DEPARTMENT OF PHYSICS
TELANGANA UNIVERSITY, NIZAMABAD – 503 322

M.Sc. (PHYSICS WITH ELECTRONICS)
SCHEME OF INSTRUCTION AND EXAMINATION
WITH EFFECT FROM 2008 – 2009

SEMESTER I

Paper	Code	Subject	Instruction Hrs/ Week	Duration of Exam In Hrs	Max. Marks
THEORY					
I	PAE 101	Mathematical Physics and Numerical Methods	4	3	100
II	PAE 102	Classical Mechanics	4	3	100
III	PAE 103	Quantum Mechanics – I	4	3	100
IV	PAE 104	Programming in C and MATLAB	4	3	100
V	PAE 105	Electronics – I	4	3	100
PRACTICALS					
VI	PAE 151	Heat & Acoustics, Optics	6	#	50
VII	PAE 152	Electronics & Computer Programming	6	#	50
Seminar			2		
Total			32+2		600

Note : **#** Examination will be at the end of Semester **II**

M.Sc. (Physics with Electronics) Semester I
Paper I (PAE 101) - Mathematical Physics and Numerical Methods

UNIT – I

Legendre's Differential Equation: Power series Solution – Legendre Functions of the first and second kind – Generating Function – Rodrigues' Formula – Orthogonal Properties – Recurrence Relations.
Bessel's Differential Equation: Power series Solution – Bessel Functions of First and second kind – Generating Function – Orthogonal Properties – Recurrence Relations.
Hermite Differential Equation: Power series Solution – Generating Function – Rodrigues' Formula – Orthogonal Properties – Recurrence Relations.

UNIT – II

Fourier Transform: Infinite Fourier Sine and Cosine transforms – Properties of Fourier transforms – Derivative of Fourier transform - Fourier transform of a derivative - Fourier Sine and Cosine transform of derivatives – Finite Fourier transforms – Applications of Fourier transforms.
Laplace Transform: Properties of Laplace transforms – Derivative of Laplace transforms - Laplace transform of a derivative - Laplace transform of periodic functions – Inverse Laplace transform and its properties – Inverse Laplace theorem – Convolution theorem – Evaluation of inverse Laplace transforms by Convolution theorem.

UNIT – III

Errors: Round off Errors – Truncation Errors – Absolute Errors – Relative Errors – Propagation Errors – Convergence of Iterative Processes – Errors estimation – Method of relaxation.
Root Finding Methods: Bisection method – Secant method – Newton Raphson method for multiple roots – Muller method.
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

Interpolation: Linear Interpolation – Lagrange Interpolation – Newton Interpolation – Divided differences – Spline Interpolation – Cubic Spline.
Curve Fitting: Linear Regression – Transcendental Regression – Polynomial Regressional Analysis.

System of Linear Equations: Gauss Elimination Method – Gauss Jordan Method – Triangular Factorisation 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 – Lious A Pipes and Lawrance R. Rarvil.
2. Mathematical Physics – A. K. Ghatak, I.C. Goyal and S. L. Chua – Macmillan India Ltd.
3. Mathematical Methods – Mathews and Walker – Pearson Education.
4. Programming in MATLAB : Mare E. Hermiter – THOMSON – BROOKS/COLE, (Vikas Publishing House)
5. Numerical Methods – E. Balaguruswamy, Tata McGraw – Hill Publishing Company Ltd.
6. Numerical Methods for Scientific and Engineering Computations – M. R. Jain, S. R. K. 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.
8. Mathematical physics including Classical Mechanics by Satya Prakash

M.Sc. (Physics with Electronics) Semester I
Paper II (PAE 102) - Classical Mechanics

UNIT–I

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

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 equation's from Hamilton's principle.

