry elements and symmetry operations, Representation theory, Homomorphism and isomorphism, Reducible and irreducible representation , Schur's lemma , The great orthogonality theorem, character table-C_2V and C_3V as examples, elementary ideas of rotation groups.

Books for Study:

1. Mathematical Physics, B.D. Gupta, Vikas Publishing House (2004).
2. Mathematical Physics, Satyaprakash, Sultan Chand and Sons (2004).
3. Mathematical Physics, P.K. Chattopadhyay, Wiley Eastern India (1990).
4. Chemical applications of group theory, F.A. Cotton, Wiley Eastern India (year).
5. Elements of group theory for physicist , A.W Joshi, New age international Publishers (year).

Credit: 5

Max. Hours: 60

CLASSICAL AND STATISTICAL MECHANICS

Paper Code: 17P1PH02

Subject Description: Classical & Statistical mechanics is studied rigorously using advanced mathematical and numerical techniques.

Goal: The main goal of the course is to introduce students to classical mechanics and its applications in physics

Objectives

- To develop fundamental concepts in mechanics more rigorously as needed for further study in physics and technology.
- To contribute to the development of the students thinking process through the understanding of the theory and application of this knowledge to the solution of the practical problems.

Unit-I Fundamental Principles and Lagrangian Formulation 12

Mechanics of a system of particles - Conservation laws - Constraints, Generalized coordinates - D' Alembert's principle and Lagrange's equation – Application of Lagrange's formulation – linear harmonic oscillator – simple pendulum - Applications of Lagrange's formulation – linear harmonic oscillator – simple pendulum - Hamilton's principle - Lagrange's equation of motion - conservation theorems and symmetry properties .

Unit-II Hamilton's Formulation 12

Hamilton's canonical equations of motion - Physical Significance of H-Hamilton's canonical equations from variation principle - Principle of least action - Canonical transformations - Poisson brackets - Hamilton - Jacobi method - Harmonic oscillator problem using Hamiltonian Jacobi method - Lagrange's brackets - Properties.

Unit-III Rigid Body Motion **12**

Generalized coordinates for Rigid Body Motion -- Euler Angles – Eulerian theorem - Angular Velocity -Angular Momentum of a rigid body – motion symmetrical top - motion of symmetrical top - Moments and Products of Inertia - Euler's equation of motion.

Relativistic Approach

Lorentz transformation - Kinematic effects of Lorentz transformation - mass energy equivalence - Lagrangian formulation of Relativistic mechanics - Hamiltonian Formulation of Relativistic mechanics.

Unit-IV Classical Statistics **12**

Phase space - Ensemble - Definition of Micro Canonical - Canonical and Grand Canonical ensembles - Liouville's theorem - Microstates and Macro states – Sterling's formula, entropy in statistical mechanics - Partition function - Doppler broadening of spectral lines - Principle of equipartition of energy - connection between Partition function and Thermodynamically quantities.

Unit-V Quantum Statistics **12**

Identical particles and symmetry requirements - Maxwell's, Bose-Einstein and Fermi Dirac statistics. Ideal Bose Einstein gas and its application: Black body radiation and Planck Radiation Law - Gas degeneracy Bose Einstein Condensation - Random walk and Brownian motion - Ideal Fermi Dirac gas and its application: Electron gas - Thermionic emission - Pauli's theory of Paramagnetism.

Books for Study:

1. Classical Mechanics, Gupta and Kumar, Pragati Prakashnan, Meerut (2005).
2. Classical Mechanics, H. Goldstein, Narosa Publishing House, New Delhi.(2005)
3. Classical Mechanics, . C.R.Mondal, Prentice - Hall of India, New Delhi.

4. Statistical Mechanics, Gupta and Kumar, Pragati Prakashnan, Meerut (2005).
5. Statistical Mechanics, B.K. Agarwal and M. Eisner, New Age International, 2nd Edition, New Delhi. (1998).
6. Statistical Mechanics, Satya Prakash, Pragati Prakashan, Meerut (2005)

Credit: 5

Max. Hours: 60

ADVANCED ELECTRONICS

Paper Code: 17P1PH03

Subject Description: The aim of the course is to introduce the students to the advanced concepts of electronics.

Goal & Objectives

- An understanding of basic analog circuit designs.
- The primary objective of this course is to understand and implement the advanced electronic circuits with the help of theoretical and practical problem solving.

Unit-I Operational Amplifier 12

Operational amplifiers: Basic information - Ideal op-amp - Open loop operation - Feedback in ideal op-amp - Inverting and Non-inverting op-amp, Voltage Follower, Differential op-amp, CMRR.

DC Characteristics- Input bias current, Input offset current, Input offset voltage, Total output offset voltage, Thermal drift. AC Characteristics- Frequency response, stability of an Op-amp, Frequency compensation, Slew rate. Electrical parameters.

Unit-II Analog Computation and Waveform Generators 12

Basic Op-amp Applications - Sample and hold circuits, logarithmic amplifiers, antilogarithmic amplifiers. Analog multiplier - analog divider – Differentiator - Integrator - Analog computation - solving simultaneous equation and differential equation.

Sine wave oscillation with phase shift and wein's network, comparator, Schmitt trigger, Astable and monostable operations, triangular wave generator.

Unit-III Filters and Data Converters 12

RC Active filters - First order low pass filter, second order active filter, higher order low pass filter, High pass active filter, band pass filters and band notch filters.

DAC - binary weighted resistor, R-2R Ladder. ADC- Counter type, successive approximation method, Dual slope ADC, resolution, accuracy and linearity.

Unit-IV IC Fabrication **12**

Basic monolithic IC's – thin film fabrication - epitaxial growth – masking – etching - impurity diffusion, fabricating monolithic resistors, diodes, transistors, inductors and capacitors. IC 555 timer - description of the functional diagram, mono stable operation - astable operation - Bi-Stable Operation - schmitt trigger.

Unit- V Memory and Optoelectronic Devices **12**

ROM-PROM, EPROM, EEPROM, EAROM. RAM- Static RAM - Dynamic RAM and integrated RAM - Compact Disk.

