NOORUL ISLAM CENTRE FOR HIGHER EDUCATION

NOORUL ISLAM UNIVERSITY, KUMARACOIL

M.Sc. PHYSICS

CURRICULUM & SYLLABUS

SEMESTER – I

SL. NO.	SUBJECT CODE	SUBJECT	L	T	P	C
THEORY						
1.	PH1701	Mathematical Physics - I	3	1	0	4
2.	PH1702	Classical Mechanics	3	1	0	4
3.	PH1703	Quantum Mechanics - I	3	1	0	4
4.	PH1704	Electronics and Microprocessor	3	1	0	4
PRACTICAL						
5.	PH1771	General Experiments and Electronics	0	0	6	6
TOTAL CREDITS			**12**	**4**	**6**	**22**

PH1701 MATHEMATICAL PHYSICS – I 3 1 0 4

UNIT I : Vector Analysis 9

Gradient of a Scalar Field- Line, Surface, Volume Integrals- Divergence of a Vector Function- Curl of a Vector Function -Physical Significance- Vector Identities – Gauss , Stokes, Green, Helmholtz theorem (statement only)- Cylindrical and Spherical coordinates– Poisons Equation.

UNIT II : Linear Vector space and Matrix Theory 9

Vector spaces: Linear independence of Vectors – Inner product space – Schmitt's Orthogonalisation process – Schwartz inequality – Solution of linear Algebraic equation – Rank of matrix – Characteristic equation of matrix– Eigenvalues and Eigenvectors – Trace of a matrix – Cayley Hamilton's theorem – Inverse of a matrix – Reduction of a matrix to diagonal form – Hermition and unitary matrix

UNIT III : Ordinary Differential Equations 9

Power Series Solution- Forbenius Method –Linear independence of Solution – Legendre Differential Equation- Legendre Function- Legendre Polynomial –Recurrence Formula using contour.

UNIT IV : Complex Analysis 9

Functions of complex variables – Cauchy-Riemann conditions – Complex integration – Cauchy's integral theorem and integral formula – Taylor's and Laurent's series –Poles-Residues and singularities – Cauchy's residue theorem – Evaluation of definite integrals using contour

UNIT V : Fourier series and Fourier integrals 9

Fourier series – Dirichlet conditions – Half range series – Fourier cosine and sine series, Fourier integral theorem – Fourier cosine and Sine integrals.

L: 45 + T: 15 = TOTAL: 60 PERIODS

Books for study:

1. L.A. Pipes and L.R. Harvill, *Applied Mathematics for Engineering and Physicists* (McGraw Hill, Singapore, 1967)
2. B.D. Gupta, *Mathematical Physics* (Vikas, Publishing House Pvt Ltd., New Delhi, 2003).
3. G. B. Arfken and H. J. Weber, *Mathematical Methods for Physicists, 6th Edition: A Comprehensive Guide* (Academic Press, San Diego 2005).

References:

1. E. Butkov, *Mathematical Physics* (Addison Wesley, London, 1973)
2. A.K. Gattak, T.C. Goyal and S.J. Chua, *Mathematical Physics* (Macmillan, New Delhi, 1995).
3. P.K. Chattopadhyay, *Mathematical Physics* (Wiley Eastern, New Delhi, 1990)
4. SatyaPrakash, *Mathematical Physics* (Sultan Chand and Sons, New Delhi, 2004).

PH1702 CLASSICAL MECHANICS 3 1 0 4

UNIT I :Particle Dynamics 9

Mechanics of a system of particles - conservation laws – constraints –generalized coordinates –generalized velocity and force –virtual work – D'Alembert's principle – Lagrange's equations –applications: simple pendulum and atwood's machine.

UNIT II: Lagrangian and Hamiltonian Formulation 9

Techniques of the calculus of variations –Hamilton's principle of least action – Lagrange's equations from Hamilton's principle – symmetries and conservation laws – Hamilton's equations of motion – cyclic co-ordinates– canonical transformations – Poisson bracket: equation of motion in Poisson bracket form – Hamilton Jacobi theory – Harmonic oscillator problem.

UNIT III: Two-body Central Force Problem 9

Equation of motion and first integrals – classification of orbits – motion in a central force field – differential equation of the orbit – Kepler problem – virial theorem – scattering in central force field –transformation to laboratory frames.

UNIT IV: Rigid Body Dynamics and Small Oscillations 9

Rigid body dynamics – moment of inertia tensor –Euler's angles – Euler's equation of motion of a rigid body– symmetrical top –non-inertial frames and pseudoforces.

Theory of small oscillations – Normal coordinates and normal modes - Linear triatomic molecules – forced vibrations and the effect of dissipative forces.

UNIT V: Special Theory of Relativity 9

Principles and postulates of relativity – Lorentz transformation – relativistic kinematics – $E = mc^2$ – momentum four-vector for a particle – relativistic invariance of physical laws.

L: 45 + T: 15, TOTAL: 60 PERIODS

Books for study:

1. H. Goldstein - Classical Mechanics - Addison Wesley, II Edition (1980)
2. N.C. Rana and P.S. Joag - Classical Mechanics - Tata McGraw-Hill, I Edition , 1991.

References:

1. R. G. Takwale and P. S. Puranik – Introduction to Classical Mechanics - Tata McGraw - Hill Publishing Company Ltd. (1989).
2. L.D. Landau and E.M. Lifshitz, Mechanics, Buttorworth-Heinemann (1976).
3. I.C. Percival and D. Richards, Introduction to Dynamics, Cambridge University Press (1983).
4. J.V. Jose and E.J. Saletan, Classical Dynamics: A Contemporary Approach, Cambridge University Press (1998).
5. E.T. Whittaker, A Treatise on the Analytical Dynamics of Particles and Rigid Bodies, 4th edition, Cambridge University Press (1989).
6. A. Sommerfeld - Mechanics – Academic Press, 1952

PH1703 QUANTUM MECHANICS – I 3 1 0 4

UNIT I: Foundation of Quantum Mechanics 9

Inadequacy of classical mechanics, wave packets, uncertainty relations. Postulates of quantum mechanics. Schrodinger equations, probability interpretation, probability current density. Expectation values, Ehrenfest theorem, Stationary states. Hermitian operators and their properties, Eigen values and eigen functions .

UNIT II:One dimensional and three dimensional problems 9

Particle in a box, potential step, square well potential, rectangular barrier potential, Harmonic oscillator. Three dimensional problems- Spherically symmetric potential, Harmonic oscillator, spherical harmonics, hydrogen atom.

UNIT III: General formalism of Quantum Mechanics 9

Hilbert space, commutation relations, Representation of states and dynamic variables, Completeness of eigen functions. Dirac delta function, bra and ket notation, Time evolution, Schrodinger, Heisenberg and Interaction pictures. Unitary Transformation.

UNIT IV: Angular Momentum 9

Angular momentum, commutation relations, spin angular momentum, Eigen values of J^2 and J_z, Eigen values of J_+ and J_- ,Pauli's Matrices, Addition of angular momenta, Clebsch-Gordon coefficients.