UNIT–III

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

Mechanics of Continuous Systems: Analysis of the free vibrations of a linear triatomic molecule - Eagan 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 Mechaincs : By Goldstein,Poole & Safko (Pearson 2002)
2. Classical Mechanics: Rana & Joag (TMH)
3. Introduction to Classical Mechaincs: Takwale & Puranik (TMH)
4. Classical Mechaincs: By J.C. Upadhyaya
5. Classical Mechanics.P.V.Panat (Narosa 2005)
6. Lagrangian and Hamiltonian Mechanics: Calkin(Allied Publishers 2000)
7. Lagrangian Dynamics : Dave Wells (Schaum series 1967)
8. Classical mechanics: T.L.Chow (John Wiley 2000)

M.Sc. (Physics with Electronics) Semester I
Paper III (PAE 103) - Quantum Mechanics – I

UNIT–I

Fundamental Concepts: Basic principles of Quantum mechanics- probability density and probability current – equation of continuity – The Enhrenfest theorem. Hilbert space – State vectors and operators - Ket, Bra notation. Superposition principle - Matrix representations of vectors and operators – Hermitian operators and their properties- Eigen vectors and eigen values – change of basis – diagonalization. Observables and their measurement- Expectation value of an observable – compatible and incompatible observables - projection operator and its physical significance - change of basis. Uncertainty principle -The Schrödinger, Heisenberg and Interaction pictures. Solution of simple harmonic oscillator in operator method.

UNIT–II

Symmetry principles: Symmetries in Classical and Quantum mechanics-Conservation Laws. Translational symmetries in space and time-Equations of motion. Generators of infinitesimal rotations. Discrete symmetries - space inversion - unitary inversion operator. Time reversal operator with application to spin zero and non-zero spin particles.

UNIT–III

Theory of Angular momentum: Orbital angular momentum, ladder operators and commutation relations. Generalized angular momentum- J_+, J_- 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 $j_1 = ½$ & $j_2 = ½$ and $j_1 = ½$ & $j_2 = 1$ as examples.

UNIT–IV

Approximation Methods: Time-independent perturbation theory. Non-degenerate case –first and second order corrections. Perturbed harmonic oscillator and ground state helium atom. Degenerate case - linear Stark effect. Variation method- application to ground state of Helium atom. WKB approximation – alpha decay.

RECOMMENDED BOOKS

1. Introduction to Quantum Mechanics : P.T.Mathews (McGraw Hill 1974)
2. Modern Quantum Mechanics: J.J.Sakurai (Pearson 1994)
3. Quantum Mechanics: L.I.Schiff (McGraw Hill 1968)
4. Quantum Mechanics: E.Merzbacher(Wiley 1970
5. Quantum Mechanics: Arul das
6. Quantum Mechanics: B. K. Agarwal and Hari Prakash (PHI 1997)
7. Quantum Mechanics: Ghatak and Lokanathan
8. Quantum Mechanics : P A M Dirac
9. Feynman Lectures on Physics- Vol.3 (Addition Wesley 1965)
10. Quantum Mechanics: Satya Prakash

M.Sc. (Physics with Electronics) Semester I
Paper IV (PAE 104) – Programming in C and MATLAB

UNIT–I

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 – Initialisation – 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

Structures: Declaration – Initialisation - 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

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.

UNIT–IV

File Input and Output: Opening and Closing Files – Writing Formatted Output Files – Reading Formatted Data from Files – Writing and Reading Binary Files.
Plotting in MATLAB: Line Styles, Markers and Colors – Important Plotting Commands – Obtaining Numerical values from graphs- Different Plot types – Three Dimensional Plots – Handle Graphics – Saving and Plotting Graphs.
MATLAB Numerical Methods: Linear Algebra – Curve Fitting – Data Analysis and Statistics – Numerical Integration – Numerical Differentiation - Ordinary Differential Equations - Nonlinear Algebraic Equations – Eigen vectors and Eigen values.
MATLAB Electronic Applications: Fourier Analysis – Fourier Transforms and Applications.

RECOMMENDED BOOKS

1. C Programming Language – Brain W.Kernighan – Dennis M. Ritchie – PHI
2. Programming in C : Ravichandra - New Age International
3. Programming in MATLAB – Marc E. Hermiter – THOMSON Brooks/Cole (Vikas Publishing House)
4. Data structures Using C – Tenenbium , …, …. – PHI
5. Data Structures – Seymour , Lipsehutz - Schum's Series – Tata Macgraw Hill
6. MATLAB programming – Rudrapratap

M.Sc. (Physics with Electronics) Semester I
Paper V (PAE 105) - ELECTRONICS – I (Semiconductor Electronics)

UNIT – I

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 π model)

UNIT – II

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.
Feed back 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

Sinusoidal Oscillators (Using BJT's): Criterion for oscillations, Phase shift, Wein bridge, Hartley and Colpitts Oscillators, Crystal Oscillator.
Collector coupled Astable, Monostable, Bistable multivibrator and Schmitt trigger.