Solar cells – LED - photo diode - Pin Diode – LCD - LDR.

Books for Study:

1. Handbook of Electronics, Gupta and Kumar, Pragati Prakashnan, Meerut.
2. Linear Integrated Circuits, D. Roy, New Age Publications.
3. Semiconductor Devices, S.M. Sze, Wiley Publications.
4. Principles of Electronics, V.K.Mehta, S.Chand Publication
5. Electronic Measurement and instrumentation, William Cooper, TMG Hill.
6. Operational Amplifier, Gayakwad, TMG Hill.
7. Integrated Electronics, J.Milman and C.C. Halkias, McGraw Hill (1972)
8. Digital Electronics ,V.K.Puri,Tata McGraw-Hill Publication

Credit: 5

Max. Hours: 60

ELECTROMAGNETIC THEORY

Paper Code: 17P2PH04

Subject Description: Electromagnetic theory exposes the students to the fundamentals of electromagnetic fields and their applications in Physics.

Goal & Objectives

- To provide the basic skills required to understand, develop, and design various physics applications involving electromagnetic fields.

Unit-I Electrostatics 14

Coulomb's law – field due to point and continuous charges - Gauss Law and its application - Laplace and Poisson's equation - solution of Laplace equation in spherical coordinate - Conducting sphere - multipole expansion. Electrostatic energy - dielectrics-polarization and displacement vectors, boundary conditions - dielectric sphere in a uniform field - molecular polarizability and electrical susceptibility - electrostatic energy in dielectric medium - Clausis-Mossotti equation.

Unit-II Magnetostatics 10

Biot-Savart's law - divergence and curl of magnetic induction - magnetic vector potential - Ampere's circuital law - magnetic field of a localized current distribution - magnetic moment and force on a current distribution in an electric field - magneto static energy - magnetic induction and magnetic field in a macroscopic media - concept of magnetic dipole - boundary conditions - uniformly magnetized sphere. Magnetic Scalar & Vector potential-Characteristics

Unit-III Electromagnetics 10

Faraday's law of induction - Maxwell's equation in free space and isotropic media - Maxwell's displacements current - vector and scalar potential - boundary conditions on the field at interfaces - relation between field theory and circuit theory -

Gauge transformation, Lorentz Gauge - Coulomb Gauge - conservation laws for a system of charges - Poynting theorem.

Unit-IV Wave Propagation **14**

Propagation of an electromagnetic wave in free space - conducting and non conducting medium - skin depth, reflection and transmission at dielectric boundaries – polarization - Fresnel's Law - interference, coherence and diffraction - Guided waves - wave guides - propagation of waves in rectangular wave guide, inhomogeneous wave equation and retarded potentials, field and radiation due to an oscillating electric dipole.

Unit-V Plasma Physics **12**

Plasma - Debye length - plasma oscillations - plasma behaviour in a magnetic field - Boltzmann equation - magneto hydrodynamic equations - electron plasma oscillations - Debye shielding problem - plasma confinement in a magnetic field - pinch effect - magneto hydrodynamic waves - Alfven waves - dynamics of charged particle in uniform electromagnetic fields.

Books for Study:

1. Introduction to Electromagnetics, Griffith, Prentice Hall of India.
2. Classical Electrodynamics, J.D. Jackson, John Wiley Publishers.
3. Electromagnetic Waves and Fields, Paul Corson and Dale, CBS Publishers.
4. Fundamentals of Electromagnetics, M.A. Wazed, TMC Publishing.
5. Basic Electromagnetics with Application, N. Narayana, Prentice Hall of India.
6. Electromagnetic Theory and Applications, Umesh Sinha, Tech India Publications.
7. Electromagnetic Waves and Radiating Systems, Edward and Keith, Prentice Hall of India.
8. Foundations of Electromagnetic Theory, John Reitz, Narosa Publishing House.
9. Electro magnetic Theory And Electro Dynamics, Sathya prakash

Credit: 5

Max. Hours: 60

QUANTUM MECHANICS-I

Paper Code: 17P2PH05

Subject Description: Quantum mechanics, a backbone of physics explains the behavior of matter and its interactions with energy on the scale of atoms and subatomic particles.

Goal & Objectives

- The primary objective of this course is to develop familiarity with the physical concepts and facility with the mathematical methods of quantum mechanics
- A secondary, but still very important objective is to cultivate your skills at formulating and solving physics problems.

Unit- I General formalism of quantum mechanics **12**

Expectation values of dynamical quantities- probability of current density – Ehrenfest theorem –Uncertainity principle – Relations - Simultaneous Measurability of Observables - Dirac's Notation, Equations of Motion; Schrodinger, Heisenberg and Dirac representation, momentum representation.

Unit- II Angular Momentum **12**

Orbital Angular Momentum - Spin Angular Momentum -Total Angular Momentum Operators - Commutation Relations of Total Angular Momentum with Components - Ladder operators - Commutation Relation of J_z with J^+ and J^-, Eigen values spectrum of J^2, J_x, J_y and Jz, Matrix Representation of J^2, J_z, J^+ and J^- , Addition of angular momenta, Clebsch Gordon Coefficients – Properties and its evaluation.

Unit-III Matrix Formulation of Quantum Mechanics **12**

Eigen values, Eigen vectors: Characteristic equation of a matrix, Schrödinger, Heisenberg and interaction matrix representation, Dirac's Bra and Ket vectors: Dual

space, coordinate and momentum representation, Projection Operator, Matrix theory of harmonic oscillator.

Unit- IV Approximation Methods **12**

Time Independent Perturbation Theory in Non-Degenerate Case, Ground State of Helium Atom, Degeneratcy - Stark Effect in Hydrogen - Spin-orbit interaction - Variation Method & its Application to Hydrogen Molecule - WKB Approximation.

Unit-V Time Dependent Perturbation Theory **12**

Time Dependent Perturbation Theory - First and Second Order Transitions - Transition to Continuum of States - Fermi Golden Rule - Constant and Harmonic Perturbation - Transition Probabilities - Selection Rules for Dipole Radiation - Adiabatic and sudden approximation - Charged particle in an electromagnetic field.