UNIT V: Approximation Methods 9

Time independent perturbation theory for degenerate and non- degenerate states. Applications: Stark effect in hydrogen atom, Helium atom, Anharmonic oscillator; Variation method: Helium atom, WKB approximation-connection formulae.

L: 45 + T: 15, TOTAL: 60 PERIODS

Books for study:

1. L.I. Schiff, Quantum Mechanics, Tata McGraw Hill 3rd edition.
2. P.M. Mathews and K. Venkatesan, A Text Book of Quantum Mechanics, Tata McGraw Hill 2nd edition

Reference books:

1. E. Merzbacher, Quantum Mechanics 2nd edition
2. V.K. Thankappan, Quantum Mechanics, 2nd Edition
3. P.A.M. Dirac, The Principles of Quantum Mechanics.
4. J.L. Powell and B. Crasemann, Quantum Mechanics.
5. A.K.Ghatak and S.Lokanathan, Quantum Mechanics:Theory and applications.

PH1704 ELECTRONICS AND MICROPROCESSOR 3 1 0 4

UNIT I : Applications Op-amp 9

Op-Amp Circuits: Characteristics of ideal and practical op-amp; Nonlinear amplifiers using op-amps- Instrumentation amplifier - V to I and I to V converter - Op-amp circuits using diodes - Sample and Hold circuits – constant current source. Log and Antilog

amplifiers - Multiplier and Divider - Schimitt Trigger - Operating modes and functioning of 555 timer, Astable and Monostable Multivibrator - Triangular wave generators - Sine wave generators.

UNIT II : Converters **9**

Basic Summing Amplifier technique, Weighted D to A, BCD D/A Converter, Ladder R-2R network. Flash ADC and successive approximation ADCs, Integrating ADC/Dual Slope A/D Converter. Voltage Controlled Oscillator - voltage to time conversion - voltage to frequency conversion - frequency to voltage conversion.

UNIT III :Counters and Registers **9**

Asynchronous and Synchronous (up and down), Mode-N-counters, ring counters, Johnson counter and counters as frequency dividers. Basic shift resisters, Left right shift resistor, serial in and parallel out, Parallel in and serial-out, Parallel-in and Parallel-out shift resistors.

UNIT IV :Microprocessor – architecture **9**

Internal architecture of 8085 microprocessor – microcomputer system – microprocessor operation – system bus – control and status signals– pin out configuration – pin description – functional description- architecture – ALU – flags – registers.

UNIT V :Programming **9**

Programming model of 8085 microprocessor - Addressing modes – Instruction set of 8085: Data transfer instructions, Arithmetic instructions, Logical instructions, Branching instructions- Instruction data, format and storage - Sample programs.

L: 45 + T: 15, TOTAL: 60 PERIODS

Books for study:

1. Millman and Halkias, Integrated Electronics, McGraw-Hill, New Delhi. 2010
2. Ramesh S. Gaonkar. Microprocessor Architecture, Programming, and Applications with the 8085 5th Edition. 2003.

References:

1. Milman and Halkias, Fundamental of Electronics Devices, McGraw-Hill, New Delhi. 2001
2. William H.Gothmann Digital Electronics - An introduction to Theory and Practice --.
3. J. Millman, , Digital and Analog Circuits and Systems, McGraw-Hill, London. 1979
4. R P Jain, Modern digital electronics, Tata mac'Hill. 2003
5. J.D.Ryder, Electronics fundamental and application. 2004
6. Electronic Instrumentation, H.S. Kalsi, TMH (1995)
7. Virendra Kumar. Digital Technology, New Age International. 1995
8. Sunil Mathur, Microprocessor Architecture, Programming and Applications with the 8085, 5th Edition, 2003.

PH1771 GENERAL EXPERIMENTS AND ELECTRONICS 0 0 6 6

(Any 12 experiments)

1. Michelson Interferometer
2. Cauchy's constant- using spectrometer
3. Thermal conductivity
4. Dielectric Constant
5. Ultrasonic studies of liquid
6. Band gap determination
7. Hartmann's constant
8. Saw tooth wave generator
9. Square wave and triangular wave generator
10. Digital to Analog conversion
11. Astablemultivibrator – using IC 555 Timer and operational amplifier
12. Modulus N counter using IC-7490
13. Monostablemultivibrator – op amp
14. Flip flops using NAND gates
15. Wein's bridge oscillator
16. Universal shift register

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M.Sc. PHYSICS

CURRICULUM & SYLLABUS

SEMESTER – II

SL. NO.	SUBJECT CODE	SUBJECT	L	T	P	C
THEORY						
1.	PH1705	Mathematical Physics - II	3	1	0	4
2.	PH1706	Quantum Mechanics - II	3	1	0	4
3.	PH1707	Electromagnetic Theory	3	1	0	4
4.	PH1708	Thermodynamics and Statistical Physics	3	1	0	4
5.	XX17A1	Supportive Course - I	3	1	0	4
PRACTICAL						
6.	PH1172	Advanced Experiments	0	0	6	6
TOTAL CREDITS			**15**	**5**	**6**	**26**

PH1705 MATHEMATICAL PHYSICS – II 3 1 0 4

UNIT I: Integral Transforms 9

Fourier Transform – Properties –Derivatives –Sine and Cosine Transform – Convolution Theorem - Laplace Transform- Properties –Derivatives – Integral- Inverse Laplace Transform.

UNIT II: Partial Differential equations 9

Partial Differential Equations- Heat Flow Equation in 1D & 2D -Steady State solutions (Method of Separation of Variable) –Equation of Motion for Vibrating String – D' Alembert's Solution (Method of Separation Variable)- Oscillation of Hanging Chain and Vibration of Rectangular Membrane (problems)

UNIT III : Tensor Analysis 9

Transformation of Coordinates – summation convention – Contravariant, Covariant and mixed tensors – Rank of a tensor – Kronecker delta – Symmetric and anti-Symmetric tensors – Contraction of a tensor – Raising and lowering of suffixes – Metric tensor – Covariant formulation of electrodynamics – Application to the dynamics of a particle- Laws of Covariant Differentiation – Covariant Derivative of an Invariant –Tensor Form of Gradient, Divergence, Laplacian and Curl.

UNIT IV : Group Theory 9

Basic definitions – Sub groups – Cosets – Factor groups – Permutation groups – Cyclic groups – Homomorphism and Isomorphism – Classes of the group – Group representation – Reducible and irreducible representation – Symmetry elements and Symmetry operations – Schurz's lemma – Orthogonality theorem – Character of representation – Construction of Character table

UNIT V : Special Functions 9

Legueree, Bessel and Hermite differential equations and their solutions – Generating functions – Orthogonality relations – Important recurrence relations – Gamma and Beta functions

L: 45 + T: 15 = TOTAL: 60 PERIODS

Books for study:

1. L.A. Pipes and L.R. Harvill, *Applied Mathematics for Engineering and Physicists* (McGraw Hill, Singapore, 1967).
2. B.D. Gupta, *Mathematical Physics* (Vikas, Publishing House Pvt Ltd., New Delhi, 2003.
3. G. B. Arfken and H. J. Weber, *Mathematical Methods for Physicists, 6th Edition: A Comprehensive Guide* (Academic Press, San Diego 2005).