UNIT – IV

Modulation and Detection: Amplituded Modulation – Frequency components in an AM signal, Balanced Amplitude Modulator, Envlope 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.

M.Sc. (Physics with Electronics) Semester I
Practical Paper – VI (PAE 151 & 251)– General Physics Lab

A) 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 thermister
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.

B) OPTICS

1. The thickness of the film using Fresnels Biprism
2. Variation of Cauchy's relation.
3. Determination of wavelength and difference in the wavelength of the sodium light using Michelson interferometer.
4. Youngs's modulus of the given glass using Newton's ring method
5. Poission'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.

M.Sc. (Physics with Electronics) Semester I
Practical Paper–VII (PAE 152 & 252): Electronics and Computer Programming

(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. Wein bridge oscillator
6. Schmitt trigger with 741 and 555
7. Astable multivibrator (555)
8. Switch mode power supply
9. Regulated power supply with 723
10. Regulated power supply with 74xx
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 microssor (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

Solution of non-linear equations

4. Newton-Raphson method
5. Bisection method.

Numerical integration

6. Trapezoidal rule
7. Simpson's 1/3 and 3/8 rule
8. Gaussian Quadrature.

Solution of differential equations

9. Eulers 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
15. Gauss seidel method.

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M.Sc. (PHYSICS WITH ELECTRONICS)

SCHEME OF INSTRUCTION AND EXAMINATION
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SEMESTER II

Paper	Code	Subject	Instruction Hrs/ Week	Duration of Exams In Hrs	Max. Marks
THEORY					
I	PAE 201	Electromagnetic Theory	4	3	100
II	PAE 202	Solid State Physics - I	4	3	100
III	PAE 203	Quantum Mechanics - II	4	3	100
IV	PAE 204	Statistical Mechanics	4	3	100
V	PAE 205	ELECTRONICS – II	4	3	100
PRACTICALS					
VI	PAE 251	Heat & Acoustics, Optics	6	5	50
VII	PAE 252	Electronics & Computer Programming	6	5	50
Seminar			2		
Total			32+2		
PRACTICALS SEMESTER I					
VI	PAE 151	Heat & Acoustics, Optics		#	50
VII	PAE 152	Electronics & Computer Programming		#	50
Total					700

Note : # Instruction during Semester I

M.Sc. (Physics with Electronics) Semester II
Paper I - Electromagnetic Theory

PAE 201

PAPER – I

ELECTROMAGNETIC THEORY

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 electrostatic 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)

Propagation of Plane Electromagnetic Waves: Electromagnetic (EM) waves in unbounded media - EM wave equation for a homogeneous isotropic dielectric medium - Propagation of plane EM waves in free space-Propagation of EM waves in homogeneous isotropic dielectric medium-Energy transmitted by a plane E.M wave -Propagation of E.M waves in conducting medium-Attenuation and Skin effect-Energy transmitted -Polarization of E.M waves.

UNIT–III: (13 Hrs)

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

UNIT–IV: (13 Hrs)

Electromagnetic Fields and Radiating Systems: Electromagnetic radiation: Inhomogeneous wave equation for potentials-Retarded potentials-Multipole expansion of EM radiation for harmonically oscillating source-Long wavelength approximation-Oscillating electric dipole radiation-Oscillating magnetic dipole radiation-Radiation from centerfed linear antenna –

Radiation from accelerated charges: Lienard Wiechert potentials-Electromagnetic field of a charge in arbitrary motion.

