M.Sc. Physics

Subject Code	Subject	Credits
	I SEMESTER	
MPY - 11	Classical Mechanics & Statistical Mechanics	4
MPY - 12	Mathematical Physics	3
MPY - 13	Digital Electronics & Microprocessors	4
MPY - 14	Electromagnetic Theory	4
MPY - 15	Laboratory-Basic Physics Laboratory-I	4
	II SEMESTER	
MPY - 21	Solid State Physics	3
MPY - 22	Nuclear Physics	4
MPY - 23	Quantum Mechanics	4
MPY - 24	Laser and OPTO-Electronics	4
MPY - 25	Laboratory-Electronics Laboratory	4
	III SEMESTER	
MPY - 31	Advanced Nuclear Physics	4
MPY - 32	Classical Mechanics	4
MPY - 33	Quantum Mechanics-I	4
MPY - 34	Electrodynamics	3
MPY - 35	Laboratory-Atomic and Molecular Physics	4
	IV SEMESTER	
MPY - 41	Quantum Mechanics-II	4
MPY - 42	Radio Physics and Electronics Special	4
MPY - 43	Computer Application in Physics-I	4
MPY - 44	Project	5
	Grand Credits	**74**

M.Sc. Bio Chemistry

Subject Code	Subject	Credits
	I SEMESTER	
MBC -11	Basic Biology	3
MBC -12	Biomolecules & Enzymology	3
MBC -13	Cell Biology & Bioenergetics	4
MBC -14	Physicochemical techniques, Statistics& Thermodynamics	3
MBC -15	Physico-chemical Techniques	4
MBC -16	Enzymology	4
	II SEMESTER	
MBC -21	Microbiology & Virology	3
MBC -22	Molecular Biology	4
MBC -23	Immunology	3
MBC -24	Intermediary Metabolism	3
MBC -25	Microbiology	3
MBC -26	General Biochemistry, Biophysics &	
	III SEMESTER	
MBC -31	Microscopy & Spectroscopy	3
MBC -32	Biotechnology	3
MBC -33	Cellular Signaling	4
MBC -34	Medical Biochemistry	3
MBC -35	Molecular biology	4
MBC -36	Clinical Biochemistry & Biophysics	
	IV SEMESTER	
MBC -36	Developmental Biology & Human Genetics	3
MBC -36	Bio informatics & Computational Biology	3
MBC -36	Unit I: Plant Biochemistry Unit II: Neuro biochemistry	4
MBC -36	Computational Techniques	3
MBC -36	Project / Seminar	5
	Grand Credits	**79**

M.Com Computer Application

Subject Code	Subject	Credits
	I YEAR	
MCO -11	Principles of Management	4
MCO -12	Business Policy and Environment	3
MCO -13	Accounting-Theory and Practice	4
MCO -14	E-Commerce	4
MCO -15	Database Management System	4
MCO -16	Computer Applications Practicals I – MS Office & Tally	4
	II YEAR	
MCO -21	Financial Management	4
MCO -22	Industrial Relations	4
MCO -23	Labour Legislation	4
MCO -24	Organisational Behaviour	3
MCO -25	Visual Basic	4
MCO -26	Computer Applications Practicals II	
	Grand Credits	**46**

KARANATAKA STATE OPEN UNIVERSITY

M.SC PHYSICS

SYLLABUS

Syllabus & Regulations Governing 'M.SC PHYSICS

1. Title of the Program: **M.SC PHYSICS**
2. Duration of the Program: 2 **Year**
3. Nature of the Program: **Semester System**
4. Eligibility Conditions**: B.Sc (PHYSICS)**
5. Allocation of Credits – **Total -74- Credits**
6. Evaluation System :

   The distribution of marks for evaluation in each subject shall be as follows –

Theory Subjects :

Internal assessment marks	20
Term End University Examination marks	80

Practicals :

Internal assessment (for each practical) marks	20
Term End University Examination marks	80

Project :

Internal Assessment marks	50
University Examination marks	150

Minimum for pass :32 marks per course in theory and aggregate 40% including assessment
Course exemption : 40% marks and above in each course

7. Academic Structure

Subject Code		Course Title	Credits	Marks		
I SEMESTER	1.1	Classical Mechanics and Statistical Mechanics	4	20	80	100
	1.2	Mathematical Physics	3	20	80	100
	1.3	Digital Electronics & Microprocessors	4	20	80	100
	1.4	Electromagnetic Theory	4	20	80	100
	1.5	Laboratory-Basic Physics Laboratory-I	4	20	80	100
II SEMESTER	2.1	Solid State Physics	3	20	80	100
	2.2	Nuclear Physics	4	20	80	100
	2.3	Quantum Mechanics	4	20	80	100
	2.4	Laser and OPTO-Electronics	4	20	80	100
	2.5	Laboratory-Electronics Laboratory	4	20	80	100
III SEMESTER	3.1	Advanced Nuclear Physics	4	20	80	100
	3.2	Classical Mechanics	4	20	80	100
	3.3	Quantum Mechanics-I	4	20	80	100
	3.4	Electrodynamics	3	20	80	100
	3.5	Laboratory-Atomic and Molecular Physics	4	20	80	100
IV SEMESTER	4.1	Quantum Mechanics-II	4	20	80	100
	4.2	Radio Physics and Electronics Special	4	20	80	100
	4.3	Computer Application in Physics-I	4	20	80	100
	4.4	Project	5	50	150	200

I Year-I Semester

M.SC. PHYSICS

I YAER

SUBJECT CODE: 1.1

SUBJECT: CLASSICAL MECHANICS AND STATISTICAL MECHANICS

UNIT I

Newtonian mechanics of single and many body systems - conservation laws -work energy theorem -constraints - De'Alembert's principle and Lagrangian equation -application of Lagrangian equation to simple pendulum and Atwood's machine - varia-tional principle - derivation of Lagrangian equation from Hamilton's principle.