Books for Study:

1. Quantum Mechanics – Theory and Problems by S. L. Kakani and H.M. Chandalia, Sultan Chand & Sons, 2007.
2. Advanced Quantum Mechanics, Satya Prakash, Kedar Nath Ram Nath Publications.
3. A text book of Quantum Mechanics, Mathews and Venkatesan, TMG Hill.
4. Quantum Mechanics, Claude, Frank and Bernard, John Wiley Interscience.
5. Quantum Mechanics, Jasprit Singh, John Wiley Interscience.
6. Quantum Mechanics, Ghatak and Loganathan, Macmillan India.
7. Quantum Mechanics, Aruldhas, Prentice Hall of India.
8. Quantum Mechanics, Leonard, TMG Hill.
9. Quantum Mechanics, Eugen, John Wiley Interscience.

Credit: 5

Max. Hours: 60

SPECTROSCOPY

Paper Code: 17P2PH06

Subject Description: This course provides a basic knowledge of different types of spectroscopic methods in theoretical aspects.

Goal & Objectives

- To provide the basic knowledge of interpreting different spectra.
- To study the spectroscopic methods for quantitative and qualitative analysis.

Unit- I Microwave Spectroscopy 12

Rotation of molecules and their spectra, diatomic molecules, intensity of line spectra , the effect of isotropic substitution , non-rigid rotator and their spectra, polyatomic molecules (Linear and symmetric top molecules), Classical theory of Raman Effect, pure rotational Raman spectra (linear and symmetric top molecules), Stark effect – Quadrupole hyperfinite interation.

Unit -II IR and Raman Spectroscopy 12

The energy of diatomic molecules, Simple Harmonic Oscillator, the Anharmonic oscillator, the diatomic vibrating rotator, vibration-rotation spectrum of carbon monoxide, Breakdown of Born-Oppenheimer approximation, the vibrations of polyatomic molecules , Influence of rotation on the spectra of polyatomic molecules (linear and symmetric top Molecules)

Raman Effect, Classical Theory & Quantum Theory of Raman Effect, Selection Rules, Degree of depolarization, Rotational Raman Spectrum, Vibrational Raman Spectrum, Structure determination using IR and Raman spectroscopy, Laser Raman Spectroscopy.

Unit- III Electronic Spectroscopy **12**

Born-Oppenheimer approximation, vibrational spectra and their progressions, Franck-Condon principle, dissociation energy and their products, rotational fine structure of electronic, vibration transition, molecular orbital theory, the spectrum of molecular hydrogen, change of shape on excitation, chemical analysis by electronic spectroscopy, reemission of energy, fundamentals of UV photoelectron spectroscopy – Zeeman effect.

Unit- IV NMR & NQR Spectroscopy **12**

NMR Spectroscopy: Quantum Mechanical and Classical Description, Bloch Equations, Relaxation Processes, Experimental Technique, Principle and Working of High Resolution NMR Spectrometer, Chemical Shift

NQR Spectroscopy: Fundamental Requirements, General Principle, Experimental Detection of NQR Frequencies ,Interpretation and Chemical Explanation of NQR Spectroscopy

Unit- V ESR &Mossbauer Spectroscopy **12**

ESR Spectroscopy: Basic Principles, Experiments, ESR Spectrometer, Reflection Cavity and Microwave Bridge, ESR Spectrum, Hyperfine Structure.

Mossbauer Spectroscopy: Mossbauer Effect, Recoilless Emission and Absorption- Mossbauer Spectrum - Experimental Methods - Hyperfine Interaction - Chemical Isomer Shift - Doppler velocity shift - magnetic hyperfine and electric quadrupole interaction.

Books for Study:

1. Vibrational Spectroscopy, Sathyanarayana, New Age International Publications.
2. Molecular Structure and Spectroscopy, Aruldhas, Prentice Hall of India.
3. Fundamentals of Molecular Spectroscopy, Banwell, TMG Hill.
4. Spectroscopy I, Straughan and Walkar, Chapman and Hall.
5. Spectroscopy II, Straughan and Walkar, Chapman and Hall.
6. Modern Molecular Spectroscopy, Randhava, Macmillan India.
7. Nuclear Magnetic Resource, Rahman, Springer Verlag.
8. C. N. Banwell, Fundamentals of Molecular Spectroscopy(McGraw Hill, New York, 1981).

Credit: 4

Max. Hours: 48

NANO SCIENCE **Paper Code: 17P1PHE01**

Subject Description: This gives an basic knowledge about Nanotechnology, its characterization and applications.

Goal & Objectives

- To provide the basic skills required to understand, develop, and design Nanomaterials.
- To enhance the research interest in Nanotechnology.

UNIT I : Basic Properties of Nanoparticle

Particle size; Top down and bottom up ideas, particles shape; Size effect and properties of nano-particles; Particle density; Melting point; Surface tension; Wettability; Specific surface area and pore; Composite structure; Crystal structure; Surface characteristics; Mechanical properties; Electrical properties; Magnetic properties; Optical properties; Concept of vacuum technology.

UNIT II : Nanofabrication and Nanopatterning

Sol-Gel synthesis, Hydrothermal Growth, Optical, X-ray, and electron beam lithography, self - assembled organic layers, scanning tunneling microscopy, atomic force microscopy.

UNIT III : Characterization Techniques

Scanning electron microscope (SEM), transmission electron microscope (TEM), atomic force microscope (AFM), scanning tunneling microscope (STM), XPS – Working Principle, Instrumentation and Applications, Photoluminescence (PL) Spectroscopy, Elemental dispersive X-ray analysis EDAX analysis.

UNIT IV : Nano Systems

An artificial and tunable atom (quantum dot); Quantum wire; Quantum Hall effect; Carbon nano-tube; Tunnel diode; Molecular transistor; Single electron transistor; Spin polarized transistor; Thin films; Self assembly.

Unit V : Applications of Nanomaterial

Optoelectronic properties of molecular materials, nanotechnology devices: OLEDs, OTFTs. Bioelectronics and biosensors: charge transport, DNA and protein functional systems, electronic noses and biosensors.