RECOMMENDED BOOKS:

1) Classical Electrodyanamics by S.P.Puri, Tata Mc Graw-Hill Publishing Co.Ltd (2000).
2) Introduction to Eletrodynamics by D.J.Griffiths, Prentice-Hall of India (1998).
3) Electrodynamics by Gupta, Kumar and Singh, Pragathi Prakashan Publishing (2007).
4) Electricity and Magnetism by M.H.Nayfeh and M.K.Brussel, John Wiley and Sons (1985).
5) Classical Electrodynamics by J.D.Jackson, John Wiley and Sons (1999).
6) Foundations of Electromagnetic Theory by J.R.Rietz, F.J.Milford and Christy, Narosa publishing house (1986).
7) Engineering Electromagnetics by W.H.Hayt and J.A.Buck, Tata Mc-GrawHill(2001).
8) Electromagnetic waves and Radiating systems by E.C.Jordan and K.G.Balmain, Prentice-Hall(1968).
9) Electrodynamics Theory by Satya Prakash

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M.Sc. (Physics with Electronics) Semester II
Paper II – Solid State Physics - I

PAE – 202

PAPER - II

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.)**

Structural Studies of Solids: **Bragg's law, Van Laue treatment of x-ray diffraction and its equivalence with Bragg's law. Atomic structure factor, Geometrical structure factor and Debye Wallar factor. Concept of Reciprocal lattice. Concept of Brillouin zones. Experimental methods of x-ray diffraction of crystals- Laue and Powder methods. Determination of unit cell parameters of a cubic crystal. Elements of neutron and electron diffraction.**

UNIT - **III**: (14 Hrs.)

Crystal Growth and Imperfections: Crystal growth from solution and melt, growth from vapour phase. Experimental techniques of growth from melt. Classification of imperfections. Schottky and Frenkel defects, expressions for their equilibrium concentrations in metals and ionic crystals. Color centers and their models. Diffusion – Mechanisms, Fick's laws of diffusion, Kirkendal effect; Ionic conductivity; Dislocations – edge and screw dislocations, Dislocation multiplication- Grain boundaries.

UNIT – IV: (14 Hrs.)

Band Theory and Semiconductor Physics**: Failure of Free electron theory of metals. Bloch theorem, behavior of electron in periodic potentials, Kronig-Penney model, E vs K relation, density of states in a band, effective mass of electron, negative effective mass and concept of hole.**

Distinction between metals, semiconductors and insulators. Intrinsic semiconductors, band model, Fermi level, expressions for electron and hole concentrations in intrinsic and extrinsic semiconductors. Hall effect in semiconductors.

RECOMMENDED BOOKS:

1. Crystallography and Solid State Physics : A.R.Verma and O.N.Srivastava
2. Physics of amorphous solids : S.R.Elloit
3. Solid Sate Physics : AJ Deckker
4. Introduction to Solid Sate Physics : Kittel
5. Solid Sate Physics : R.L.Singhal
6. Elements of Solid State Physics : J.P.Srivastava
7. Elements of Solid state Physics : Aliomar
8. Solid State Physics : Gupta Kumar

M.Sc. (Physics with Electronics) Semester II
Paper III - Quantum Mechanics - II

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 Hortree-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: (13 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:

1. Introduction to Quantum Mechanics : P.T.Mathews (McGraw Hill 1974)
2. Modern Quantum Mechanics : J.J.Sakurai (Pearson 1994)
3. Quantum Mechanics : L.I.Schiff (McGraw Hill 1968)
4. Quantum Mechanics : E.Merzbacher(Wiley 1970)
5. Quantum Mechanics : Arul das
6. Quantum Mechanics : B.K.Agarwal & Hari Prakash
7. Quantum Mechanics : Ghatak and Lokanathan
8. Quantum Mechanics : P A M Dirac

M.Sc. (Physics with Electronics) Semester II
Paper IV – Statistical Mechanics

PAE-204

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. Apriori 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)

Maxwell-Boltzmann statistics-distribution law- Maxwell velocity distribution- equipartition theorem. Canonical ensemble-partition function- Ideal gas. Grand canonical ensemble-partition function- Ideal gas. Quantum Statistical mechanics- Postulates- indistinguishability- Bose-Einstein and Fermi-Dirac statistics and distribution laws.

Partition function and thermodynamic quantities-transational, rotational and, vibrational partition functions - Specific heat of diatomic molecules.