UNIT II

Hamilton's equation from variational principle - principle of least action - canonical transformation generating function - group properties - Poisson's bracket and theorem - angular momentum Poission bracket - Hamilton - Jacobi equation - Hamilton's principle functions - application to harmonic oscillator.

UNIT III

Rigid body motion - spinning top motion - independent coordinate of rigid bodies - orthogonal transformation - central force problem -definitions and characteristics - equation of motion and first integrals - Kepler's problems - inverse square law of forces - motion in time in Kepler's problem - scattering in a central force field.

UNIT IV

Contact between statistical and thermodynamics of the system - classical ideal gas - Gibb's paradox - micro canonical ensemble - phase space - trajectory and density of states - canonical and grand canonical ensembles - micro and macro states - Sterling’s formula - most probable distributions j M-B distrjpution - law of equipartition of energy.

UNIT V

Bose - Einstein statistics - black body radiation arid photon statistics - specific heat of solids - Dulong and Petits law f Einstein's theory of specific heat - Debye's theory of specific heat - BE condensation - Fermi-Dirac statistics- equation of states of ideal gas - high temperature and low density - low temperature and high density - theory of electron gas - statistics of occupation number - calculation of thermodynamic quantities.

REFERENCE BOOKS:

1. Classical Mechanics - N.C. Rana and P.S. Joag (Tata McGraw-Hill, 1991)
2. Classical Mechanics - H. Goldstein (Addition Wesley, 1980)
3. Principles of Mechanics - Synge and Griffith '
4. Introduction to Classical Mechanics - R.G. Takwale and P.S. Puranik
5. Thermodynamics Searls and Salinger
6. Statistical Mechanics - Kerson and K. Huang
7. Statistical Mechanics-R.K. Pathria
8. Statistical Mechanics - Sears and zymanski

9.Statistical Physics - A.K. Agarwal and Melvin Eisner

SUBJECT CODE: 1.2

SUBJECT: MATHEMATICAL PHYSICS

UNIT I

Vector spaces matrices and tensors - linear independence - inner product- Schwartz inequality - matrix representation of vector and linear operators with respect to basis - change of basis - Schmidt orthogonalization - matrices - unitary - Hermitian sym- metric matrices - orthogonal matrices - inverse of a matrix-matrix multiplication-rotation matrices - eigen values and eigen vectors - concept of orthogonal sets of functions - tensors - basic ideas of contravariant- covariant and mixed tensors.

UNIT II

Power series solution - power series solution of – Legendre – Hermite – Le Lageurre - Hermite polynomials – recurrence relations – generating functions-orthogoMlity conditions.

UNIT III

Partial differential equations - separation of variables - heat conduction problem - variable linear flow two and three dimensional heat flow – temperature inside circular and rectangular plates - cooling of hot brick - electrical analogy of heat flow – current density and total current in a wire - skin effect - vibration of streched string and membrene.

UNIT IV

Complex variables - function of a complex variable - analytical function - Cauchy-Rheinman equation - Cauchy 's integral theorem and formula - Tayor's and Laurent's expansion - residue theorem and application - conformal mapping - basic concepts - mapping by w = az + b and w == exp(z).

UNIT V

Probability and statistics – discrete probability distribution - combinations

and permutations - Stirling's approximation for factorials of large numbers-continuous distribution - binominal distribution – Poisson's distribution - normal distribution-curve fitting - least square analysis.

REFERANCE BOOKS:

1. Matrices and Tensors - Jdslji
2. Vector and Tensors – Spiegel – Schaum Series
3. Applied Mathematics for Physicists and Engineers – Pipes an Harwill
4. Complex variables – Spiegel – Schaum Series
5. Mathematical Physics - Eugine Butkov.

SUBJECT CODE: 1.3

SUBJECT: DIGITAL ELECTRONICS AND MICROPROCESSORS

UNIT 1

Logic gates - block diagram - truth table- Ex OR gate - equivalent functions - combinational logic - half adder / subtract or - full adder / subtracted - De Morgan's laws-Boolean algebra - Karnaugh maps - max and min terms - encoders and decoders - multiplexers and demultiplexers.

UNIT II

Sequential logic – flip – flops – sequential circuit analysis – state diagram – state equation – registers – counters – up – down counters – timining sequenes – the memory unit – Random Access Memory (RAM) – Magnetic core memory.

UNIT III

Common microprocessor characteristic - pin diagram and functions for generic microprocessor - microprocessor architecture - the intel 8085 microprocessor - the 8085 pin diagram and functions - 8085 architecture - different addressiag modes - 8085 instruction set - arithmetic, logical and branch instructions - the 8085 stack, I/O and control instructions.