Books for Study:

1. Roland Wiesendanger – Scanning Probe Microscopy and Spectroscopy – Methods and Applications – Cambidge University Press (1994).

2. Joel I. Gersten, Frederick W. Smith – The Physics and Chemistry of Materials; John Wiley and Sons (2001).

3. Bhushan Bharat, Fuchs Harald, Tomitori Masahiko – Applied Scanning Probe Methods IX Characterization – Springer (2008).

4. John C. Vickerman; Surface Analysis (The principal Techniques); John Wiley and Sons (2003).

5. E. Wolf ; Nanophysics and Nanotechnology: An Introduction to Modern Concepts in Nanoscience Second Edition, Wiley-VCH (2006).

6. D. Briggs, M.P. Seah; Practical Surface Analysis-Auger and X-ray Photoelectron Spectroscopy, Wiley Interscience (1990).

7. Sergei N. Magonov, Myung-Hwan Whangbo; Surface Analysis with STM and AFM: Experimental and Theoretical Aspects of Image Analysis, VCH Publishers (1996).

8. John H. Davies, The Physics of Low Dimensional Semiconductors: An Introduction, Cambridge University Press (1998).

9. M.S.Ramachandra Rao, Shubra Singh, Nanoscience and Nanotechnology: Fundamentals to Frontiers, Wiley (2016).

10. Nano: The Essentials, T. Pradeep, TMG Hill.

11. Nanoscale materials in chemistry, Kenneth, John Wiley and Sons.

12. Science and technology of nanostructured magnetic materials, George, Plenum Press, New York.

Credit: 4

Max. Hours: 48

Crystal Physics

Paper Code: 17P2PHE02

Subject Description: As a traditional field of research, Crystal physics introduces the structure and characterization techniques and applications of crystalline materials.

Goal & Objectives

- To provide the basic skills required to understand, develop crystals having different applications.
- To provide basic knowledge in the research area of crystal physics.

Unit-I Nature and Symmetries of Crystals 8

Crystalline state, chemical bonding, nature of bonding, covalent, ionic, metallic, hydrogen and Vander waals bond, symmetry, space lattices, and unit cell, crystal systems, centered lattices, non primitive lattices, Bravais lattice, close packing.

Unit-II Morphology, Point Groups and Space Groups 10

Miller faces and internal arrangement, Miller indices of crystal face, laws of rational indices, Miller indices, application of Miller indices, Miller Bravais indices. Point groups-crystal class. Plane lattices- plane groups, compound symmetries, screw axes, glide planes, internal symmetry elements, space groups and symbols, simple illustration for triclinic, monoclinic and orthorhombic systems.

Unit- III Growth Techniques 10

Solution Growth Technique:

Low temperature solution growth: Solution - Solubility and super solubility – Expression of super saturation – Miers T-C diagram - Constant temperature bath and crystallizer – Seed preparation and mounting - Slow cooling and solvent evaporation methods.

Gel Growth Technique :

Principle – Various types – Structure of gel – Importance of gel – Experimental procedure – Chemical reaction method – Single and double diffusion method – Chemical reduction method – Complex and decomplexion method – Advantages of gel method.

Unit -IV Melt and Vapour Growth Techniques **10**

Melt technique:

Bridgman technique - Basic process – Various crucibles design - Thermal consideration – Vertical Bridgman technique - Czochralski technique – Experimental arrangement – Growth process.

Vapour technique:

Physical vapour deposition – Chemical vapour deposition (CVD) – Chemical Vapour Transport.

V Characterization Techniques 10

X-ray powder diffraction method - Single crystal method - Debye Scherer method - dislocation density - micro strain - Optical methods - UV-Vis spectroscopy studies - Band gap calculation- Fluorescence and Photoluminescence studies - Z scan technique - Thermal studies- TGA, DTA and DSC. Mechanical properties - Vicker hardness, Electrical properties - DC conduction mechanism -AC conduction mechanism NLO studies – Kurtz Terry powder analysis – dielectric loss analysis.

Books for Study:

1. Crystallography Applied to Solid State Physics, O.N.Srivastava, New Age International Publications.(second edition)
2. X-ray Structure Determination, Stout and Jensen, John Wiley Publications. .(second edition)
3. K.Sangawal, Elementary Crystal Growth – Sahan Publisher, UK, 1994.

Books for Reference:

1. The Growth of Crystals from Liquids, J.C. Brice, NHC Publishers (1973).

2. Fundamentals of Crystallography, Giacovazzo, Oxford University Press Publications (2011).
3. B.R.Pamplin, Progress in Crystal Growth Characterization, Pergamon Press Ltd. (UK)
4. X.F.Zong, Y.Y.Wang, J.Chen, Material and Process characterization for VLSI, World Scientific, New Jersey (1998).
5. M. William and D. Steve, Instrumental Methods of Analysis (CBS Publishers, New Delhi, (1986).
6. H. H. Williard, L. L. Merritt, J. Dean, and F. A. Settle, Instrumental Methods of Analysis – Sixth Edition, CBS Publishers & Distributors, Delhi (1986).
7. Crystal Growth Methods and Processes , P. Santhanaraghavan and P. Ramasamy, Kru Publications, 2000.