UNIT - III: (13 Hrs)

Ideal Bose-Einstein gas-Energy and pressure of the gas. Bose-Einstein condensation-Liquid Helium-Two fluid model- phonons, rotons, superfluidity.

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:

1. Statistical mechanics by Satyaprakash and J.P.Agarwal(Ed.2002)
2. Statistical mechanics by Gupta and Kumar (Pragati Prakashan -2002)
3. Statistical Mechanics by B.K.Agarwal and M.Eisner
4. Statistical mechanics and properties of matter by E.S.R.Gopal
5. Statistical Physics by Battachargee
6. Statistical Physics byTony Guenauit
7. Heat and Thermodynamics by Zeemansky

M.Sc. (Physics with Electronics) Semester II
Paper V – ELECTRONICS – II (Operational Amplifier, Digital & Microprocessors)

PAE – 205

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 amplifiers, Integrator, Differentiator, summing amplifier, Difference amplifier, Comparator, Logarithm amplifier and exponential amplifier, Analog computation, Square wave, Rectangular 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 adder 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.)

Microprocessor: Architecture of 8085 microprocessor, Introduction to Instruction set, Data transfer instructions, Arithmetic, Logic and Branch operations, Assembly language programming- Examples.

RECOMMENDED BOOKS:

1. Integrated Electronics -- Millman and Halkies.
2. Microelectronics -- Milliman & Grabel
3. Operational amplifier – Gawkward
4. Principles of Digital Electronics – Gothman
5. Digital Principles and Applications Computer Electronics -- Malvino.
6. Microprocessors Architecture, Programming and Application with the 8085/8080 -- Goankar

M.Sc. (Physics with Electronics) Semester II
Practicals

PAE – 151 &251 a) HEAT ACOUSTICS

11. Determination of Stefan's constant.
12. Study of variation of specific heat of graphite with temperature
13. Temperature variation of resistance of thermister
14. Coefficient of linear expansion of given material with Fizeau's method
15. Estimation of errors
16. Viscosity of water using oscillating disc
17. Measurement of ultrasonic velocity in liquids using Debye-Sears method
18. a). Ultrasonic velocity in liquids and liquid mixtures using ultrasonic interferometer
    b). Calculation of compressibility.
19. Determination of ultrasonic velocity in solids
20. Y and n of flat spiral spring.

b) OPTICS

20. The thickness of the film using Fresnels Biprism
21. Variation of Cauchy's relation.
22. Determination of wavelength and difference in the wavelength of the sodium light using Michelson interferometer.
23. Youngs's modulus of the given glass using Newton's ring method
24. Poission's ratio of the given glass beam using Newton's ring method
25. Wavelength of the sodium light by studying the difference and interferometer pattern obtained with single and double slit.
26. Photo elastic constants of given material
27. Variation of the birefringence of the given crystals with wave length
28. Determination of wavelength of given monochromatic light using Fresnel biprism
29. Study of temperature variation of refractive index of air using Michelson's interferometer
30. Study of double refraction of quartz and calcite crystals using spectrometer
31. Determination of birefringence of a uniaxial crystal using constant deviation spectrometer
32. Study of characteristics of phototransistor and verification Malus law
33. study of elliptically polarized light
34. Determination of wave length of He-Ne laser radiation using diffraction grating.
35. Study of profile of laser beam.
36. Study of characteristics of injection laser.
37. Study of characteristics of LED
38. Determination of angular frequency of motor using chopping technique.

a) Electronics

26. RC coupled transistor amplifier
27. RS phase shift oscillator
28. Colpitt's oscillator
29. Characteristics of OPAMP (IC741) and study inverting and non-inverting amplifiers.
30. Wein bridge oscillator
31. Schmitt trigger with 741 and 555
32. Astable multivibrator (555)
33. Switch mode power supply
34. Regulated power supply with 723
35. Regulated power supply with 74xx
36. Triangular and square wave generator (741)
37. Monostable multi vibrator (555)
38. Sawtooth generator (555)
39. Voltage controlled oscillator (555)
40. Amplitude modulation and detection (555)
41. DA converter
42. AD converter
43. Construction and verification of the following
    a. Logic gates/circuits using NAND gates (7400)
    b. AND, OR, NOT, NAND, Ex-OR
44. Half adder and full adder
45. Flip flops RS, JK, D types
46. 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
47. Construction of shift registers
48. Logic circuits with discrete components
49. Demorgan's laws and conversions
50. Experiments using microssor (8085 kit)

b) Computer Programming

16. Evaluation of functions sin x, cos x, log x etc
17. Evaluation of determinant of a matrix and matrix multiplication
18. Evaluation of the values of first order Bessel function