References:

1. A.W. Joshi, *Matrices and Tensors in physics* (New Age International (P) Ltd Publishers, New Delhi, 1995)
2. A.W. Joshi, *Elements of Group theory for physicists* (Wiley Eastern Ltd, New Delhi, 1988).

3. Dr. J.K. Goyal& K.P. Gupta *Laplace and Fourier transforms* (PragatiPrakashan, Meerut (U.P), India)
4. A.K. Gattak, T.C. Goyal and S.J. Chua, *Mathematical Physics* (Macmillan, New Delhi, 1995).

PH1706 QUANTUM MECHANICS - II 3 1 0 4

UNIT I: Perturbation Theory 9

Time dependent perturbation theory - Constant and harmonic perturbations - Transition probabilities - Selection rules for dipole radiation - Adiabatic and Sudden approximation ,Fermi Golden rule, The density matrix - Spin density matrix and magnetic resonance .

UNIT II: Scattering Theory 9

Scattering amplitude - Cross Sections - Born approximation - Partial wave analysis, Green's function, scattering for different kind of potentials, applications.

UNIT III: Identical particles and spin 9

Physical meaning of identity, Symmetric and asymmetric wave functions, Slater determinant, collision of identical particles, spin angular momentum, spin matrices and eigen functions, spin functions for many electron systems.

UNIT IV: Special topics in Radiation Theory 9

Semi-Classical theory of radiation, Transition probability for absorption and induced emission, Electric dipole and forbidden transitions, Selection rules.

UNIT V: Relativistic Quantum Mechanics 9

Klein-Gordon equation - Plane-wave solutions –Interaction with electromagnetic fields-Hydrogen like atoms. Dirac equation - Interpretation of negative energy states- Spin of electron -- Energy values in a Coulomb potential.

L: 45 + T: 15, TOTAL: 60 PERIODS

Books for study:

1. P.M. Mathews and K. Venkatesan, A text book of Quantum Mechanics. Tata MacGraw Hill 2nd edition.
2. L.I. Schiff, Quantum Mechanics, Tata MacGraw Hill 3rd edition.

Reference books:

1. E. Merzbacher, Quantum Mechanics, 2nd edition.
2. J.D. Bjorken and S.D. Drell, Relativistic Quantum Mechanics.
3. A.K.Ghatak and S.Lokanathan, Quantum Mechanics:Theory and applications.
4. V.Devanathan,Relativistic Quantum Mechanics and Quantum Field Theory .
5. P.A.M. Dirac, The Principles of Quantum Mechanics.
6. L.D. Landau and E.M. Lifshitz, Quantum Mechanics.

PH1707 ELECTROMAGNETIC THEORY 3 1 0 4

UNIT I : Electrostatics 9

Coulomb's law - Electric field – continuous charge distribution – Gauss's law – Applications of Gauss's law – electric potential - Poisson's equation - Laplace's equation – potential of a localized charge distribution- electrostatic boundary conditions – surface charge and force on a conductor – Cartesian coordinates – spherical coordinates – monopole and dipole terms - electric field of a couple.

UNIT II : Magnetostatics 9

Lorentz force law– Biot-Savart's law and Ampere's law– Magnetic vector potential - Multipole Expansion of the vector potential – Effects of a magnetic field on atomic orbits – Magnetization - Bound current and its physical interpretations – Ampere's law in Magnetised Material – magnetic susceptibility and permeability in linear media and non linear media – ferromagnetism.

UNIT III : Electrodynamics 9

Ohm's law – electromotive force - Electromagnetic induction – Faradays Laws – induced electric field – inductance - electrodynamics before Maxwell - Maxwell's Equation – Magnetic charge – Maxwell's equation in matter – the continuity equation – poynting's theorem – Newton's third law in electrodynamics - conservation of momentum – angular momentum.

UNIT IV :Electromagnetic Waves 9

Wave equation – sinusoidal waves – boundary conditions reflections and transmissions – polarization – wave equation for E and B – monochromatic plane waves - energy and momentum in electromagnetic waves – propagation in linear media - reflection and transmission at normal incidence – electromagnetic waves in conductors – reflection at a conducting surface – the frequency dependence of permittivity – wave guides.

UNIT V:Elecromagnetic Radiation 9

Radiation **–** electric dipole radiation – magnetic dipole radiation **–** radiation from an arbitrary source **-** power radiated by a point charge – radiation reaction – physical basis of the radiation reaction.

L: 45 + T: 15, TOTAL: 60 PERIODS

Book for study:

1. Introduction to Electrodynamics, David J Griffiths., Prentice Hall of India, 3rd Edition, 2012.

References:

1. Classical Electrodynamics, J.D. Jackson., Wiley Eastern Publication, second edition, 1975.
2. Foundations of electromagnetic theory, J.R. Reitz, E.J. Milford and R.W. Christy, 3rd Edition, Narosa Publication, New Delhi, 1986.
3. Electromagnetic fields and waves, P. Lorrain and D. Corson. CBS Publishers and

distributors, 1986.
4. Electrodynamics, B.P. Laud, New Age International Pvt. Ltd. 1987.
5. Principles of Electrodynamics, B. Chakraborty, Books and Allied, Kolkata, 2002.
6. Electromagnetic with Applications, J.D. Kraus and D.A. Fleisch, 5th Edition WCB McGraw-Hill, New York, 1999.
7. Fundamentals of Electromagnetic Theory, Saroj K.Dash and Smruthi R.Khuntia, PHI Learning Private Limited, New Delhi, 2010.

PH1708 THERMODYNAMICS AND STATISTICAL PHYSICS 3 1 0 4

UNIT I **9**

Review of thermodynamics – thermodynamics laws and its consequences –Gibb's free energy and Helmholtz' free energy – Thermodynamical potential – Phase-space –Micro canonical, canonical and grand canonical ensembles – Chemical potential – Density of states – Liouville's theorem – Probability consideration of tossing of distinguishable and indistinguishable coins – General expression for probability of distribution – Stirling's formula – Most probable distribution – Maxwell-Boltzmann's distribution law – Law of equipartition of energy.

UNIT II **9**

Quantum statistics of identical particles – Density matrix and limitations – Bose-Einstein distribution law – Black body radiation – Planck's radiation law – Specific heat of solids – Einstein theory – Debye's theory – Ideal Bose-Einstein gas – Degeneracy of Bose- Einstein gas – Bose-Einstein Condensation.

UNIT III **9**

Fermi-Dirac distribution law – Ideal Fermi-Dirac gas – Fermi energy – degeneracy – Weak degeneracy, strong degeneracy – Electron gas in metals – Thermionic emission of electrons – Specific heat of gases – monoatomic, diatomic and polyatomic gases – variation with temperature.

UNIT IV **9**

Relation between statistical and thermodynamical quantities – Partition function and thermodynamical quantities – Entropy mixing and Gibbs' paradox – Saucker-tetrode equation for entropy – Molecular partition function – Translational partition function – rotational and vibrational partition functions and applications.