Credit: 4

Max. Hours: 60

PRACTICAL – I

ADVANCED ELECTRONICS

PAPER CODE: 17P2PHP01

1. FET Characteristics and construct FET amplifier circuit.
2. Design Phase shift oscillator.
3. Construct Schmitt trigger using Ic555& IC 741.
4. Design square wave generator using Ic555 & IC741.
5. Design monostable multivibrator using Ic741 & IC 555.
6. Binary addition and subtraction using Ic 7483.
7. BCD counter- Seven segment display.
8. UJT Characteristics and construct saw tooth wave oscillator.
9. Multiplexer and De-Multiplexer.
10. Decoder and encoder.
11. Analog computation –solving simultaneous equation.
12. Shift registers using 7476/7473 IC
13. Study of Flip Flops using IC 7400
14. Design second order butter worth active filter circuit – Low pass, high pass and band pass filters using IC 741
15. Design of R/2R ladder and Binary weighted method of DAC using IC 741

Credit: 4

Max. Hours: 60

PRACTICAL-II

ADVANCED EXPERIMENTS

Paper Code: 17P2PHP02

1. Determine the Young's Modulus of the material of the given plate by forming elliptical fringes. Repeat the experiment at least twice by changing the position of the suspended masses.
2. Determine the Young's Modulus of the material of the given plate by forming hyperbolic fringes. Take 2 sets of readings.
3. Using the given experimental setup determine the value of Stefan's constant. Assuming the solar constant 'S'. Calculate the temperature of the SUN.
4. Find the thickness of the air film in FP etalon.
5. Determine the compressibility of the given solution by using an ultrasonic interferometer. Repeat the experiment at least for four different concentrations and hence draw the concentration vs. compressibility graph.
6. Determine the compressibility of the given four liquids/solution by using an ultrasonic interferometer.
7. Determine
   (a) Hall voltage and Hall coefficient
   (b) Number density of the charge carriers and
   (c) Hall angle and mobility.

   Repeat the experiment for a different value of magnetic field.
8. Measure the diameter of a circular aperture, the diameter of a thin wire and diameter of sleeve using Fresnel's diffraction phenomenon.
9. Determine the wavelength of the laser light by using transmission grating and determine the number of lines in a transmission grating.

Credit: 5

Max. Hours: 60

CONDENSED MATTER PHYSICS

Paper Code: 17P3PH07

Subject Description: This paper gives an idea about fundamentals of solids and its bond theory which will be used for studying solids and how they are formed.

Goal: To provide understanding of the enormously rich behavior of condensed matter systems under a wide variety of conditions.

Objectives

To probe the system by studying the

- Crystal properties
- Electrical and thermal transport
- optical interactions.

UNIT- I Electron Energy Bands **14**

The Bloch's Theorm- the Kronig Penney model – zone schemes for energy bands- Energy bands in a general periodic potential-motion of an electron in one dimensional lattice- Effective mass of an electron- Effective band gap and band over lapping – Fermi surface- Anamalous skin effect-De Hass van Alphen effect and Brillouin zones.

UNIT- II Free Electron Theory of Metals **12**

Free electron in metals- Drude Lorentz free electron theory –Electrical conductivity- Thermal conductivity-Weidemann Franz law- Sommerfield free electron theory –Mattiessen's Rule-Thermionic emission- Relaxation time-collision time - mean free path-Quantum theory of free electrons - Escape of electrons from metal-potential energy of an electron outside the metal.

UNIT - III Diamagnetism, Paramagnetism and Ferromagnetism **12**

Diamagnetism and ferromagnetism – Langevin classical theory of Diamagnetism – Weiss theory – Quantum theory of Paramagnetism – Demagnetization of a paramagnetyic salt – Determination of susceptibility of para and diamagnetism using Guoy's method – Ferromagnetism – Spontaneous magnetization in ferromagnetic materials – Quantum theory of

ferromagnetism – Curie - Weiss law – Weiss molecular field – Ferromagnetic domains – Antiferromagnetism – Ferrimagnetism.

UNIT - IV Superconductivity **12**

Superconductivity and its historical perspective-Critical Temperature-persistent current-Energy gap and its Temperature dependence - DC and AC Josephson effect – London equation - BCS theory –Flux quantization – Type I and Type II superconductors - Josephson tunneling effect – SQUID - Applications-High temperature Super conductors-High temperature Ceramic Super conductors.

UNIT - V Semiconductor Devices **10**

Hall effect in semi conductors – vacuum level and work function of metals – Solar cells, Qualitative ideas of MEM's, Spintronics, quantum Dots (QD's) & Molecular Electronics.

Book for Study and References:

1. Introduction to solid state physics-C.Kittel (John Wiley and Sons),2005, 7^{TH} Edition
2. Solid state physics – Gupta & Saxeena, Pragatti Praashan, 9th edition (2004).
3. Solid state physics- S.O.Pillai, New age Publication, 2nd edition (2002).
4. Material Science, S.L.Kakani, Amit Kakani, New Age International Publishers, 2010, 2^{nd} Edition.
5. Super conductivity fundamentals and applications – W.Buckl, Wiley-VCH Publications, 2nd revised and enlarged edition (2004).

Credit : 5

Maximum Hours : 60

QUANTUM MECHANICS –II

PAPER CODE: 17P3PH08

Subject Description: This paper describes the behaviour of matter and energy at the sub atomic scale.

Goal: To provide understanding of the semiclassical, quantum and quantum field approach to the physical system.

Objectives

- To acquire knowledge of non-relativistic and relativistic quantum mechanics .
- The ability to understand concepts and to perform calculations of scattering of particles.
- The ability to critically understand and evaluate modern research utilizing quantum theory in condensed matter, nuclear and particle physics.

UNIT I Semiclassical Theory of Radiation 12

Emission & Absorption of radiation – Electric dipole approximation – Einstein's Transition probabilities and A & B Coefficients – Selection rules – Quantisation of radiation field – interaction with matter – spontaneous & stimulated emissions.

Quantum theory of valence band

VB method – Hitler – London theory of Hydrogen molecule in VB method – directed bonds – sp, sp^2, sp^3 hybridisations.

UNIT II Scattering Theory 12

Scattering amplitude – Expression in terms of Green's function – Born approximation and its validity – Partial wave analysis – Phase shifts – Asymptotic behavior of partial waves – The scattering amplitude in terms of phase shift – Scattering by Coulomb potential and Yukawa potential - Low energy scattering: Scattering length and effective range – scattering by a perfectly rigid sphere.

UNIT III Many Electron Atoms 12

Indistinguishable particles – Pauli's principle – Inclusion of spin – spin functions for two electrons- The Helium atom – Central field approximation – Thomas Fermi model of the atom – Hatree Equation – Hatree- Fock Equation.

Symmetrical and Anti symmetrical wave functions – Hund's rules – Atomic Structure – Effect of Magnetic Field – Hydrogen Atom – Weak & Strong magnetic field.