Solution of non-linear equations

19. Newton-Raphson method
20. Bisection method.

Numerical integration

21. Trapezoidal rule
22. Simpson's 1/3 and 3/8 rule
23. Gaussian Quadrature.

Solution of differential equations

24. Eulers method
25. Runge Kutta method
26. Making difference table
27. Lagrange's interpolation
28. polynomial curve fitting method

Solution of system of linear equations

29. Gauss elimination method
30. Gauss seidel method.

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M.Sc. (PHYSICS WITH ELECTRONICS)
SCHEME OF INSTRUCTION AND EXAMINATION
WITH EFFECT FROM 2009– 2010

SEMESTER III

Paper	Code	Subject	Instruction Hrs/ Week	Duration of Exam In Hrs	Max. Marks
THEORY					
I	PAE 301	Solid State Physics–II	4	3	100
II	PAE 302	Modern Optics	4	3	100
III	PAE 303	Digital Logic Circuits	4	3	100
IV	PAE 304	Microprocessors & Interfacing	4	3	100
V	PAE 305	Electronic Instrumentation	4	3	100
PRACTICALS					
VI	PAE 351	General Physics Lab	6	#	50
VII	PAE 352	Analog, Digital & Simulation Lab	6	#	50
Seminar			2		
Total			32+2		600

Note : # Examination will be at the end of Semester **IV**

M.Sc. (Physics with Electronics) Semester III
Paper I -Solid State Physics–II
(Thermal, Electrical and Magnetic Properties of Solids)

UNIT–I: Lattice Vibrations and Thermal Properties

Elastic waves in one-dimensional array of identical atoms. Vibrational modes of a diatomic linear lattice and dispersion relations. Acoustic and optical modes. Infrared absorption in ionic crystals. Phonons and verification of dispersion relation in crystal lattices. Lattice heat capacity – Einstein and Debye theories. Lattice thermal conductivity- Phonon mean free path. Origin of thermal expansion and Gruneisen relation.

UNIT - II: Dielectrics and Ferroelectrics

Macroscopic description of the static dielectric constant . Concept of local field. The electronic ,ionic and orientational polarizabilities. Measurement of dielectric constant of a solid. Clausius-Mosotti relation. Behaviour of dielectrics in an alternating field, elementary ideas on dipole relaxation. Classification of ferroelectric crystals- Ba TiO3 and KDP. Dipole theory of ferroelectricity Spontaneous polarization and ferroelectric hysteresis.

UNIT - III: Magnetic Properties

Diamagnetism- Langevin's theory and quantum theory. Origin of permanent magnetic moment. Theories of paramagnetism. Paramagnetic cooling. Spontaneous magnetization – Weiss theoty of spontaneous magnetization. Nature and origin of Weiss molecular field, Heisenberg exchange interaction. Ferromagnetic domains and hysteresis. The Bloch wall, Neel's theory of anti ferromagnetism. Ferrimagnetism, ferrites and their applications (basic concepts only)

UNIT - IV: Superconductivity

Occurrence of superconductivity. Experimental observations – persistent currents,effectof magnetic field, Meissner effect, Type I and type II superconductors. Isotope effect, entropy, heat capacity and thermal conductivity. Energy gap . Microwave and infrared absorption. Theoretical explanations: London's equations- penetration depth. Coherence length, Cooper pairs and elements of BCS theory. Giaver tunneling, Josephson effects (Basic ideas only). Elements of high temperature superconductors (basic concepts). Applications of superconductors.