UNIT V **9**

Fluctuations in thermodynamical quantities – one dimensional Random walk – Brownian movement – Fokker Planck equation – solution – Wiener – Khintchine theorem – Phase transition – The Ising model (one dimensional).

L: 45 + T: 15, TOTAL: 60 PERIODS

Books for study:

1. F.W. Sears and G. L. Salinger, Thermodynamics, Kinetic theory, and statistical Thermodynamics - Third Edition,NarosaPublishong House (1986).
2. A.K. Agarwal and Melvin Eisner - Statistical Mechanics – New Age International (P) Limited, New Delhi, 1998.

References:

1. Kerson Huang – Statistical Mechanics – John Wiley & Sons, Inc., New York, 1987, Second edition.
2. A.K.Dasgupta – Fundamentals of Statistical Mechanics – New Central Book Agency (P) Ltd., Calcutta, 2000.
3. Sears and Zymanski – Statistical Mechanics – McGraw Hill Book Company, New York, 1961.
4. Fundamentals of Statistical and thermal Physics – FederickReif. – McGraw Hill International Editions, Singapore, 1985.
5. F. Mandl - Statistical Physics – Second edition, ELBS & Wiley (1988).
6. R. K. Pathria and Paul D. Beale - Statistical Mechanics – Third edition, Academic Press (2011).

PH1772 ADVANCED EXPERIMENTS 0 0 6 6

(Any 12 experiments)

1. Determination of wavelength of laser beam
2. Determination of particle size, numerical aperture and loss calculation using laser beam.
3. Young's double slit experiment
4. Haidinger's fringes – Laser
5. Fraunhoffer diffraction- Laser
6. Spectrometer- Determination of refractive index of liquid
7. Hall effect- Determination of hall parameter
8. Guoy Balance
9. Four Probe Method
10. Measurement of lattice parameters and indexing of powder photograph
11. Quinck's Method
12. Hysteresis (B – H Curve)
13. Hyperbolic fringes
14. Elliptical fringes
15. BCD to Decimal display
16. Schmitt trigger Op-Amp and 555 Timer
17. GM counter

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M.Sc. PHYSICS

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SEMESTER – III

SL. NO.	SUBJECT CODE	SUBJECT	L	T	P	C
THEORY						
1.	PH1709	Numerical Methods	3	1	0	4
2.	PH1710	Condensed Matter Physics	3	1	0	4
3.	PH1711	Atomic and Molecular Physics	3	1	0	4
4.	PH1712	Nuclear and Particle Physics	3	1	0	4
5.	XX17A2	Supportive Course - II	3	1	0	4
PRACTICAL						
6.	PH1773	Microprocessor and C++ programming	0	0	6	6
TOTAL CREDITS			**15**	**5**	**6**	**26**

PH1709 NUMERICAL METHODS 3 1 0 4

UNIT I: Errors and the measurements 9

General formula for errors – Errors of observation and measurement – Empirical formula – Graphical method – Method of averages – Least square fitting – curve fitting – parabola, exponential.

UNIT II: Numerical solution of algebraic and transcendental equations 9

The iteration method – The method of false position – Newton – Raphson method – Convergence and rate of convergence - Simultaneous linear algebraic equations: Gauss elimination method – Jordon's modification – Gauss–Seidel method of iteration.

UNIT III: Interpolation 9

Linear interpolation – Lagrange interpolation Gregory – Newton forward and backward interpolation formula – Central difference interpolation formula – Gauss forward and backward interpolation formula – Divided differences – Properties – Newton's interpolation formula for unequal intervals.

UNIT IV: Numerical differentiation and integration 9

Newton's forward and backward difference formula to compute derivatives – Numerical integration : the trapezoidal rule, Simpson's rule – Extended Simpson's rule.

UNIT V: Numerical solutions of ordinary differential equations 9

Nth order ordinary differential equations – Power series approximation – Pointwise method – Solutions of Taylor series – Euler's method – Improved Euler's method – Runge-Kutta method – second and fourth order – Runge-Kutta method for solving first order differential equations

L: 45 + T: 15, TOTAL: 60 PERIODS

Book for study:

1. Numerical Mathematical Analysis (sixth edition) –James B.Scarborough, Oxford&IBH Publishing Co.Pvt.Ltd.

References:

1. Introductory Methods of Numerical analysis – S.S. Sastry, Prentice – Hall of India, NewDelhi (2003) 3rd Edition.
2. Numerical Methods in Science and Engineering – The National Publishing Co. Madras(2001).
3. Numerical Methods for Scientific and Engineering Computation- M.K.Jain,S.R.K.Iyengar,R.K.Jain ,New age International publishers limited.

PH1710 CONDENSED MATTER PHYSICS 3 1 0 4

UNIT I: Crystal Structure & Diffraction 9

Lattice Constant-symmetry operation-miller indices-Bravais lattice-Reciprocal lattice concept-Reciprocal Lattice to BCC, FCC Lattices-Brillouin zones-Brag and Laue diffraction and structure factor – bonding of solids-: molecular crystals, repulsive interaction, cohesive energy, ionic metallic and covalent crystals**.**

UNIT II: Lattice Vibrations and thermal properties 9

Vibrations of One Dimensional Diatomic Linear Lattice- determination of dispersion relations- quantisation of elastic waves -Acoustic and Optical Branches-Phonon momentum- density of states- Debye model of specific heat-thermal expansion-- thermal conductivity- Thermal resistivity of phonon gas – Fermi gas- Ohm's law, Widemann-Franz law-Umklapp process.

UNIT III: Free electron theory and semiconductors 9

Free electron theory: Bloch theorem, Fermi surface-nearly free electron model, classification of metal, insulator and semiconductor, Electron motion in a periodic potential - motion of electron in energy bands, effective mass, tight binding.Semiconductors-Conductivity of Semiconductor- Fermi level, Hall effect – thermoelectric power.

UNIT IV: Superconductors& magnetic materials 9

Superconductivity-Meissener effect -ElectronPhonon Interaction-Cooper Pairs- Type I and type II-BCS Theory-Energy Gap-Josephson Effect-High Temperature Superconductivity. Diamagnetism- Hund's rules-Quantum Theory of paramagnetism-exchange interaction, -Curie temperature-Ferromagnetism-Curie Weiss Molecular Field Theory-Heisenberg model-mean field theory-Domain Theory-magnons-Spin Waves-magnetic anisotropy energy, hysteresis-antiferromagnetic-Neel temperature.

UNIT V: Surface physics and phase transition 9

Defects: Classification-Point Defects-Schottky Defect-Frenkel Defect-Colour Centers-F Centre-Other in alkali halides- Dislocations: Slip and Plastic Deformation-Shear Strength of Single Crystals-Edge Dislocation-Screw Dislocation-Stress Field around an Edge Dislocation -Ordered phases of matter, translational and orientational order, kinds of liquid crystalline order.