UNIT IV Relativistic Wave Equation **12**

Klein Gordan Equation –Phase Wave Equation – Charge and Current Density –Application to the study of Hydrogen like atom – Dirac Relativistic Equation for a free particle – Dirac matrices – free particle solutions - Dirac Equation in Electromagnetic field – Negative Energy states – Dirac's equation in Covariant form.

UNIT V Quantum Field Theory **12**

Quantization of wave fields – Classical Lagrangian equation – Classical Hamiltonian equation – Field Quantization of the non relativistic Schrodinger equation – Creation, Destruction and Number Operators- Anti Commutation Relations – Quantization of Electromagnetic Field, Energy and Momentum.

Books for Study and References:

1. A text Book of Quantum Mechanics – P.M.Mathews & K.Venkatesan – Tata Mc Graw Hill, 2004.
2. Quantum Mechanica – G Aruldhas- Prentice Hall of India 2006
3. Introduction to Quantum Mechanics – David J.Griffths – Pearson Prentice Hall 2009, 2ND edition.
4. Quantum Mechanics – V.Devanathan – Narosa Publishing – New Delhi, 2006.
5. Quantum Mechanics – A.K.Ghatak and S.Loganathan – McMillan India, 2003
6. Quantum Mechanics – Satyaprakash- Sultan Chand Publishers,2013.
7. Quantum Mechanics – Gupta Kumar Sharma- Jaiprakash Nath Publications, Meerut, 32nd Edition, 2013.
8. Quantum Mechanics – L. I. Schiff - Tata Mc Graw Hill- 2010 edition.

Credit : 5

Maximum Hours : 60

MICROPROCESSORS AND MICROCONTROLLER

PAPER CODE: 17P3PH09

Subject Description: This subject deals with the functions and principles of Micro Processors and Microcontrollers.

Goal: To learn about function of micro processors and Microcontrollers and operate them by learning with different features.

Objectives

On successful completion of this subject the student should have

- The basic knowledge of computers and its processors.
- To operate the processors and controllers with basic idea.

UNIT I EVOLUTION AND ARCHITECTURE OF MICROPROCESSORS 8085 12

Evolution of Microprocessors – INTEL 8085 microprocessor Pin configuration – Pins and their functions - Bus system–control and status signals – externally initiated signals including interrupts- architecture – ALU – Flags – registers.

Timing and sequencing: Insertion cycle, machine cycle-halt state and wait state

Interrupts: Types of interrupts – hardware and software interrupts – masking and unmasking interrupts.

UNIT II MICROPROCESSORS 8085 INSTRUCTION SETS & PROGRAMMING 12

Assembly language, Instruction sets of 8085, Stacks, Counters, Subroutines, MACRO, Delay Subroutine. Examples of Assembly language Programming- addition- subtraction- To find the largest and smallest number in a data array- sorting-sum of a series- Multiplication- Division- multi-byte addition and subtraction.

UNIT III APPLICATIONS OF MICROPROCESSORS 12

Address space – partitioning, interfacing – memory and I/O interfacing – I/O ports: non programmable I/O port INTEL 8212, Programmable Peripheral Interface (PPI) INTEL 8255, Programmable Interval (Counter) Timer (PIT) INTEL 8253. – Data transfers: types of parallel and serial data transfer schemes – Direct Memory Access (DMA) controller INTEL 8257–

8085A interrupt system: software & hardware interrupts – interfacing, working and programming of PIC 8259 with 8085.

UNIT IV ARCHITECTURE OF MICROCONTROLLER 8051 12

Introduction – comparison between microcontroller and microprocessors - Architecture of 8051 – Key features of 8051 – memory organization – Data memory and program memory – internal RAM organization – Special function registers – control registers – I/O ports – counters and timers – interrupt structure.

UNIT V PROGRAMMING THE MICROCONTROLLER 8051 12

Instruction set of 8051 – Arithmetic, Logical, Data move jump and call instructions, Addressing modes – Immediate, register, direct and indirect addressing modes – Assembly language programming – simple programs to illustrate arithmetic and logical operations (Sum of numbers, biggest and smallest in an array) – software time delay.

Books for Study and References:

1. Microprocessor Architecture, Programming and Applications with 8085, Ramesh S. Gaonkar, III Edition, Penram International Publishing, 1997.
2. Fundamentals of Microprocessor and Microcomputers, B. Ram,V Edition, Dhanpat Rai publications (P) Ltd. New Delhi, 2003.
3. The 8051 Microcontroller – Architecture, Programming & Applications, Kenneth J. Ayala, II Edition., Penram International, India, 1996.

Credit : 5

Maximum Hours : 60

NUCLEAR AND PARTICLE PHYSICS

PAPER CODE: 17P4PH10

Subject Description: This paper presents the key topics in nuclear and particle physics including the standard model, properties of nuclei and nuclear models, radioactive decay and nuclear reactions.

Goal: To enable students to describe and explain key concepts in nuclear and particle physics, provide them with the problem solving skills required to address questions in nuclear and particle physics.

Objectives

To acquire knowledge and apply it to

- explain central concepts, laws and models in nuclear and particle physics
- interpret basic experiments
- use basic laws and relations to solve simple problems

UNIT I NUCLEAR MODELS 12

Nuclear size, shape and distribution of charge – spin and magnetic moment – determination of nuclear mass – binding energy – semiemprical mass formula – nuclear stability - Liquid drop model – Bohr-Wheeler theory of fission –Shell Model – Evidence for Magic numbers – prediction of Shell-model- Optical Model – Collective model of Bohr and Mottelson.

UNIT II NUCLEAR REACTIONS 12

Nucler reactions and reaction mechanism, Types of reactions and conservation laws – Energetics of nuclear reactions –Dynamics of nuclear reactions – Q-value equation – Scattering and reaction cross sections – Compound nucleus reactions – Direct reactions –Stripping, Pick up reactions – Partial Wave analysis of nuclear reaction cross-section- Resonance scattering – Breit-Wigner one level formula- continuum theory of nuclear reaction.