RECOMMENDED BOOKS

1. Solid state Physics by AJ Deckker
2. Introduction to solid state Physics by Kittel
3. Solid state Physics by R.L.Singhal
4. Solid state Physics by Gupta Kumar
5. Elements of solid state Physics by J.P.Srivastava

M.Sc. (Physics with Electronics) Semester III
Paper II - Modern Optics

UNIT – I: Principles of Lasers

Lasing idea. Pumping schemes. Emission and absorption of Radiation. Einstein Relations. Population inversion. Optical feedback. Rate equations for two, three and four level lasers. Pumping threshold conditions. Laser modes properties of laser beams.

UNIT – II: Lasers

Gas lasers and Energy level schemes: He – Ne, Argon Co2 and Excimer lasers. Applications.
Solid State lasers: Ruby, Neodymium, YAG lasers, Dye lasers.
Semiconductor lasers: Ga-As lasers and applications.

UNIT – III: Holography

Introduction to Holography, Recording of amplitude and phase. The recording medium. Reconstruction of original wave front. Image formation by wave front reconstruction. Gaber Hologram, Limitations of Gaber Hologram. Off axis Hologram. Forier transform Hlolograms. Volume Holograms. Aplications of Holograms.

UNIT – IV: Fourier and Non-Linear Optics

Thin lens as phase transformation. Thickness function. Various types of lenses. Forier transformaing properties of lenses. Object placed in front of the lens. Object placed behind the lens.

Non-Linear Optics – Harmonic generation. Second harmonic generation. Phase matching. Optical mixing. Parametric generation of light. Self focusing of light. Phase conjugate optics.

REFERENCES

1. Opto Electronics and an introduction – Wilson & J F B Hawkes 2nd Edition.
2. Introduction to Fourier optics – J.W. Goodman
3. Lasers and Non-Linear optics – B.B. Laud
4. Optical Electronics – Ghatak nd Thyga Rajan.
5. Principles of Lasers – O.Svelto.

M.Sc. (Physics with Electronics) Semester III
Paper III - Digital Logic Circuits

UNIT-I

COMBINATIONAL LOGIC CIRCUITS: Simplifying Logic Circuits, Sum of products form - Algebraic simplification, designing combinational logic circuits, Karnaugh Map Method, looping - pairs, quads, octets, complete simplification process, Don't care conditions, examples.

DIGITAL ARITHMATIC OPERATIONS AND CIRCUITS: Binary addition, representing signed numbers, binary subtraction, BCD addition, Hex arithmetic, ALU, parallel binary adder, design of full adder, carry propagation's, IC parallel adder, 2's compliments system, IEEE/ANSI symbols.

UNIT-II

FLIP-FLOPS: NAND and NOR gate latches, locked signals and clocked flip-flops, clocked R-S, J-K, and D-FFs, D latches, Asynchronous inputs, IEEE/ANSI symbols, Timing consideration, one shot.

COUNTERS AND REGISTERS: Ripple counters, Counter with MOD numbers < 2n. IC asynchronous counters, asynchronous down counters, propagation delay in ripple counter, Up/Down counters. Presettable counters, 74193 counter, Decoding a counter, Decoding glitches, synchronous counter design, Left & Right shift registers, shift register counters, IEEE/AMSI symbols.

UNIT- III

IC LOGIC FAMILIES: Digital IC terminology, TTL logic family, TTL series characteristics, improved TTL series, TTL loading and fan-out other TTL characteristics, connecting TTL outputs together, tristate TTL, ECL Family, MOS digital IC's and characteristics, CMOS logic and characteristics, bilateral switch, TTL driving CMOS and vice versa. Low voltage technology

MSI LOGIC CIRCUITS: Decoders, BCD to 7 segment decoder/driver, liquid crystal display, Encoders, multiplexers and their applications, demultiplexers, magnitude comparators, code converters, data busing, data bus operations, IEEE./ANSI symbols,

UNIT- IV

MEMORY DEVICES: General Memory Operation, CPU-Memory connection, Read only memories, ROM architecture, ROM timing, and types of ROMs, Flash memory, and ROM applications. Semiconductor RAMs, RAM architectures, static RAM, Dynamic RAM (DRAM), DRAMS structure and its operation, DRAM Read/Write cycles, DRAM refreshing expansion of word sizes and capacity

PROGRAMMABLE LOGIC DEVICES: Basic ideas, PLD architectures (PROM), PAL, PLAS, Application of programmable logic devices - GAL 16V, 8A programming PLD's Development Softwares, Universal Compiler for programmable logic (CUPL).