UNIT IV

Programming the 8085 microprocessor - 8 bit addition, subtraction, multiplication and division - looping programs - sum of data - maximum, minimum values of the given array - ascending / descendmg - data transfer- 16 bit addition – relay generation – multiple precision arithmetic - decimal arithmetic - subroutine programs - ASCII to decimal multiple precision addition subroutine.

UNIT V

Timining diagram - instruction cycle, machine cycle, R/W cycle - m interfacing the microprocessor - interfacing with ROM - interfacing with RAM - I/O interfacing basics.

SUBJECT CODE: 1.4

SUBJECT: ELECTROMAGNETIC THEORY

UNIT I

Electrostatics – Field and potential due to a point charge - line charge – surface charge and volume charge – divergence and curl of electrostatic field – energy due to point charge distribution and continuous charge distribution – Poisson equation and Laplace equation – electrostatic boundary condition – separation of variables – Cartesian and spherical coordinates – multipole and dipole – problems in dipole interaction – electrostatic fields in matter – dielectrics – dipoles induced in polarisability – polarisability tensor – electric field produced by uniform polarized sphere – field inside dielectric – Gauss law with dielectric – susceptibility – permeability and dielectric constant – susceptibility tensor field inside a linear dielectric sphere when placed in a electric field – force on a charge outside a linear dielectric slab – energy in a dielectric system – forces on dielectrics – connection between polarisability and susceptibility.

UNIT II

Magnetostatics - Lorentz force - cyclotron motion - continuity equation - Blot and Savart's law for line, surface and volume currents - divergence and curl of B - Ampere's law – applications - magnetic vector potential - multiple expansion of vector potential - Dia, Para and ferromagnet torques and forces on magnetic dipoles - magnetic field of a uniformly magnetized sphere - magnetic susceptibility and permeability in linear media and non linear media - ferromagnetism.

UNIT III

Ohm's law - Faraday's law - electromagnetic inductance - energy in magnetic field Maxwell's equations - boundary conditions - scalar. and vector potentials – gauge transformation – Coulomb gauge and Lorentz gauge – energy arid momentum in electrodynamics - Maxwell's stress tensor – conservation of momentum.

UNIT IV

Electromagnetic waves - the wave equation - oolarization - reflection and transmission - boundary conditions - electromagnetic waves In non conducting media - propagation through linear media - reflection and transmission at normal incidence and oblique incidence - electromagnetic waves in conductors - reflection and transmission at conducing surface - plasma wave guides -T£ waves in rectangular wave guides - coaxial transmission line.

UNIT V

Electromagnetic radiation - retarded potential and potential - electric and magnetic dipole radiation - radiation from point charge – fields of a point charge Bremsstrauhlung, Synchrotron radiation and Cerenkov radiation.

REFERENCE BOOKS:

1. Classical Electrodyhamics - J.D. Jackson.
2. Foundation of electromagnetic theory - Rietz, Milford and Griffith.
3. Electromagnetic fields and waves - P. Lorrain and D. Corson.

SUBJECT CODE: 1.5

Basic Physics Laboratory – I

(Any 10 Experiment)

1. Michelson Interferometer.
2. Resistivity of Ge at various temperature by Four Probe method and determination of
band gap.
3. Susceptibility, Gauy method.
4. Ionic Conductivity of NaCl.
5. Skin depth in Al using electromagnetic radiation.
6. Counting statistics, G.M. tube.
7. End point energy and Absorption coefficient using G.M.tube.
8. Conductivity of Plasma at various pressure for AC/DC source.
9. Electron Spin Resonance. (ESR)
10. Fabry-Parot Etalon.
11. Electron Diffraction.
12. Thermionic Emission.
13. Franck – Hertz Experiment.
14. Zeeman Effect.
15. 'e' by Millikan oil drop method.
16. Stefan's constant – Black body radiation.
17. Clausius – Mossotti equation using sugar solution (Determination of Polarisation.)
18. To study absorption spectra of Iodine molecule and to determine its dissociation energy
using spectrometer.
19. Comparison of resolving limit of optical instruments with human eye.(Pg. 300-301,
A world view of Physics by Prof. D.P. Khandelwal et al. South Asian Publishers pvt. Ltd.
New Delhi, 1999)
20. Study of electromagnetic damping (Pg. 320, A world view of Physics by Prof. D.P.

Khandelwal et al. South Asian Publishers pvt. Ltd.New Delhi, 1999)

Reference Books :

1. Solid State Laboratory Manual in Physics, Department of Physics, University of Pune,
Pune-7. (1977)
2. Experimental Physics, Wersnop and Flint.
3. Molecular structure and Spectroscopy, G.Aruldas Prentice-hall of India Pvt. Ltd. New Delhi.
4. Solid State Physics, S.P. Pillai (3rd Edition), New age International Publisher.
5. Practical Physics, D.R. Behekar, Dr.S. T. Seman, V.M.Gokhale,P.G.Kale (Kitab Mahal Publication)
6. Introduction to experimental Nuclear Physics, R.M. Singru, Wiley Eastern private Ltd.
New Delhi.

SUBJECT CODE: 2.1

SUBJECT: SOLID STATE PHYSICS

UNIT I

Crystal lattices.- two and three dimensional lattice types - simple crystal structure - reciprocal lattice - Brillouin sones - structure factor of the basis - atomic scattering factor - cohesive energy - compressibility and bulk modulus - dielectric and ferroelectric properties of crystals - local electric field at an atom - Lorentz field - different types of polarisation - complex dielectric constants - Clausius-Mosetti relation.

UNIT II:

Phonons and lattice vibrations - quantisation of lattice vibrations - vibrations of monoatomic lattices - lattice with two atoms per primitive cell - lattice heat capacity - Einstein and Debye's models - density of states - an harmonic crystal - their interactions Tlattice thermal conductivity - Umplkapp process.

UNIT III:

Energy bands - nearly free electron model - Bloch function - Kroneig - Penny model -wave equation of electrons in a periodic potential - number of orbitals in a band - effective mass -classification of solids - free electron gas - heat capacity of electron gas - motion in magnetic fields -Hall effect.

UNIT IV:

Magnetism - Langevin's theory of paramagnetism – quantum theory of paramagnetism – Hund’s rules – paramagnetic susceptibility of conduction electrons – Weiss theory of ferromagnetism – ferromagnetic order – Curie point – spin waves – quantization of spin waves – magnons – ferri, antiferri and antiferro magnetism.

UNIT V:

Superconductivity - Meissner effect - heat capacity- energy gap - isotopic

effect - thermodynamics of the superconducting transitions - London equations – BCS theory - Type I and type II super-conductors.

REFERENCE BOOKS:

1. Introduction to Solids -LV.Azaroff
2. Introduction to Solid State Physics - Charles Kittel V edition
3. Elementary Solid State Physics - Ali Omar
4. Solid State Physics- AJ. Dekkar

SUBJECT CODE: 2.2

SUBJECT: NUCLEAR PHYSICS

UNIT I

Elementary Particles: Classification of elementary particles and types of interaction of elementary particles - Leptons - Hadrons - Mesons - Hyperons - strange particles -conservation laws - CPT theorem - Quark model - Gellmann-Okubo mass formula - SU3 multiplet - Baryon octet and baryon decouplet - Mesons nonet- elementary idea of Gauge bosons.

UNIT II

Nuclear decay: Gamow's theory of alpha decay – Dermi's theory of beta decay – Curie plot – shape of beta ray spectrum – parity violation in beta decay – Fermi and Gamow Teller selection rules – multipole radiation – selection rules – internal conversion – nuclear isomerism.

UNIT 111

Nuclear models: Liquid drop model, Bohr - Wheeler theory of fission - evidence for shell effect - shell model - spin - orbit coupling - angular momentum and parity of nuclear ground states - magnetic moment and Schmidt lines - collective model of Bohr.

UNIT IV

Ground state of deuteron - excited states - magnetic moment and quadrupole moment of deuteron - n-p scattering and p-p scattering - effective range theory - meson theory of nuclear force - Compound nuclear theory - Reciprocity theorem - Resonance scattering - Breit-Wigner one level formula.

UNIT V

Neutron sources - classification of neutrons - energy distribution of thermal neutrons - neutron diffusion - current density - leakage rate – thermal neutron diffusion - fast neutron diffusion - Fermi age equation - nuclear

chain reaction - four factor formula - critical size of a reactor -classification of reactors - thermal reactors - power reactor research reaction - breeder reaction.

REFERENCE BOOKS

1. Nuclear Physics - D.C. Tayal
2. Elements of Nuclear Physics, - M.L. Pafi|dya and PJ.P.S. Yadav
3. Nuclear Physics - Irwin Kaplan
4. Introduction to Nuclear Physics – Herald Enge
5. Nuclear Physics - Roy and Nigam
6. Nuclear Physics - Cohen

SUBJECT CODE: 2.3

SUBJECT: QUANTUM MECHANICS

UNIT I

Schrodinger equation - free particle in one dimension - Generalization to three dimension - Shrodinger equation for a particle subjected to a force - continuity equation - normalization - probability interpretation.- conservation of probability - Ehrenfast theorem - time independent Shrodinger equation - particle in a square well potential - bound states in a square well E<0 non localized states E > 0 - Adjoint and self adjont operators - eigenvalue problem - degeneracy - eigenvalues and eigenfunctions of self adjoint operators^ uncertainty principle - proof commutation relations.

UNIT II

Angular momentum in quantum mechanic - central force problems - addition of angular momenta - exactly solvable eigenvalue problems - the simple harmonic oscillator - Hydrogenatom - Rigid rotator - schrodinger, Heisenberg and interaction pictures - matrix theory of harmonic oscillator - Raising and lowering operators.

UNIT III

Stationary perturbation theory -1 arid II order perturbation of oscillator - Zeeman effect without electron spin - variation method - ground state of helium - WKB approximation - Time dependent perturbation theory - Fermi Golden rule.

UNIT IV

Scattering theory - kinematics of scattering process - scattering amplitudes and scattering cross section - partial wave analysis from simple potentials - phase shift - scattering amplitude in terms of phase - Optical theorem - Born approximation - Scattering by a perfectly rigid system - square well, coulomb arid Yukawa potentials.

UNIT V

Semiclassical theory of radiation –Einstein's coefficients for spontaneous and stimulated emission of radiation - relations between them – transition probability for absorption and induced emission - Klein Gordon equation - difficulties – Dirac equation – Dirac matrices and their properties - Free particle solution of Dirac equation - negative energy states – positrons – spin angular momentum and magnetic moment of election in a magnetic field.

REFERENCE BOOKS:

1. Quantum Mechanics - Matthews and Venkatesan.
2. Quantum Mechanics-L.L Schiff.
3. Quantum Mechanics - Satyaprakash.
4. Quantum Mechanics - Lee.
5. Quaritum Mechanics - A.P.Messiall

SUBJECT CODE: 2.4

SUBJECT: LASER AND OPTO - ELECTRONICS

UNIT I

Lightwave fundamentals - electro-magnetic waves - dispersion -pulse distortion - information rate - polarization - resonant cavities - reflection at a plane boundaries - critical angle - reflections.

UNIT II

Integrated optic wave guides - dielectric slab wave guide - modes in the symmetric slab wave guide -modes in the asymmetric slab wave guide - coupling to the wave guide - integrated optic networks - optic fibre wave guides - step index fibre - graded index fibre - attenuation - modes in step index fibre and graded index fibre - pulse distortion - information rate - optic fibre cables.

UNIT III

Light soured and detectors – LED's – characteristics – LASER principles – ruby LASER – Nd YAG LASER, Neodymium glass LASER, He-Ne LASER CO_2 LASER, LASER diodes, operating characteristics, light detectors, principles of photo detection, PMT, PIN photo diode, avalanche photo diode, CCD.

UNIT IV

Couples and connectors -connector principles - fibre end preparation, splices, connectors, source coupling, modulation, LED modulation and circuits, analog modulation formats, digital modulation formats, optic heterodyne receivers, holography.

UNIT V

Harmonic generation - 2nd and 3rd harmonic generation - phase matching - optical mixing - parametric generation of light - cell focussing of light

REFERENCE BOOKS:

1. Fibre optic communications - Joseph & Palaias
2. LASERS and non-linear optics -B.B.Laud

SUBJECT CODE: 2.5

Electronics Laboratory

(Any 10 Experiment)

1. Study of voltage controlled oscillator using IC-566.
2. Frequency multiplier using PLL-565(for 2 & 3 operation using counter.)
3. Fold back power supply.
4. Precision rectifier.
5. Crystal oscillator- Millar type and Digital clock.
6. Diode pump using UJT.
7. DAC (R-2R and Binary type for 4-bit).
8. Pulse train generator.
9. SMPS power supply.
10. CVCC power supply.
11. Active filter- Low pass, High pass, Band pass, and Notch Filter using OP-AMP.
12. Function generator using OP-AMP/IC –8038.
13. Study of optocoupler, MCT2E and their application.
14. Constant current source using OP-AMP.
15. Class-B push pull amplifier using Dual power supply and OP-AMP.
16. Design, built and test oscillator – Wien Bridge oscillator / phase shift oscillator using
OP-AMP.
17. Inductive simulation using OP-AMP.
18. tudy of multiplexer and Demultiplexer.
19. Voltage to Frequency / Frequency to voltage converter using OP-AMP.
20. Study of errors in electrical measurement and results due to loading.
21. Fourier analysis (Pg. 18, Experiments in Electronics, S.V. Subramaniam, McMillan India
Limited, 1982)

22. To determine the transition capacitance of a varactor diode and use it as a variable
capacitor.(Pg. 28, Experiments in Electronics, S.V. Subramaniam, Mcmillan India
Limited, 1982)
23. Measurement of efficiency of a power amplifier.(IC 810)and study of its frequency
response.(Pg. 118, Experiments in Electronics, S.V. Subramaniam, Mcmillan India
Limited, 1982)
24.Study of noise performance of an amplifier.(Pg. 449, Art of Electronics, Horowitz and Hill,
Cambridge, University Press, Low Price Edition, 1995.)

Reference Books :

1.Signetic manual.
2. Power supplied, B.S.Sonde.
3. Digital Principles, Malvino (6th Edition, Tata McGraw Hill Publication Co. Ltd. Delhi.)
4. Operational Amplifier , G.B.Clayton.
5. OP-AMPS and Linear integrated circuits, Ramakant Gaikwad.
6.Data Converters, B.S. Sonde, Tata Mc-Graw Hill Pub. Co. Ltd. (1974).
7. Pulse, Digital and Switching Circuits, Miliman & Taub.
8. Electronic Integrated Circuits and Systems, Franklin, C. Fitchen(Van No strand
Reinhold Company).
9. Digital Principles and applications, Leach and Malvino, Tata Mc-Graw Hill Pub.Co.
Ltd. N.Delhi(5th Edition,2002).

II YEAR

SUBJECT CODE: 3.1

SUBJECT: ADVANCED NUCLEAR PHYSICS

UNIT I

Addition of angular momentum – Clebsch – Gordan coefficients – symmetry properties – evaluation of Clebsch – Gordan coefficients in simple cases – rotational matrices forspinors – spherical tensors – rotation matrices – Wigner – Eckart theorem – simple applications.

UNIT II

Nilsson model – collective model of Bohr – Mottelson – rotation and vibration – residual interaction – 0.18 energy level calculations – two centre shell model.

UNIT III

Strutinsky's prescription – shell effect – potential energy surfaces – nuclear moment of inertia – cranking model – pairing correlation in nuclei – BCS theory.

UNIT IV

Nuclear stress – backbending – high spin states – hot nuclei – statistical theory – nuclear level density – thermal fluctuations – giant dipole resonance.

UNIT V

Charactertistics of accelerators – beam modulation – column structure – electrostatic accelerators – Van de Graff accelerator – tandem principle – pelletron – AVF cyclotron – principles of phase shift.

REFERENCE BOOKS:

1. Nuclear Physics – Roy and Nigam

2. Introduction to Nuclear Physics – Herald Enge
3. Nuclear Physics – D.C.Tayal
4. Nuclear Physics – S.B.Patel
5. Nuclear Physics – Irwin Kaplan

SUBJECT CODE: 3.2

SUBJECT: CLASSICAL MECHANICS

1 Constrained Motion

Constraints, Classification of Constraints, Principal of Virtual Work, D'Alembert's
principal and its applications (Problems only), (One or Two Problems should be discussed
with D'Alembert's, Lagrangian, Hamiltons from same set of problems). (2L+2P)

.

2 Lagrangian formulation

Generalized coordinates, Langrange's equations of motion, properties of kinetic
energy function, theorem on total energy, generalized momenta, cyclic-coordinates, integrals
of motion, Jacobi integrals and energy conservation, Concept of symmetry, invariance under
Galilean transformation, velocity dependent potential. (6L+5P)

3 Hamilton's formulation

Hamilton's function and Hamilton's equation of motion, configuration space, phase
space and state space, Lagrangian and Hamiltonian of relativistic particles and light rays.
(3L+4P)

4 Variational Principle

Variational principle, Euler's equation, applications of variational principle, shortest
distance problem, brachistrochrone, Geodesics of a Sphere. (3L+2P)

5 Canonical Transformations

Generating function, Conditions for canonical transformation and problem. (3L+2P)

6 Poisson Brackets

Definition, Identities, Poisson theorem, Jacobi-Poisson theorem, Jacobi identity,
(statement only), invariance of PB under canonical transformation.
(2L+3P)

7 Rotational Motion

Rotating frames of reference, inertial forces in rotating frames, Larmour precision,
electromagnetic analogy of inertial forces, effects of Coriolis force, Focoult's pendulum.
(3L+3P)

8 Central Force

Two body central force problem, stability of orbits, condition for closure, integrable
power laws, Kepler's problems, orbits of artificial satellites, Virial theorem. (3L+2P)

Reference Books :

1. Classical Mechanics by H.Goldstein, Narosa Publishing Home,, New Delhi.
2. Classical Dynamics of Particles and Systems by Marion and Thomtron, Third Edition,
Horoloma Book Jovanovich College Publisher.
3. Classical Mechanics by P.V.Panat, Narosa Publishing Home,, New Delhi.
4. Classical Mechanics by N.C.Rana and P.S.Joag, Tata Mc-Graw Hill Publishing Company Limited, New Delhi.
5. Introduction to Classical Mechanics by R.G.Takawale and P.S.Puranik, Tata Mc-Graw
Hill Publishing Company Limited, New Delhi.
6. Classical Mechanics by J.C.Upadhyaya, Himalaya Publishing House.

SUBJECT CODE: 3.3

SUBJECT: QUANTUM MECHANICS-I

1. Revision of the following topics with emphasis on problem solving :

Inadequacy of classical Physics, wave packets and uncertainity relations. Schrodinger wave equation and probability interpretation, Simple one dimensional problems –
wells, barriers and harmonic oscillator (One and three dimensional). (6L + 5P)

2. General formalism of Quantum Mechanics :-

Postulates of quantum mechanics :
Representation of states and dynamical variables, observables, self-adjoint operators, eigen
functions and eigen values, degeneracy, Dirac delta function,
Completeness and closure property,
Physical interpretation of eigen values, eigen functions and expansion co-efficients, eigen values
and eigen functions of momentum operator.
Hilbert space, Dirac's bra and ket notation, dynamical variables and linear operators,
projection operators, unit operator, unitary operator, matrix representation of an operator, change of
basis, unitary transformation. Eigen values and eigen functions of simple harmonic oscillator by
operator method. (13L +4P)
Ref. 1. a) Chapter 3 (article 3.1 to 3.10)
b) Chapter 7 (article 7.1 to 7.7)
c) Chapter 4 (article 4.4)

3. Angular Momentum :

Eigen values and eigen functions of L2 and Lz operators, ladder operators L+ and L-, Pauli

theory of spins(Pauli's matrices), angular momentum as a generator of infinitesimal rotations, matrix
representation of J in ljm> basis. Addition of angular momenta, Computation of Clebsch-Gordon
co-efficients in simple cases (J1=1/2, J2=1/2) Central forces with an example of hydrogen atom.
Ref. 1. Chapter 8 (article 8.1 to 8.3, 8.5, 8.6) (11L+4P)

4. Evolution of system with time :

Constants of motion, Schrodinger and Heisenberg picture, Heisenberg's matrix mechanics
for harmonic oscillator .
Ref..1. Chapter 3 (article 3.14)
Chapter 9 (article 9.16 to 9.18) (4L +1P)

Reference books :-

1) A Text-book of Quantum Mechanics by P.M.Mathews and K.Venkatesan.
2) Quantum mechanics by A.Ghatak and S.Lokanathan
3) Quantum Mechanics by L.I.Schiff
4) Modern Quantum mechanics by J.J.Sakurai
5) Quantum Physics by R. Eisberg and R.Resnick
6) Introduction to Quantum Mechanics by by David J.Griffiths
7) Introductory Quantum mechanics by Granier, Springer Publication.
8) Introductory Quantum Mechanics, Li boff, 4th Edition, Pearson Education Ltd.

SUBJECT CODE: 3.4

SUBJECT: ELECTRODYNAMICS

1. Multipole expansions and material media :

Multipole expansions for a localised charge distribution in free space, Linear
quadrapole potential and field, static electric and magnetic fields in material media,
Boundary conditions. (4L)
Ref. 1, Ref. 6.

2. Time varying fields :

Time dependents field, Faraday's law for stationary and moving media,Maxwell's
displacement current, Differential and Integral forms of Maxwell's equations, Maxwell's
equations for moving medium. (6L)
Ref.1, Ref.2, Ref.3, Ref.4

3. Energy, Force and Momentum relations in electromagnetic fields :

Energy relations in quasi-stationary current systems, Magnetic interaction between
two current loops, Energy stored in electric and magnetic fields, Poynting's theorem,
General expression for electromagnetic energy, Conservation laws.
(6L)
Ref;1, Ref;2, Ref;4, Ref;5, Ref;6, Ref;8

4. Electromagnetic wave equations :

Electromagnetic wave equations,Electromagnetic plane waves in stationary medium ,
Reflection and refraction of electromagnetic waves at plane boundaries (Oblique incidence),

Electromagnetic waves in conducting medium, Skin effect and skin depth. (8L)

Ref. 1; Ref;2, Ref;4, Ref;5, Ref;8

5. Inhomogeneous wave equations :

Inhomogeneous wave equations, Lorentz's and Coulomb's gauges, Gauge transformations, Wave equations in terms of electromagnetic potentials, D'Alembertian
operator, Solutions of inhomogeneous wave equations by Fourier analysis, Hertz potential
and its use in computation of radition fields, Dipole radiation, Radiation energy and
Radiation resistance. (8L)

Ref.1, Ref.2,Ref.4, Ref.5, Ref.8.

6.Relativistic Kinematics:

Experimental basis for special theory of relativity (Michelson – Morley experiment),
Lorentz transformations , Relativistic velocity addition, Mass- Energy relation (E=mc2). (6L)

Ref.1; Ref.2; Ref.3; Ref;7.

7.Covariance and Relativistic Mechanics :

Minkowski's space-time diagram, light cone, Four vectors, Lorentz transformation
of Four vectors, Some tensor relations useful in special relativity, Minkowski's force. (6L)

Ref.1;Ref.2; Ref.3; Ref.6.

8. Covariant formulation of electrodynamics:

Four vector potential, Electromagnetic field tensor, Lorentz force on a charged particle. (4L)

Ref.1, Ref.2, Ref.3, Ref.6.

Text Book :

1. Introduction to Electrodynamics, (3rd Edition) by David J.Griffith. Publication :Prentice-Hall of India, New Delhi

Reference Books :

2. Introduction to Electrodynamics, by A.Z.Capri and P.V.Panat Narosa Publishing House

3.Classical electricity & Magnetism, by panofsky and Phillips, Addison Wesley

4.Foundations of Electromagnetic theory, by Reitz & Milford, World student series Edition.

5.Classical Electrodynamics, by J.D.Jackson, 3rd Edition John Wiley.

6.Electromagnetic theory and Electrodynamics, by Satya Prakash, Kedar Nath and co.Meerut.

7. Special theory of Relativity, by Robert Resnick.

8. Electromagnetics by B.B.Laud, Willey Eastern.

9. Matrices and Tensors in Physics, A. W. Joshi, 3rd Edition, New Age International

SUBJECT CODE: 3.5

SUBJECT: ATOMIC AND MOLECULAR PHYSICS

ATOMIC AND MOLECULAR PHYSICS

1. Study of line spectra on photographed plates/films and calculation of plate factor.
2. Verification of Hartman's dispersion formula.
3. Study of sharp and diffuse series of potassium atom and calculation of spin orbit
interaction constant.
4. Determination of metallic element in a given inorganic salt.
5. To record the spectrum of CN violet bands and to perform vibrational analysis.
6. To record the visible bands of ALO and to perform vibrational analysis.
7. To photograph and analyse the reddish glow discharge in air under moderate pressure.
8. To photograph the analyse the whitish glow discharge in air under reduced pressure.
9. To perform vibrational analysis of a band system of N2.
10. To perform vibrational analysis of band system of C2
11. To photograph and analyse the line spectrum of Calcium atom.
12. To record/analyse the fluorescence spectrum of a sample.
13. To record/analyse the Raman spectrum of a sample.
14. Study of Hyperfine structure of the green line of mercury.
15. To photograph the (O, O) band of CuH and to perform rotational analysis.
16. Flashing & quenching in Neon Gas.
17. E/m of electron.
18. Experiments on Prism/Grating Spectrometer.
19. Wavelength of laser light.

20. Faraday effect with laser.
21. Michelson interferometer.
22. Analysis of ESR Spectra of transition metals.
23. Analysis of H-atom spectra in minerals.
24. Measurements of dielectric constant.
25. E.S.R. of DPPH.

SUBJECT CODE: 4.1

QUANTUM MECHANICS – II

1.Approximation Methods :

i) Time-independent Perturbation theory: Non degenerate and degenerate cases (upto
second order). Applications: Zeeman effect, Stark effect, anharmonic oscillator.

ii) Time-dependent Perturbation theory: Transition amplitude 1st and 2nd order, selection
rules, constant perturbation(1st order). Fermi's golden rule, Harmonic perturbation,
Interaction of atom with em radiation, dipole approx. Einstein coefficient for spontaneous
emission.

iii)Variational method: Basic principles and applications to particle in box, SHO, hydrogen
atom, helium atom.(qualitative approach.)

iv) WKB approximation : Qualitative development and condition for validity of this approx.,
Bohr's quantization condition, applications to tunnelling such as □-particle, field emission.

Ref.1 : chapters 5,9 (16L+8P)
M &W

2. Theory of Scattering :

i) Kinematics: Differential and total cross sections, scattering amplitudes using Green's function
scattering by symmetric potential, mutual scattering of two particles, Centre of Mass frame,
Laboratory frame.

ii) Dynamics – a) Born approximation, Validity of Born Approx., Application to square
well potential and Yukawa potential.
b) Partial wave analysis, phase shift, scattering amplitudes in terms of phase shift, optical
theorem, scattering by square well potential and perfectly rigid sphere.
Ref.1: Chapter 6 (6.1 to6.5)(6.8 to 6.11)(6.14 to 6.15)(6.17,6.18) (10L +6P)

3. Symmetry in Quantum Mechanics :

Symmetry Parity, Identical particles, symmetric and antisymmetric wave functions,
Slater determinant, collison of identical particles, spin functions for system with more than
one electron. (5L+3P)
Ref.1 Chapter 9, Chapter 6(6.19), Chapter 7 (7.13)

Reference Books :

1.A Text book of Quantum Mechanics, P.M.Mathews and K.Venkatesan, Tata McGraw Hill
2.Quantum Mechanics by A.Ghatak and S.Lokanathan, Macmillan India Ltd.
3.Quantum Mechanics by L.I.Schiff, McGraw Hill
4.Modern Quantum Mechanics by J.J.Sakurai
5.Quantum Physics by R.Eisberg and R.Resnick(Wiley and Sons)
6.Introduction to quantum mechanics by D.I.Griffiths (Pearson Education)(IInd Edition)

SUBJECT CODE: 4.2

Subject:Radiophysics & Electronics special

1. IC Technology : Hybrid and monolithic IC; Semiconductor processing diffusion, implanation, oxidation, epitaxy, lithography; Si IC technology-MOS and Bipolar; Packaging and testing. (3 lectures)

2. Analog Integrated Circuits. Differential amplifier, OP-AMP comparator; continuous time filters, switched capacitance implementation of sample data filters; analog multiplexers, PLL and frequency synthesizer. (10 lectures)

3. Digital Integrated Circuits: Logic families – TTL, ECL, MOS, MESFET; design of combinational and sequential circuits – MUX, decoder/ encoder, registers, counters, gate arrays; programmable logic devices – PAL, GAL, PLA, Programmable gate arrays. (7 lectures)

4. Special purpose ICs: ICs for analog communication; Digital signal processing ICs; Basic concepts of MIC, MMIC and OELC; GaAs technology; (3 lectures)

5. Memories: Sequential and Random access memories; RAM bipolar and MOS static and dynamic memories; programmable memories PROM, EPROM, EEPROM. (5 lectures)

6. Microprocessor and their applications: Architecture of 8 bit (8085) and 16 bit (8086) microprocessors; addressing modes and assembly language programming of 8085 and 8086. 8086 machine cycles and their timing diagrams; Interfacing concepts memory and I/O interfacing; Interrupts and interrupt controllers; microprocessor

based system design; comparison of different microprocessors. (13 lectures)

7. Fundamentals of speech synthesis and recognition, Image processing and biomedical signal processing. (4 lectures)

Books Recommended:

1. Geiger, Allen and Strader – *VLSI – Design Techniques for Analog and Digital Circuits*.
2. Gray and Meyer – *Analysis and Design of Analog Integrated Circuits*.
3. A P Mathur – *Microprocessors.*
4. R S Gaonkar – *Microprocessor Architecture, Programming and Applications with 8085/ 8085A* (2^{nd} Ed.).
5. D V Hall – *Microprocessor and Interfacing*.
6. Lin and Gibson – *Microprocessor*.
7. S Soelof – *Applications of Analog Integrated Circuits*.

SUBJECT CODE: 4.3

Computer Applications in Physics-I

1. **Computer fundamentals**:

Functional units-CPU, Memory, I/O units; Information representation- integral and real number representation; Character representation: Alphanumeric codes; BCD, Gray, ASCII codes; Error detection and error correcting codes; Hamming codes; CRC codes.

2. **Computer Software and Operating Systems**:

System software and application software; Translator programs; Loaders and linkers; Operating systems- classification; Elements of DOS and Windows- basic commands.

3. **Elements of C Programming Language**:

Algorithms and flowchart; Structure of a high level language program; Features of C language; constants and variables; expressions; Input and output statements; conditional statements and loop statements; arrays; functions; character strings; structures; pointer data type; list and trees

4.FUNCTIONS AND POINTERS

Arrays – Handling of Character Strings-User-Defined Functions-
Structures and Unions- Pointers- Developing a C Programs.

Books Recommended:

1. Tanenbaum, Operating system. Prentice Hall.
2. Gottfried, Programming with C. Schaum series.
3. Balaguruswamy, ANSI C. TMH.