UNIT I NUCLEAR INTERACTIONS 12

Nature of Nuclear forces – Exchange forces - Two body problem – ground state of duetron - Magnetic moment – quardrapole moment - Tensor forces –Nucleon-nucleon interaction – NP scattering, PP scattering at low energy, non- central- Meson theory of nuclear forces –Yukawa potential – Nucleon-Nucleon scattering- form of nucleon – nucleon potential – Effective range

theory – Spin dependence of nuclear forces – Charge independence and charge symmetry of nuclear forces – Isospin formalism.

UNIT IV NUCLEAR DECAY **12**

Gamow's theory of alpha decay & Fermi's theory of beta dacay – Total decay rate - Mass of the neutrino – Angular momentum and parity selection rules – Allowed and forbidden decays – Comparative half-lives – Neutrino physics Neutrino Hypothesis – Helicity – Non-conservation of parity – Multipole transitions in nuclei – Angular momentum and parity selection rules – Internal conversion – Nuclear isomerism.

UNIT V ELEMENTARY PARTICLE PHYSICS **12**

Types of interaction between elementary particles – Hadrons and leptons – Symmetries and conservation laws – Elementary ideas of CP and CPT invariance – Classification of hadrons – SU(2) and SU(3) multiplets CPT Violation in neutral k-meson decay –Gellman – nishijima formula- Quark model - Gell-Mann-Okubo mass formula for octet and decuplet hadrons – Charm, bottom and top quarks .parity non conservation in weak interactions. Relativistic kinematics, Quantum Chromo Dynamics (QCD).

Books for Study and References:

1. D. Griffiths, Introduction to Elementary Particle Physics, Harper & Row, New York., 2006.
2. R. R. Roy and B.P. Nigam, Nuclear Physics, New age Intl. New Delhi, 2005.
3. M.L. Pandya and R.P.S. Yadav, Elements of Nuclear Physics 7th edition, Kedar Nath Ram Nath, Delhi, 2003.
4. H. A. Enge, Introduction to Nuclear Physics, Addison-Wesley, Tokyo , 2006.
5. Y. R. Waghmare, Introductory Nuclear, Physics, Oxford-IBH, New Delhi, 2006.
6. Ghoshal, Atomic and Nuclear Physics, Vol. 2 , 2008.
7. B. L. Cohen, Concepts of Nuclear Physics, TMH, New Delhi , 2006.

Credit: 5

Max. Hours: 60

COMMUNICATION SYSTEMS

PAPER CODE: 17P4PH11

Subject Description: This paper presents the fundamentals electronics communication systems.

Goal: To enable the students to acquire the knowledge about the types of communication systems, elements used in communication systems and modes of communications.

Objectives

To acquire knowledge about

- The working principles of communication systems.
- How to handle the communication elements.

UNIT I MODULATION SYSTEMS 12

Theory of Amplitude modulation-Theory of frequency modulation-Theory of phase modulation-pulse code modulation-pulse width modulation-Sampling theorem-low pass and band pass signals, PAM, Channel BW for a PAM signal, Natural Sampling, Flat top Sampling, Signal recovery through holding, Quantization of signals, Differential PCM delta modulation-Delta modulation- Adaptive Delta modulation- BPSK, QPSK.

UNIT II FIBER OPTICS COMMUNICATION 12

Basics of Fiber Optics- Classification- Single mode and multimode, Step index and Graded index. Acceptance angle, Numerical Aperture, Fiber Losses- Attenuation, Absorption, Leaky modes, Bending losses, Transmission losses, and Core and cladding losses. Chromatic and modal dispersion. Splicing and connectors.

UNIT III MICROWAVE COMMUNICATION SYSTEM 12

Microwave Generation – Multicavity Klystron – Reflex Klystron – Magnetron – Travelling Wave Tubes (TWT) - Propagation modes, Microwave communication system. Analog Microwave Communication-LOS microwave system-OTH microwave system- Digital Hierarchies, Digital Microwave Systems, Bandwidth efficiency, Digital Radio Systems, Hybrid Microwave systems.

UNIT IV SATELLITE COMMUNICATIONS 12

Orbital Satellites, Geostationary Satellites, Orbital Patterns, Look angles, Orbital Classifications, Spacing and frequency allocation, Radiation Pattern, foot prints, satellite system link models, satellite system link equation..Non-ideal system parameters. INSAT communications satellites. Multiple Accessing Frequency Hopping, Channel Capacity. RADAR.

UNIT V MOBILE COMMUNICATION.

Evaluation and fundamentals – cellular structure and planning – frequency allocations – propagation problems – Base station antennas and mobile antennas – type of mobile system – access methods – TDMA, FDMA and CDMA – DIGITAL Cellular Radio.

Books for Study and References:

1. Taub and Schiling, Principles of Communication Systems, Second edition, Tata Mc Graw Hill, 2010, 3rd edition.
2. Simon Haykin, Communication system, Third edition John Wiley & Sons, Inc.2007, 4th Edition.
3. Wayne Tomasi, Advanced electronics communication systems, fourth edition, Prentice Hall, Inc., 2005, 6th edition.
4. Dennis Roddy, Satellite Communications, Second edition, Mc graw Hill, 2006, 4th edition.
5. John M. Senior, Optical Fiber Communications, Second Edition, PHI, 2009, 6th Edition.
6. Electronic Communication Systems –George Kennedy& Davis, Tata McGraw Hill, 2006, 4th Edition.
7. Wireless Communication Principles & Practice – TS. Rapport.
8. Wayne, Electronic Communication Systems, 2004, 6th Edition.

Credit: 4
Max. Hours: 48

THIN FILM PHYSICS

PAPER CODE: 17P4PHE03

Subject Description: This paper presents the preparation of thin film and its various properties.

Goal: To enable the students to acquire the knowledge about the various coating, its thickness measurements and its influence on the properties of thin films.

Objectives:

- To examine the electrical properties in metalliv thin films.
- To explore the transport properties of semi conducting and insulating film.
- To know how the optical properties of thin film is utilized in solar cell applications.

Unit I Preparation of Thin Films

Study of thin film vacuum coating unit - Construction and uses of vapour sources-wire, sublimation, crucible and electron bombardment heated sources. Physical vapour deposition – Thermal evaporation – electron beam evaporation – Sputtering - Study of glow Discharge - Physical nature of sputtering - Sputtering yield - Experimental set up for DC and RF magnetron sputtering, Pulsed laser deposition and Ion beam assisted deposition. Chemical vapour deposition – Thermodynamics of CVD - Atmospheric pressure CVD – MOCVD and PECVD processes. Chemical methods: Qualitative study of preparation of thin films by Electroplating, vapour phase growth and anodization. (8)

Nucleation and growth: Nucleation and growth of thin films – four stages of film growth - Directionality of evaporation molecules - Cosine law of emission. Emission from a point source. Mass of material condensing on the substrate. (6)

Unit II Deposition Monitoring and Control

Microbalance, Crystal oscillator thickness monitor, optical monitor, Resistance Monitor. Thickness measurement: Multiple Beam Interferometer, Fizeau (Tolansky) technique - Fringes of equal chromatic order (FECO) method - Ellipsometry (qualitative only). (8)

Unit III Electrical properties

Sheet resistance - size effect - Electrical conduction in thin metallic films. Effect of ageing and annealing - Oxidation - Agglomeration. (7)

Unit IV

Dielectric properties: DC conduction mechanism - Low field and high field conduction. Breakdown mechanism in dielectric films - AC conduction mechanism. Temperature dependence of conductivity. (5)

Structure and Optical Properties: Study of structure of thin films using x-ray diffraction method, Optical constants of thin films – spectrophotometer- Transmittance, absorption, determination of band gap (5)

Unit V Application of Thin Films

Thin film resistors: Materials and Design of thin film resistors (Choice of resistor and shape and area) - Trimming of thin film resistors - sheet resistance control - Individual resistor trimming. Thin film capacitors: Materials - Capacitor structures - Capacitor yield and capacitor stability. Thin film field effect transistors: Fabrication and characteristics - Thin film solar cells – antireflection coatings. (9)

Books for Study and References:

1 . Hand book of Thin films Technology : L I Maissel and R Clang .

2 . Thin film Phenomena : K L Chopra .

3 . Physics of thin films, vol. 12 , Ed George Hass and others .

4 . Thin films solar cells – K L Chopra and S R Das .

5 . Thin films processes – J L vilsan

6 . vacuum deposition of thin films – L Holland .

7 . The use of thin films in physical investigation – J C Anderson . 8 . Thin films technology – Berry, Koil and Harris

Credit: 4

Max. Hours: 45

SOLAR ENERGY

Paper Code: 17P3PHED01

Subject Description: This paper gives an idea about energy production, storage and conservation systems.

Goal: To enable the students to aware about renewable energy types, energy resources and conservation of energy.

Objectives

To acquire knowledge about

- Energy resources around us.
- Threatening to our energy resources.
- How to conserve energy.

UNIT I INTRODUCTION TO ENERGY SOURCES 12

Classification of Energy sources, Worlds reserve of commercial energy sources and their availability-Geothermal energy-wind energy-ocean thermal energy conversion-energy from waves and tides(basic ideas)-merits and demerits.

UNIT II SOLAR THERMAL ENERGY 12

Renewable energy sources-solar energy-solar water heater-solar space heating and cooling- solar thermal technologies-solar cooker-merits and demerits of solar energy.

UNIT III SOLAR CELL 12

Photo voltaic effect - performance of cell-choice of materials for solar cells-Basic requirements for obtaining an effective solar cell-PV power generation.

UNIT IV BIOMASS ENERGY FUNDAMENTALS 12

Biomass energy – classification - Photosynthesis- Biomass conversion technology-advantages and disadvantages of biomass as an energy source-Gobar gas plants.

UNIT V ENERGY STORAGE 12

Conservation of energy-Patterns of Energy consumption in domestic, Industrial, transportation-and agricultural sectors- conservation principles in these sectors.

Books for Study and References:

1. G.D .Rai, Solar energy utilization,Ed, 2011, 5th Edition.
2. S.P.Sukhatme,Solar energy,Tata McGraw Hill Publishing company,Ed.,2005, 3rd Edition.
3. G.D .Rai,Non Convantional Energy Sources,Ed.IV, 2011, 5th Edition.
4. D.S. Chauhan,S.K. Srivastava, Non Convantional Energy Sources,Ed.V, 2004, first edition.

Credit: 4

Max. Hours: 48

PRACTICAL – III

MICROPROCESSOR

Paper Code: 17P4PHP03

1. 8 Bit Decimal Addition and Subtraction and Multi-byte Addition and Subtraction
2. Number Conversion: BCD to Binary, Binary to BCD, ASCII to Hexadecimal/Decimal, Hexadecimal to ASCII
3. 16 bit Addition ,Subtraction, Multiplication and Division
4. 16 bit Square root of a number, and Square of a number
5. Sum of simple series and Factorial of a number
6. ADC interfacing
7. Stepper motor interfacing
8. Interfacing of an 8 bit DAC Converter and Waveform generation-Triangular, Saw tooth, Sine, Square, Rectangular
9. Traffic light controller
10. Finding the Largest/Smallest number in a data array and arranging a series of numbers in ascending/descending order.
11. Multibyte decimal addition
12. Data transfer Program

Credit: 4

Max. Hours: 48

PRACTICAL – IV

ADVANCED GENERAL EXPERIMENTS-II

Paper Code: 17P4PHP04

1. Rydberg constant-grating –Hydrogen spectrum.
2. Magnetic susceptibility – Quincke's method
3. Magnetic susceptibility – Guoy's method.
4. Band gap of a semiconductor – Four probe method.
5. Rydberg constant -Solar Spectrum.
6. Thermal conductivity of a good conductor – Forbe's method.
7. Coefficient of Viscosity - Searle's Viscometer.
8. Charge of an electron using Spectrometer.
9. Determination of wavelength - Michelson's Interferometer.
10. charge of an electron - Milikan's oil drop method
11. Compressibility of the Liquid - Ultrasonic Diffractometer.
12. Temperature Coefficient & Energy Band Gap of a Thermistor.