L: 45 + T: 15, TOTAL: 60 PERIODS

Books for Study:

1. Introduction to Solid State Physics-C. Kittel-Wiley Eastern-New Delhi 8th Edition 2012.
2. Solid State Physics- S.O Pillai – New Delhi 6th edition 2005

References:

1. Solid State Physics-B.S. Saxena, R.C. Gupta & P.N. Saxena-PragatiPrakashan- Meerut 8th edition 2001

2.Solid State Physics-A.J. Dekker-Macmillan India 1995
3. Solid State Physics-S.L. Kahani& C. Hemaranjani-Sultan Chand & Sons
4.Solid State Physics-H.E. Hall-John Wiley & Sons
5. An Introduction to Solid State Physics & Its Applications-R.J. Elliot & A.P. Gibson-ELBS & Macmillan
6. Principles of Solid State-H.V. Keer-Wiley Eastern
7. Physics of Solids-C.A. Wert & R.M. Thomson-McGraw Hill 1600
8. Fundamentals of Solid State Physics-J.R. Christmann- John Wiley & Sons 1600

PH1711 ATOMIC AND MOLECULAR PHYSICS 3 1 0 4

UNIT I: Atomic & Microwave Spectroscopy 9

Electron spin; Stern-Gerlach experiment; Spectrum of hydrogen, helium and alkali atoms; Relativistic corrections for energy levels of hydrogen; Spectra of alkali metal vapours-normal Zeeman effect-anomalous Zeeman effect-Magnetic moment of atom and the G factor-Lande's 'g' formula-Paschen Back effect-Hyperfine structure of spectral lines-Stark effect. Hyperfine structure and isotopic shift; width of spectral lines; LS & JJ coupling;Microwave Spectroscopy-Experimental Method-Theory of Microwave Spectra of Linear, Symmetric Top Molecules-Hyperfine Structure-Quadrupole Moment-Inversion Spectrum of Ammonia.

UNIT II: Infrared & Raman Spectroscopy 9

IR Spectroscopy: Practical Aspects-Theory of IR Rotation Vibration Spectra of Gaseous Diatomic Molecules-Applications-Basic Principles of FTIR Spectroscopy-Raman Spectroscopy: Classical and Quantum Theory of Raman Effect-Rotation Vibration Raman Spectra of Diatomic and Polyatomic Molecules-Applications-Laser Raman Spectroscopy.

UNIT III: Electronic Spectra: Fluorescence & Phosphorescence Spectroscopy 9

Electronic Excitation of Diatomic Species-Vibrational Analysis of Band Systems of Diatomic Molecules-Deslandre's Table-Intensity Distribution-Franck Condon Principle-Rotational Structure of Electronic Bands-Resonance and Normal Fluorescence-Intensities of Transitions-Phosphorescence Population of Triplet State and Intensity-Experimental Methods-Applications of Fluorescence and Phosphorescence.

UNIT IV: NMR Spectroscopy 9

NMR Spectroscopy: Quantum Mechanical and Classical Description-Bloch Equation-RelaxationProcesses-Experimental Technique-Principle and Working of High Resolution NMR SpectrometerChemical Shift

UNIT V: ESR &Mossabauer Spectroscopy 9

ESR Spectroscopy: Basic Principles-Experiments-ESR Spectrometer-Reflection Cavity and Microwave Bridge-ESR Spectrum-Hyperfine Structure-Electron spin resonance Mossabauer Spectroscopy: Mossabauer Effect-Recoilless Emission and Absorption-

Mossabauer Spectrum-Experimental Methods-Hyperfine Interaction-Chemical Isomer Shift-Magnetic Hyperfine and Electric Quadrupole Interaction

L: 45 + T: 15, TOTAL: 60 PERIODS

Books for Study:

1. Fundamental of molecular spectroscopy – C.B.Banwell
2. Molecular structure and spectroscopy-G.Aruldhas 2004 edition.

Books for Reference:

1. Spectroscopy: Volumes I, II and III-B.P. Straugham& S. Walker
2. Introduction to molecular spectroscopy - G.M.Barrow.
3. Atomic Physics - J.B.Rajam, S.Chand Publications.

PH1712 NUCLEAR AND PARTICLE PHYSICS 3 1 0 4

UNIT I: Nuclear models 9

Binding energy, semi-empirical mass formula; Liquid drop model; Fission and fusion; Nuclear stability –Bohr-Wheeler theory of Nuclear Fission –Magic numbers – Evidence for magic numbers – Shell model - Collective nuclear model.

UNIT II: Nuclear Radiations 9

Introduction, Ionization chamber, Geiger-Muller counter, Scintillation Counters, Bubble chamber, Gamow's theory of alpha decay – Fermi theory of beta decay - selection rules – Neutrino hypothesis – Parity violation – Multipole radiation – Selection rules - Nuclear isomerism - Disintegration energy Calculation for alpha, beta and gamma decay.

UNIT III: Nuclear forces 9

Introduction- Nature of the nuclear force - Meson theory of nuclear forces– n-p scattering at low energies–scattering length– phase shift analysis – spin dependence – shape independent effective range theory of n-p scattering – p-p scattering at low energies – Saturation of nuclear forces.

UNIT IV: Nuclear Reaction 9

Types of nuclear reactions – Nuclear reaction kinematics – Compound nuclear theory – Reciprocity theorem – Resonance Scattering – Breit- Wigner dispersion formula – Classification of Neutrons – Neutron Sources – Neutron Diffusion – Neutron current density – Fermi age Equation – Four factor formula – Critical size of a reactor – reactor buckling – Classification of Nuclear reactors

UNIT V :Elementary Particles 9

Elementary particles (quarks, baryons, mesons, leptons); Spin and parity assignments, isospin, strangeness; Gell-Mann-Nishijima formula; C, P, and T invariance and applications of symmetry arguments to particle reactions –Quark Theory

L: 45 + T: 15, TOTAL: 60 PERIODS

Books for study:

1. Nuclear Physics, D. C Tayal, Himalaya Publications.
2. Elements of Nuclear Physics, M. C. Pandia and R. P. S YadavKedarnath.

References:

1. Concepts of Nuclear Physics, Bernard L Cohen, Tata McGraw-Hill
2. Nuclear Physics an Introduction, S. B. Patel, Wiley Eastern Ltd.
3. Nuclear Physics, R. R Roy and B. P. Nigam. New Age International Ltd.