RECOMMENDED BOOKS

1. Digital Systems - Principles and Applications - Ronald J.Tocci, 6/e, PHI, New Delhi. 1999.
2. Modern digital electronics – R.P.Jain, Tata McGraw Hill 3rd Edition.
3. Digital Design – M.Morris Mano.

ADDITIONAL REFERENCES

1. Digital Principes and Design-Donald D. Givone.
2. Digital Integrated Electronics - Herbert Taub and Donal Schilling, McGraw Hill, 1985.
3. Digital Electronics - An introduction to Theory and Practice by William H.Gothmann.
4. Digital Principles and Applications by Albert Paul Malvino and Donald P. Leach, TMH, India.
5. Computer Architecture and Logic Design by Thomas C.Bartee, McGraw-Hill. Inc.
6. Switching theory and Logic design – R.P. Jain.

M.Sc. (Physics with Electronics) Semester III
Paper IV - Microprocessors & Interfacing

UNIT- I

The 8086 Microprocessor - General Organization of a Microcomputer, Detailed Architecture of 8086, Addressing Modes, Instructions, Assembly Language Programming, Programming Examples. The 8086-Based System Design - Pins and Signals, System Components, Interfacing Memory, I/O Devices, Data Converters, Stepper Motor. Interrupts. Basic DMA operation.

UNIT- II

Peripheral Interfaces and Advanced Microprocessors - Parallel I/O Methods, Programmable Peripheral Interface (8255 A), Priority Interrupt Controller (8259 A), DMA Controller (8237), Programmable Interval Timer (8254), Serial I/O, UART (PC 16550 D).

UNIT- III

The IBM PC Motherboard and Drives - Motherboard Components, System Resources, ROM BIOS Services. Drives - Principles of Magnetic Storage, Floppy Disk Drive, Hard Disk Drive, IDE Interface, SCSI Interface, CD-ROM Drive, BIOS Disk Drive Services.

UNIT- IV

I/O Buses, Ports and Universal Serial Bus - ISA, MCA, EISA, PCI Buses; Local Buses, VL Bus, AGP. Parallel and Serial Ports. USB - USB System, USB Transfer, USB Controller. Advanced Microprocessors - Protected Mode Operation, The 80286, 80386, 80486, Pentium, Pentium-Pro and Pentium I - IV Microprocessors.

RECOMMENDED BOOKS

1. Microprocessors, PC Hardware and Interfacing - By N. Mathivanan, PHI, 2003
2. The Intel Microprocessors 8086/8088, 80186/80188, 80286,80386,80486, Pentium, Pentium Pro Processor, Pentium II, Pentium III, Pentium 4, Architecture, Programming, and Interfacing - By Barry B. Brey, 6th Ed., PHI / PEA, 17th Reprint, 2003
3. The 8086 Microprocessor : Programming & Interfacing the PC - By Kenneth J. Ayala Penram International Publishing, 1995

ADDITIONAL REFERENCES

1. Advanced Microprocessors and Peripherals - Architecture, Programming and Interfacing - By A K Ray and K M Bhurchandi, TMH, 2000
2. Advanced Microprocessors and Interfacing - By Badri Ram, TMH, 2nd Reprint 2002
3. Microprocessors and Interfacing, Programming and Hardware - By Douglas V. Hall, TMH, 2nd Ed., 18th Reprint, 2003
4. The 8088 and 8086 Microprocessors - Programming, Interfacing, Software, Hardware and Applications - By Walter A Triebel and Avtar Singh, PHI, 4th Ed., 2002
5. Microcomputer Systems: The 8086/8088 Family, Architecture, Programming, and Design - By Yu-cheng Liu and Glenn A. Gibson, PHI, 2nd Ed., 1986.
6. Microprocessors – Data Hand Book, BPB.

M.Sc. (Physics with Electronics) Semester III
Paper V - Electronic Instrumentation

UNIT – I

Performance characteristics of an instrumentation system: Zero, First and Second Order Systems- