Telangana University

M.Sc. Physics - I year Syllabus
DEPARTMENT OF PHYSICS
OSMANIA UNIVERSITY, HYDERABAD - 500007
M.Sc. (Physics) and M.Sc. (Applied Electronics)
I-Semester Syllabus w.e.f 2008-2009

PAE - 101
PAPER - I
MATHEMATICAL PHYSICS and NUMERICAL METHODS

UNIT - I: (13 Hrs)
Bessel's Differential Equation: Power series Solution - Bessel Functions of First and Second kind - Generating Function - Orthogonal Properties - Recurrence Relations.

UNIT - II: (13 Hrs)

UNIT - III: (13 Hrs)
Numerical Differentiation: Forward Difference Quotient - Central Difference Quotient - First and Higher order derivatives - Errors in derivatives.
Numerical Integration: Newton-Cotes methods, Simpson's One third and Three eighth methods - Gaussian Quadrature methods.

UNIT - IV: (13 Hrs)
Curve Fitting: Linear regression - Transcendental regression - Polynomial regression Analysis.
System of Linear Equations: Gauss Elimination method - Gauss Jordon method -
Triangular Factorization Method - Jacobi Iterative method.

Ordinary Differential Equations: Taylor Series method - Euler's method - Runge-
Kutta second order method - Runge-Kutta fourth order method.

RECOMMENDED BOOKS:

1. Applied Mathematics for Engineers and Physicists - Ious A Pipes and Lawrance
   R. Rarvill.
4. Programming in MATLAB - Marc E. Hermite - THOMSON - BROOKS/COLE,
   (Vikas Publishing House).
   Limited.
   Iyengar and R.K.Jain - PHI Publisher.
7. Applied Numerical Methods for Engineers using MATLAB and C -
   Robert J. Schilling, Sandra L. Harris, Brooks/Cole Publishing.

******
DEPARTMENT OF PHYSICS
OSMANIA UNIVERSITY, HYDERABAD - 500007
M.Sc. (Physics) and M.Sc. (Applied Electronics)
I Semester Syllabus w.e.f 2008-2009

PAE 102

PAPER II
CLASSICAL MECHANICS

UNIT – I (13 Hrs)
Newtonian Formalism: Inertial frames and Galilean transforms - Non-inertial frames -
pseudo forces - rotational frames, rotational transforms - conservation theorems.
Description of rotations in terms of Euler angles - Euler equations and application to
motion of symmetric top, gyroscope - Minkowski space, Space-time diagrams, world
point and world line - Relativistic motion and Lorentz transforms as rotations in four-
space - Four Velocity, Energy - Momentum vectors with few examples.

UNIT – II (13 Hrs)
Lagrangian Formalism: Constraints - generalised coordinates. Principle of virtual
work and D’Alembert’s principle - Applications of D’Alembert’s principle (lever,
inclined plane, plane pendulum). Lagrange’s equations from D’Alembert’s principle -
applications (plane and spherical pendulum) Velocity dependent Potential. Lagrangian
for a charged particle in Electromagnetic field - Euler’s equations from Lagrange
equations - Hamilton’s principle - Lagrange equations from Hamilton’s principle.

UNIT – III (13 Hrs)
Hamiltonian Formalism: Principle of Least Action and Hamilton’s equations. Cyclic
coordinates and conservation theorems - Canonical coordinates and Canonical
transformations, Conditions for a transformation to be canonical - Generating functions -
Lagrange and Poisson brackets. Hamilton equations in Poisson bracket form - Hamilton-
Jacobi theory.

UNIT – IV (13 Hrs)
Mechanics Of Continuous Systems: Analysis of the free vibrations of a linear
tritomic molecule - Eigen value equation - Principal axis transformation - frequencies
and normal coordinates. Lagrangian formulation for continuous systems - Stress-Energy
tensor and conservation theorems, Hamiltonian formulation.

RECOMMENDED BOOKS:
1. Classical Mechanics: By Goldstein, Poole & Safko (Pearson 2002)
2. Classical Mechanics: Rana & Joag (TMH)
3. Introduction to Classical Mechanics: Takwale & Puranik (TMH)
7. Lagrangian Dynamics: Dave Wells (Schuam series 1967)

***************
DEPARTMENT OF PHYSICS
OSMANKIA UNIVERSITY, HYDERABAD - 500007
M.Sc. (Physics) and M.Sc (Applied Electronics)
1 Semester Syllabus wef 2008-2009

PAE - 103
PAPER - III
QUANTUM MECHANICS - I

Unit - I: (13 Hrs)

Unit - II: (13 Hrs)

Unit - III: (13 Hrs)
Theory of Angular momentum: Orbital angular momentum, ladder operators and commutation relations. Generalized angular momentum J_0, J_1 and their commutation relations. Eigen values of J^2 and J_z. Matrix representation for J^2 and J_z. Spin angular momentum - Pauli spin matrices and their properties. Addition of angular momenta - Clebsch-Gordon coefficients - recursion relations - C-G coefficients for j_1 = 1/2 & j_2 = 1/2 and j_1 = 1/2 & j_2 = 1 as examples.

Unit - IV: (13 Hrs)

RECOMMENDED BOOKS:
6. Quantum Mechanics: N. K. Agarwal and Lokanathan
7. Quantum Mechanics: P. A. M. Dirac
8. Feynman Lectures on Physics: Vol 3 (Addison Wesley 1965)

************
DEPARTMENT OF PHYSICS
OSMANIA UNIVERSITY, HYDERABAD - 500007
M.Sc., (Physics) and M.Sc (Applied Electronics)
I Semester Syllabus wef 2008-2009

PAE - 104

PAPER - IV
PROGRAMMING in C and MATLAB

UNIT - I : (13 Hrs)
Identifiers - Key words - Basic program structure - constants - Variables
Operators: Arithmetic, Relational, Logical, Increment, Decrement, Bitwise, Assignment
Operators - Precedence and order of Evaluation.
Control Flow: if - if Else - While - Do While- Switch - For - Break - Continue -
GOTO statements.

Functions and Programming Structure: Defining a function - Return statement
Types of function - actual and formal arguments - Local and Global variables - Scope of
variables - Automatic, Register, Static and External variables - Recursive functions
- Header Files - C Preprocessor.

Arrays and Pointers: Declaration - Initialization - Arrays and Functions
Multidimensional arrays - Character arrays - Pointer Declaration - Pointer arithmetic
- Pointer and Functions - Pointers and Strings - Arrays of Pointers -Malloc-Calloc
-Realloc- Command Line Arguments - Pointers to Functions.

UNIT - II (13 Hrs)
Structures: Declaration - Initialization - Functions and Structures - Arrays of Structure
- Structures within structures - Pointers and structures - Unions - Bit Fields - Typedef
- Enumerators.

Data File Operations: Standard Input and Output - Formatted Output - Formatted
Input - File Access - Line Input and Line Output - Low level I/O - Read and Write.

Data Structures: Introduction - stacks and queues - circular queues - singly linked lists
- doubly linked lists - circular lists - binary trees - tree traversal - searching methods
- linear and binary search - sorting methods - bubble sort - selection sort - insertion sort.

UNIT - III : (13 Hrs)
MATLAB Environment: MATLAB as a calculator - Variables - Functions
- Displaying Formats - Complex Numbers - Matrices and Vectors - Strings - Input and
Output Statements - Simple Plotting in MATLAB - MATLAB Package Environments.

MATLAB Operators and Control Flow: Relational Operations - Logical Operations
- Elementary math functions - Matrix Functions - Characters and Strings - IF-END
- IF-ELSE-END - ELSEIF - SWITCH - CASE - FOR Loops - WHILE Loops
- Interactive Computations: Matrices and Vectors - Matrices and Array operations
- Vectorization - Command line functions - Using Built-in functions.

Scripts and Functions: Script Files - Function Files - General Structure of Files - Scope
of Variables - Passing Parameters - Global Variables - Recursive Functions.

φTO
UNIT- IV: (13 Hrs)

File Input and Output: Opening and Closing Files – Writing Formatted Output Files – Reading Formatted Data from Files – Writing and Reading Binary Files.


RECOMMENDED BOOKS:
2. Programming in C – Ravichandra – New Age International
4. Data structures Using C – Tenenbium – PHI
5. Data Structures – Seymour, Lipsethutz – Schum’s Series – Tata Macgraw Hill
6. MATLAB programming – Rudrarupat
DEPARTMENT OF PHYSICS,
OSMANIA UNIVERSITY, HYDERABAD – 500 007.
M.Sc. (Physics) & M.Sc. Applied Electronics
1 Semester Syllabus w.e.f. 2008 – 2009

PAPER – V (ELECTRONICS – I)
(Semiconductor Electronics)

UNIT – I (13 Hrs)
Semiconductor Devices: Characteristics of Tunnel Diode, Photo diode, BJT, JFET,
MOS, CMOS, UJT, SCR, DAIC and TRAIC.
Amplifiers: h-parameter model of BJT, Biasing of Transistor, Self bias, Single Stage
RC coupled amplifier and its frequency response (using hybrid α model).

UNIT – II (13 Hrs)
Regulated Power Supply: Basic Principles of Zener regulated, Transistorized Series
regulated (Circuits using 723, 78XX) and Switching Mode Power Supplies (SMPS).
Wave Shaping: Integration and differentiation using passive elements. Clipping and
Clamping circuits using diodes.
Feedback Amplifiers: Classification of Amplifiers, The concept of feed back, Positive
and Negative feed back. Advantages of Negative feed back. Emitter follower and
Darlington pair.

UNIT – III (13 Hrs)
Sinusoidal Oscillators (Using BJTs): Criterion for oscillations, Phase shift, Wein
bridge, Hartley and Colpitts Oscillators, Crystal Oscillator.
Collector coupled Astable, Monostable, Bistable multivibrator and Schmidt trigger.

UNIT – IV (13 Hrs)
Modulation and Detection: Amplitude Modulation – Frequency components in an
AM signal, Balanced Amplitude Modulator, Envelope and square law detectors.
Frequency Modulation – Frequency components in FM signal, Basic Reactance
modulator, FM discriminator. Phase Modulation.

RECOMMENDED BOOKS:
1. Integrated Electronics by Millman and Hallkias
2. Pulse Digital & Switching Waveforms by Millman and Taub
3. Microelectronics by Millman & Grabel.
4. Fundamentals of electronics by J.D. Ryder
5. Electronic Communication System By Kennedy.

*******
UNIT-I : (13 Hrs)
Electro-Static Potentials And Maxwell's Field Equations: Special techniques for calculating electrostatic potential - Poisson's and Laplace's equations - Solutions of Laplace's equations for electrostatic potential in cartesian, spherical and cylindrical coordinates-Multipole expansion of the energy of a system of charges in an electromagnetic field-The scalar and vector magnetic potentials. Derivation of Maxwell's equations-General wave equation-Gauge transformations-Lorentz and Coulomb gauges-Momentum, angular momentum and free energies of electromagnetic field Poynting Theorem (Work energy theorem in electrodynamics).

UNIT-II : (13 Hrs)

UNIT-III : (13 Hrs)
Interaction Of Electromagnetic Waves With Matter: Propagation of EM waves in bounded media-Boundary conditions for E,D,B and H-Reflection and Refraction of plane EM waves at planar surface between two dielectrics-Laws of reflection and refraction-Fresnel's relations-Reflection(R) and Transmission(T) coefficients-Brewster's angle-Total internal reflection-Total internal reflection and Refraction of plane EM waves at plane interface between non-conducting and conducting medium-Metallic reflection and its applications-Dispersion in non-conductors-Nort and anomalous dispersion.

UNIT-IV : (13 Hrs)

RECOMMENDED BOOKS:
DEPARTMENT OF PHYSICS,
OSMANIA UNIVERSITY, HYDERABAD – 500 007.
M.Sc., (Physics) & M.Sc., Applied Electronics
II Semester Syllabus w.e.f. 2008 – 2009

PAE – 202

PAPER - II

General Solid State Physics - I
(Structural Studies, Imperfections & Band Theory of solids)

Unit - I: (12 Hrs.)
Crystalline state: Crystal translational vectors, unit cell, Bravais lattices, Crystal systems, Miller indices, symmetry operations, Point groups, Space groups and their notation. Crystal structures of fcc, bcc, hcp, CsCl, NaCl, ZnS and Diamond.
Non-Crystalline state: Distinction between crystalline and non-crystalline states of solids, Glass formation - Definitions of glass - Methods of preparation of glasses – melt quenching and vapour condensation techniques, sol-gel process and solid state amorphisation methods, Glass characterizing properties.

Unit - II: (12 Hrs.)

Unit - III: (14 Hrs.)

Unit – IV: (14 Hrs.)

RECOMMENDED BOOKS:
2. Physics of amorphous solids  -- S.R. Elliot
4. Introduction to Solid State Physics  -- Kittel
5. Solid State Physics  -- R.L. Singh
7. Elements of Solid state Physics  -- Aloomar
DEPARTMENT OF PHYSICS
OSMANIA UNIVERSITY, HYDERABAD - 500007
M.Sc., (Physics ) and M.Sc (Applied Electronics )
II Semester Syllabus wef 2008-2009
PAE - 203

PAPER - III
QUANTUM MECHANICS - II

Unit-I: (13 Hrs.)
Scattering theory : Laboratory and centre of mass frames of references. Kinematics of
the scattering process. Scattering cross section -- Asymptotic form of scattering wave
function. Scattering amplitude by Green's method -- Born Approximation -- screened
potential and square well potential -- Partial wave analysis and phase shift -- Optical
theorem -- Relationship between Phase Shift and Potential -- scattering by a hard
sphere. Collisions between identical particles.

Unit-II: (13 Hrs.)
Time Dependent Perturbation Method : Time dependent perturbation theory.
Transition probability -- selection rules for transitions. Constant perturbation. Transition
probability to closely spaced levels -- Fermi's golden rule. Harmonic perturbation --
transition probability rate. Interaction of an atom with electromagnetic radiation-- electric
dipole approximation. The Einstein Coefficients.

Unit-III: (13 Hrs.)
Many Electron Atom and Molecules : Thomas-Fermi atom. Hartree Method of self-
consistent methods. The Hartree-Fock Method. Constants of motion in central field
approximation -- corrections to the central field approximation. Born-Oppenheimer
method -- Molecular Orbital theory. Valence bond theory. $H^+_2$ ion -- Hydrogen molecule.

Unit-IV: (12 Hrs.)
Relativistic Quantum Mechanics : Klein-Gordon equation, plane wave solutions and
equation of continuity -- Dirac equation -- probability density -- Dirac matrices -- plane
wave solutions -- Significance of Negative energy states -- spin of the Dirac particle --
Dirac particle in electromagnetic fields. Dirac equation in covariant form. Gamma
matrices.

RECOMMENDED BOOKS:
5. Quantum Mechanics: Ari das
7. Quantum Mechanics: Ghatak and Lokanathan
8. Quantum Mechanics : P A M Dirac
DEPARTMENT OF PHYSICS,
OSMANIA UNIVERSITY, HYDERABAD-500007
M.Sc. (Physics) & M.Sc., (Applied Electronics)
II Semester Syllabus: w.e.f. 2008-2009

PAPER – IV
STATISTICAL MECHANICS

Unit-I : (13 Hrs)
Relation between thermodynamics and statistical mechanics - micro states and macro states of a system - phase space ensembles – mean values and ensemble average - density distribution in phase space - Liouville’s theorem. A priori probability postulate - micro canonical, canonical and grand canonical ensembles - quantization of phase space.
Entropy and probability - equilibrium conditions - Thermal, mechanical and concentration equilibrium. Entropy of a perfect gas using micro canonical ensemble - Gibbs paradox - Sackur-Tetrode equation.

Unit-II : (13 Hrs)
Partition function and thermodynamic quantities - translational, rotational and, vibrational partition functions - Specific heat of diatomic molecules.

Unit-III : (13 Hrs)
Ideal Fermi-Dirac gas - Energy and pressure of the gas - electronic specific heat, thermionic emission, white dwarfs.

Unit-IV : (13 Hrs)
Fluctuations - mean square deviation - fluctuations in energy, volume and concentration - Brownian motion - Classification of phase transitions - Phase transitions of first and second kind, Ising model, Bragg-Williams approximation - one dimensional Ising model application to Ferro magnetic systems - Order-Disorder transition.

Recommended books:
3. Statistical Mechanics by B.K Agarwal and M. Eimer
4. Statistical mechanics and properties of matter by E.S.R. Gopal
5. Statistical Physics by Battacharjee
6. Statistical Physics by Tony Guemani
7. Heat and Thermodynamics by Zeemanisky

*********
DEPARTMENT OF PHYSICS,
OSMANIA UNIVERSITY, HYDERABAD – 500 007.
M.Sc. (Physics) & M.Sc. Applied Electronics Syllabus
II Semester Syllabus w.e.f. 2008 – 2009

PAE – 208

PAPER – V (ELECTRONICS – II)
(Operational Amplifier, Digital & Microprocessors)

UNIT - I (13 Hrs.)
Operational Amplifiers: Characteristics of Ideal operational Amplifier, Block diagram of an IC
Op-Amp. Analysis of inverting amplifier, Non-inverting amplifier, Integrator, Differentiator,
Summing amplifier, Difference amplifier, Comparator, Logarithmic amplifier and exponential
amplifier, Analog computation, Square wave, Triangular wave and Sine
wave generators.
IC 555: Working of IC 555, Astable and Monostable Multivibrator circuits with 555.

UNIT - II (13 Hrs.)
Logic Circuits: Boolean laws and theorems, SOP and POS representation, Min terms and Max
terms, Karnaugh Maps (upto 4-variables), Tabulation method, Half and Full adder, Parity
checker and Generator, Decoder/Demultiplexer, Data selector/Multiplexer, Encoder.
Flip-Flops: RS, D, JK and M/S JK flip flops.
Shift Registers: Types of registers, Serial in Serial out, Serial in Parallel out, Parallel in Serial
out and Parallel in Parallel out Registers, IC 7496, Ring Counter.

UNIT - III (13 Hrs.)
Counters: Ripple (Asynchronous) Counters, Divide by N Counter, Synchronous Counters,
Decade Counter using Flip-Flops and ICs 7490, 7493.
D/A Converters: Variable Resistor Network type, R – 2R ladder type, 4 bit Binary Converter,
D/A Accuracy and Resolution.
A/D Converters: Simultaneous Conversion, Counter method, Continuous A/D conversion,
Successive approximation Conversion, Dual Slope A/D conversion,
A/D Accuracy and Resolution.

UNIT - IV (13 Hrs.)
Microprocessors: Architecture of 8085 microprocessor, Introduction to Assembly language
programming, Examples.

RECOMMENDED BOOKS:
1. Integrated Electronics -- Millman and Haikie.
2. Microelectronics -- Millman & Grabel
3. Operational amplifier -- Goworker
4. Principles of Digital Electronics -- Gotham
6. Microprocessors Architecture, Programming and Application with the 8085/8080
   -- Goankar

******
HEAT ACOUSTICS

1. Determination of Stefan’s constant
2. Study of variation of specific heat of graphite with temperature
3. Temperature variation of resistance of thermistor
4. Coefficient of linear expansion of given material with Fizeau’s method
5. Estimation of errors
6. Viscosity of water using oscillating disc
7. Measurement of ultrasonic velocity in liquids using Debye-Sears method
8. a. Ultrasonic velocity in liquids and liquid mixtures using ultrasonic interferometer
   b. Calculation of compressibility
9. Determination of ultrasonic velocity in solids
10. Y and n of flat spiral spring

OPTICS

1. The thickness of the film using Fresnel’s biprism
2. Variation of Cauchy’s relation
3. Determination of wavelength and difference in the wavelength of the sodium light using Michelson interferometer.
4. Young’s modulus of the given glass using Newton’s ring method
5. Poisson’s ratio of the given glass beam using Newton’s ring method
6. Wavelength of the sodium light by studying the difference and interferometer pattern obtained with single and double slit.
7. Photo elastic constants of given material
8. Variation of the birefringence of the given crystals with wave length
9. Determination of wavelength of given monochromatic light using Fresnel biprism
10. Study of temperature variation of refractive index of air using Michelson’s interferometer
11. Study of double refraction of quartz and calcite crystals using spectrometer
12. Determination of birefringence of a uniaxial crystal using constant deviation spectrometer
13. Study of characteristics of phototransistor and verification Malus law
14. Study of elliptically polarized light
15. Determination of wave length of He-Ne laser radiation using diffraction grating
16. Study of profile of laser beam
17. Study of characteristics of injection laser
18. Study of characteristics of LED
19. Determination of angular frequency of motor using chopping technique.
a) Electronics

1. RC coupled transistor amplifier
2. RS phase shift oscillator
3. Colpitt’s oscillator
4. Characteristics of OPAMP (IC741) and study inverting and non-inverting amplifiers
5. Wien bridge oscillator
6. Schmitt trigger with 741 and 555
7. Astable multivibrator (555)
8. Switching mode power supply
9. Regulated power supply with 723
10. Regulated power supply with 78xx
11. Triangular and square wave generator (741)
12. Monostable multi vibrator (555)
13. Sawtooth generator (555)
14. Voltage controlled oscillator (555)
15. Amplitude modulation and detection (555)
16. DA converter
17. AD converter
18. Construction and verification of the following
   a. Logic gates/circuits using NAND gates (7400)
   b. AND, OR, NOT, NAND, Ex-OR
19. Half adder and full adder
20. Flip flops RS, JK, D types
21. Construction and verification of the following counters
   a. Divide by 10 counter with 7490
   b. Divide by 16 counter with 749
   c. Divide by 12 counter with 7492
   d. Divide by N counter with 7476
22. Construction of shift registers
23. Logic circuits with discrete components
24. Demorgan’s laws and conversions
25. Experiments using microprocessor (8085 kit)

b) Computer Programming

1. Evaluation of functions sin x, Cos x, log x etc
2. Evaluation of determinant of a matrix and matrix multiplication
3. Evaluation of the values of first order Bessel function
4. Solution of non-linear equations
5. Newton-Raphson method
6. Trapezoidal rule
7. Simpson's 1/3 and 3/8 rule
8. Gaussian Quadrature.
Solution of differential equations
9. Euler's method
10. Runge-Kutta method
11. Making difference table
12. Lagrange's interpolation
13. Polynomial curve fitting method
Solution of system of linear equations
14. Gauss elimination method