PH1773 MICROPROCESSOR AND C++ PROGRAMMING 0 0 6 6

(Any 12 experiments)

1. 8 bit addition
2. 8 bit subtraction
3. 8 bit multiplication
4. 8 bit division
5. Ascending order
6. Descending order
7. Biggest number
8. Smallest number
9. Stepper motor interface
10. Display of any character
11. Rolling Display
12. Evaluation of area under the curve using Simpson's (1/3) rule
13. Evaluation of area under the curve using Simpson's (3/8) rule
14. Evaluation of area under the curve using Monte Carlo Method
15. Evaluation of the Q factor and Bandwidth using LCR series
16. Solution of Radioactive decay problem using Runga-Kutta Method
17. Current in a network

NOORUL ISLAM CENTRE FOR HIGHER EDUCATION

NOORUL ISLAM UNIVERSITY, KUMARACOIL

M.Sc. PHYSICS

CURRICULUM & SYLLABUS

SEMESTER – IV

SL. No.	Course Code	Course Title	L	T	P	C
1.	XX17E1	Elective I	4	1	0	5
2.	XX17E2	Elective II	4	1	0	5
PRACTICAL						
3.	PH17P1	Project and Viva - Voce	0	0	12	6
TOTAL			**8**	**2**	**12**	**16**

NOORUL ISLAM CENTRE FOR HIGHER EDUCATION

NOORUL ISLAM UNIVERSITY, KUMARACOIL

M.Sc. PHYSICS

LIST OF ELECTIVES

LIST OF SUPPORTIVE COURSES						
1.	PH1713	Basic Biophysics	3	1	0	4
2.	PH1714	Renewable energy	3	1	0	4
3.	CH1708	Chemistry and Industry	4	0	0	4
4.	CH1712	Chemistry and Environment	4	0	0	4
LIST OF ELECTIVES						
1.	PH17A1	Lasers and Applications	4	1	0	5
2.	PH17A2	Crystal growth and characterization techniques	4	1	0	5
3.	PH17A3	Molecular Biophysics and Biophysical methods	4	1	0	5
4.	PH17A4	Solar Photovoltaics	4	1	0	5
5.	PH17A5	Astronomy and Astrophysics	4	1	0	5

PH1713 BASIC BIOPHYSICS 3 1 0 4

UNIT I: Basics of Biophysics 9

Role of biomolecules in biological functions, Atoms bonds, types of bonds, molecular configuration and conformation, structural isomerism, geometrical isomerism, optical isomerism, optical activity, basis of molecular interactions, Lennard –Jones potential, various bonds involved in structural stabilization of biomolecules.

UNIT II: Proteins 9

Structure and properties of amino acids, peptide unit, allowes conformation for a pair of links peptide units, Ramachandran contact criteria and Ramachandran map, Primary Secondary Tertiary and Quaternary structure of proteins stabilizing forces in proteins, globular and fibrous proteins.

UNIT III: Nucleic acids 9

Nucleotides, Double helical structure of DNA, Watson and Crick model, base pairing and base stacking, Interactions stabilizing the structure of DNA, A,B and Z forms of DNA, structure of tRNA.

UNIT IV: Carbohydrates 9

Structure and conformations of monosaccharide's chair and boaf conformations Disaccharides, glycosidic linkage and glycosidic torsional angles, conformational map for disaccharides , oligosaccharide and polysaccharide structure of cellulose and amylose glycoproteins and glycolipids.

UNIT V: Biological Databases 9

Database in proteins, Sequence database, Structural database, sequence comparison methods Nucleic acid database, Human genome mapping project, carbohydrate database.

L: 45 + T: 15, TOTAL: 60 PERIODS

Basic for Study and References:

1. Basic Biophysics
   Vasantha Pattabhi and N. Goutham,
   Alpha Sceince International,2002
2. P.Narayanan
   Essentials of Biophysics
   New Age Interantional,2000
3. Biochemistry
   Jeremy M.Berg, John L.Tymoczko and Lubert Srryer
   W.H.Freeman 2002, 5th Edition
4. www.3DS DSCAR.ORG
5. Conformations of Carbohydrates
   R.Chandrasekarans, P.V.Balaji, P.K.Qasba and V.S.R.Rao
   Harwood Academic Press, 1998

PH1714 RENEWABLE ENERGY 3 1 0 4

UNIT I: Energy 9

Energy – forms of energy – measurement - non-renewable energy and renewable energy –types and sources. Energy conservation- carbon sequestration.

UNIT II: Solar Energy and Geothermal Energy 9

Solar thermal energy - various methods of using solar energy – photovoltaic cell, solar cooker and water heater - artificial photosynthesis - advantages and disadvantages of solar energy. Geothermal energy – resources - geothermal exploration - geothermal heat pump - types - geothermal desalination - advantages and disadvantages of geothermal energy.

UNIT III: Wind Energy and Wave Energy 9

Wind energy – wind turbine – types - factors affecting efficiency of wind turbines – wind farm – capacity factor- factors affecting. Wave energy - wave motion– wave power formula, wave energy and energy flux. Ocean Thermal Energy Conversion (OTEC) – ocean wave energy devices -OTEC power generation.

UNIT IV: Hydro Energy and Biomass 9

Hydropower –generation methods - types of turbine - power calculation - advantages and disadvantages. Biomass – conversion process – types - biomass for power and heat – biofuels – types of biofuels - advantages and disadvantages.

UNIT V: Hydrogen Energy and Fuel Cell 9

Hydrogen as a renewable energy source - sources of hydrogen - hydrogen production - direct electrolysis of water - thermal decomposition of water - biological and biochemical methods. Storage of hydrogen. Fuel cell – working principle – Types of fuel cells and applications. advantages and disadvantages of fuel cells.

L: 45 + T: 15, TOTAL: 60 PERIODS

Reference Books:

1. G. N. Tiwari, Rajeev Kumar Mishra. Advanced Renewable Energy Sources. Royal Society of Chemistry, 2011
2. D. Mukherjee. Fundamentals of Renewable Energy Systems. New Age International, 2007
3. S. A. Abbasi, Naseema Abbasi. Renewable Energy Sources and Their Environmental Impact. PHI Learning Pvt. Ltd., 2004
4. S. L. Sah. Renewable and Novel Energy Sources. M.D. Publications Pvt. Ltd., 1995
5. Paul Komor. Renewable Energy Policy. iUniverse, 2004
6. Tushar K. Ghosh, Mark A. Prelas. Energy Resources and Systems Volume 2: (2011), springerlink
7. Dr. Sathyajith Mathew Wind Energy Fundamentals, Resource Analysis and Economics (2006), springerlink

8. S.P. Sukhatme. Solar Energy Priciples of Thermal Collection and Storage, ,2nd Ed. TMH
9. N.K Bansal, M. Kleemanm & M. Melss, Renewable Energy Source and Conversion Technology, TMH.
10. G.T. Wrixon, A.M.E. Rooney & W. Palz, Renewable Energy. Springer Verlag 2000
11. D.O.Hall and R.P. Overeed. Biomass Renegerable Energy – (John Wiley and Sons, New york, 1987)

CH1708 CHEMISTRY AND INDUSTRY 4 0 0 4

Unit-I: Petroleum Products 9

Petroleum –its occurrence, mining, composition and classification; distillation of crude petroleum; gaseoline for motor and aerroplanes, diesel and kerosene knocking and anti-knocking; octane number;pyrolysis of heavy oil and production of gasoline

Unit-II: Plastics 9

Natural and Synthetic polymers, plastics – thermosetting and thermoplastic and their general methods of preparation; synthesis of important plastics and their applications-polythene,polypropylene,nylon,polyester,PVC and Bakelite, melanin plastics

Unit-III: Soaps and Detergents 9

Soap – hard& Soft –manufacture; toilet,laudery,shaving and other types of soaps; cleaning action of soap

Detergents-their different types and manufacture

Unit –IV: Fertilizers 9

Fertilizers' –different types and their requirements; manufacture of urea ammonium phosphate, superphosphate and potassium sulphate and their utilization complexes fertilizers; micronutrients

Unit –V: Cement 9

Portland and other types of cement; manufacture of Portland cement- wet and dry processes; settling of cement; cement industry in india.

L: 45 + T: 15, TOTAL: 60 PERIODS

References

1. B.K Sharma, Industrial chemistry, Goel publications,Ist revised Edn ,1993
2. M.G, Arora,M,Singh,Industrial chemistry Vol, . 1& 2 Anmol publications. Ist Edn, 1994
3. B.N.Chakrabarthy,industrial chemistry, Oxford & IBH,5th reprint 1991.

CH1712 CHEMISTRY AND ENVIRONMENT 4 0 0 4

Unit I – Environment and Ecology

Introduction to environment – concept and scope, environmental segments. Ecosystem and environment. The natural cycles (H_2O, O_2, N_2) of environment. Environmental pollution and its classification.

Unit II – Air Pollution

Atmosphere – composition, structure and evolution; green house effect and global warming; photochemical smog and acid rain. Ozone hole and El Nino phenomenon. Different types of air pollutants and sources; air quality standards.

Unit III – Water Pollution

Different types of water pollutants and sources. Eutrophication; heavy metal ions (Hg, Pb and Cr) poisoning; fluoride and defluoridation. Water quality standards.

Unit IV – Soil Pollution

Composition of soil; micro and macronutrients; wastes and pollutions in soil; disposal of municipal, medical and industrial wastes. Plants as indicators of soil pollution.

Unit V- Environmental Restoration

Environmental restoration; recycling and further use of waste. Conservation of forests and wild life. The state of global environment and earth summit.

References:

1. K. De, Environmental Chemistry, New Age publishers, New Delhi, 3, 4 & 5th Edn., 2003.
2. K. Sharma and H. Kaur, Environmental Chemistry, Goel Publishing House, Meerut, 3rd Edn., 1996.
3. G. S. Sodhi, Environmental Chemistry, Narosa Publishing House, New Delhi, 2000.

PH17A1 LASERS AND APPLICATIONS 4 1 0 5

UNIT I: Principles and Types of Lasers 9

Introduction*:* spontaneous and stimulated emission, Einstein Relations, population inversion – Pumping threshold condition, Properties:temporal and spatial coherence, directionality – Types of lasers:ruby laser, helium-neon laser, Nd-YAG laser, CO2 laser,dye lasers, semiconductor lasers.

UNIT II: Holography 9

Basic principle of holography – Recording and reconstruction of a hologram– applications of holography – Holographic Non-Destructive Testing – holographic storage

– optical disk storage –Non-Linear Optics – Harmonic generation - Second harmonic generation.

UNIT III: Fibre Optics **9**

Optical fibre principle – concept of an optical wave guide – types of fibres –properties – fiber optical communication – fibre amplifiers –Losses in fibers – Splicing – Fiber-optic sensors: intensity-phase polarization and frequency dependent techniques.

UNIT IV: Lasers in Science **9**

Saturation spectroscopy – excited state spectroscopy – nonlinear spectroscopy – time domain and its applications – stimulated Raman emission – laser fusion – isotope separation – medical applications, photo-chemical applications.

UNIT V: Lasers in Industry **9**

Materials processing – drilling, cutting, welding – alloying – glazing – oblation – laser chemical vapour deposition (LCVD) – laser thermal deposition – hardening, annealing – laser tracking – LIDAR.

L: 45 + T: 15, TOTAL: 60 PERIODS

References

1. K. Thyagarajan and A.K. Ghatak, Lasers Theory and Applications, Mcmillan (1981).
2. Lasers and Non-Linear optics – B.B. Laud Wiley Eastern
3. K. Koebner (ed.), Industrial Applications of Lasers, Wiley (1984).
4. Principles of Lasers – O.Svelto.
5. J.T. Cuxon and D.E. Parker, Industrial Lasers and their Applications, Prentice Hall (1985).
6. B. Culshaw, Optical Fiber Sensing and Signal Processing, Peter Peregrinus Ltd. (1984).
7. F.C. Appard, Fiber Optics Handbook, McGraw-Hill (1989).

PH17A2 CRYSTAL GROWTH AND CHARACTERIZATION TECHNIQUES **4 1 0 5**

UNIT I: Crystal growth in Gel media **9**

Crystal growth in gel media – Advances in gel growth –Methods of gel growth – Theory of Nucleation – Homogeneous and heterogeneous nucleation – Nucleation control – Morphologies of gel grown crystals.

UNIT II : Crystallization from Solution **9**

Introduction – basic requirements – crystallization apparatus –crystal growth methods – the chemical physics of crystal growth – saturation and seeding – Solid growth techniques – Melt growth techniques – solution growth methods – low and high temperature solution growth – Vapour phase growth – Epitaxial growth techniques.

UNIT III: Crystalline Perfection **9**

Crystalline defects – volume, surface, line and point defects –Grain Size Determination– Stacking Faults –Threshold concentration of defects in crystals –Internal Stresses – Methods of detecting imperfections

UNIT IV: Electrical and Microscopic characterization **9**

Electricalproperties: Two probe method, Fourprobemethod; Microscopic properties– Magnification – resolution – Rayleigh criteria – optical microscope – scanning electron microscope – elemental analysis –transmission electron microscope – applications for each technique.

UNIT V: Spectroscopic Characteization Techniques **9**

Structural , Optical and Thermal Investigations- XRD,Fourier Transform Infrared spectrometer – Raman spectroscopy, UV-Vis-NIR spectrophotometer – thermogravimetric analysis – differential thermal analysis – differential scanning calorimetry – applications for each technique.

References:

1. "Crystals in gels and Liesegang rings", Heinz K. Henisch, Cambridge University Press, Cambridge, 1988
2. " Crystal growth in gel media", A. R. Patel and A. VenkateswaraRao, Bulletin of materials science, 4(5), 1982, P. 527 to 548.
3. "Crystal growth" edited by Brain R. Pamplin (II edn.)Pergman Press, Oxford, 1980.
4. Fundamentals of Molecular Spectroscopy, C.N. Banwell, and E.M. McCash, Tata McGraw Hill, Fourth Edition (1995).
5. Thermal Analysis, B. Wunderlich, Academic Press Inc. (1990)
6. Materials Characterization Techniques, Sam Zhang, Lin Li and Ashok Kumar, CRC Press (2008).
7. Electron and Ion Microscopy and Microanalysis Principles and Applications, Lawrence E. Murr, Marcel Dekker Inc., New York (1991).
8. Characterization of Materials, Shirley Jackson, Wiley Online Library, Second Edition (2003).

PH17A3 MOLECULAR BIOPHYSICS AND BIOPHYSICAL METHODS **4 1 0 5**

UNIT I : Basics of Biophysics **9**

Amino acids, nucleic acid bases, saccharides and lipids –Biomolecules in biological functions – Geometry of biomolecules – Conformation and Configuration – Lennord-Jones potential – Basis of molecular interactions – Various bonds involved in structural stabilization of biomolecules

UNIT II : Proteins **9**

Structure and properties of Amino acids - Structure and Conformation of proteins - Primary, secondary, tertiary and quaternary Structures - main chain and side chain torsion angles – Allowed conformations for a pair of linked peptide units – Ramachandran contact criteria and Ramachandran map – Alpha helix, beta sheet, turns – globular and fibrous proteins – Protein databases.

UNIT III : Nucleic acids **9**

Base pairs - nucleotides – Double helical Structure of DNA, Watson and Crick model - base pairing and base stacking, Interactions stabilizing the structure of DNA – DNA polymorphism - A, B and Z forms – DNA Supercoiling – circular DNA – Environmental effects on DNA – tRNA and ribosomal RNA

UNIT IV : Carbohydrates **9**

Structure and conformations of Monosaccharides, Disaccharides and oligosaccharides – chair, boat and other conformations of saccharides – Glycosidic torsional angles – Conformational map for disaccharides – Detailed structure of polysaccharides, cellulose, amylose, chitin, xylan – Glycosylation-Types of Glycosylation-Importance of Glycosylation-Carbohydrates as integral part of biological systems, glycoconjugates – Glycoproteins, glycolipids.

UNIT V : Biophysical Methods **9**

Fundamentals of X-ray diffraction – Protein Crystallography – X ray fibre diffraction in determining macromolecular structure – Basic principle of NMR spectroscopy, Experimental technique and Instrumentation, Chemical shift, Spin-Spin coupling, Relaxation process – Nuclear Overhauser Effect – Applications of NMR spectroscopy – Electron Microscopy-TEM, SEM-CD and ORD.

References:

1. Biophysics by VasanthaPattabhi, Gautham N, Narosa Publishing House, 2nd Edition,2011
2. Biophysics: An Introduction by Rodney Cotterill, John Wiley & Sons, 2003
3. Elementary crystallography by D. Velmurugan Edition 1, 2008, MJP Publications.
4. Essentials of Biophysics by P. Narayanan, New Age International Publishers,2000
5. Lehninger Principles of Biochemistry by David Lee Nelson, Albert L. Lehninger& Michael M. Cox, 5th Edition, W.H. Freeman,2008
6. J.M. Berg, J.L. Tymoczko and L. Stryer, Biochemistry, Edition: 5, 2002.

PH17A4 SOLAR PHOTOVOLTAICS 4 1 0 5

UNIT I: Solar Radiation 9

The Sun as a source of radiation, Extra-terrestrial solar radiation, solar spectrum at the Earth's surface, Basic Sun-Earth angles, Depletion of solar radiation by atmosphere, Diffuse radiation at the ground, Estimating solar radiation empirically, Measurement of global, diffuse and direct solar radiation.

UNIT II: Physics of Solar Cells 9

Photovoltaic effect, PV cell circuit model, P-N junctions, Depletion region, Enegry Band diagram, Charge movement and Current densities, I-V characteristics in dark and light, Irradiation and temperature on I-V characteristics, P-N junction under illumination, I-V equations of Solar Cells.

UNIT III: Solar cell types and Fabrication methods 9

Types: Crystalline and Amorphous Silicon cells, II-VI cells, Thin film solar cells- CdTe and CIGS. Organic solar cells, Dye-sensitized solar cells

Fabrication Methods: Growth of crystalline silicon by Czochralski, Float- zone method, Thin film deposition by thermal evaporation, sputtering and spray pyrolisis. Epitaxial growth methods, MBE, MOCVD.

UNIT IV: Design and Analysis 9

Solar cell parameters-short circuit current, open circuit voltage, fill factor, efficiency; Losses in a solar cell- effect of series and parallel resistance and temperature on efficiency, Solar cell design –design for high I_{sc},V_{oc} and fill factor; quantum efficiency measurements.

UNIT V: PhotoVoltaic systems and Applications 9

PV modules, PV systems- Stand-Alone PV systems, Grid-connected PV systems, PV applications- Grid-connected power plants, off grid system for rural electrification, battery charging, solar car, solar powered satellites.

References:

1. Chetan Shingh Solanki, Solar Photovoltaics Fundamentals,Technologies and Applications, PHI Learning Pvt Ltd,New Delhi.
2. J. Nelson, Physics of Solar Cells, Imperial college press,2003
3. H.P.Garg and J.Prakash, Solar Energy: Fundamentals and Applications
4. J.Balfuor,M.Shaw,S.Jarasola, Introduction to Photovoltaics
5. G.N.Tiwari, Solar Energy, Narosa Publishing House,2002

PH17A5 ASTRONOMY AND ASTROPHYSICS 4 1 0 5

UNIT I: General Astronomy 9

System of Coordinates – Time – Stellar Parallaxes – The Proper Motion – Stellar Magnitudes – Stellar Classification – Saha's ionization formula. (Page: 1-38 –V. B. Bhatia)

UNIT II: Stellar Atmosphere I 9

Stellar Masses – RadiativeTransfer – Local Thermodynamic Equilibrium - DetailedBalancing – Basic Definitions –Energy Density – Mass Emission Coefficient – Mass Absorption Coefficient – Equation of Transfer –Solution of Transfer – Chandrasekhar's Method.(Page: 55-110 –V. B. Bhatia)

UNIT III: Stellar Atmosphere II 9

Model Atmosphere–Theory of Absorption Lines –Basic Theory – Line Formation –The Line Profile –Collisional Broadening –Doppler Broadening –Natural Broadening – Virial Theorem.(Page: 114-146 –V. B. Bhatia)

UNIT IV: Stellar Structure 9

Hydrostatic Equilibrium–Thermodynamics of a Mixture of Gas and radiation –Radiative and Convective Transport of Energy –Standard Model –Convective Energy Transport – Mixing Length.(Page: 146-190 –V. B. Bhatia)

UNIT V: Stellar Energy and Nucleosynthesis 9

Energy Sources –Helmholtz-Kelvin Hypothesis –Nuclear Reactions as a Possible Energy Source–Energetics of Nuclear Reactions –Reaction Cross-Section and Reaction Rates – The Neutrino Problem –Nucleosynthesis–Origin of Elements.(Page: 191-252 –V. B. Bhatia)

Book for Study:

(1) Text book of Astronomy and Astrophysics with elements of Cosmology, V. B.Bhatia, Narosa Publishing House, New Delhi, 2001.

References:

(1) An Introduction to Astrophysics, Second Edition,BaidyanathBasu, TanukaChattopadhyay, SudhindraNathBiswas, PHI Learning Private Limited, New Delhi 2010.

(2) An Introduction to Astrophysics, BaidyanathBasu, Prentice Hall of India Private Limited, New Delhi 2003.

(3) Astrophysics for Physicists, ArnabRaiChoudhuri, Cambridge University Press, New Delhi 2010.

(4) Particle Astrophysics, Donald Perkins, Oxford University Press, New York 2003.

(5) Modern Astronomy, C. Sivaram, KenathArun, Ane Books Pvt. Ltd.,New Delhi 2009.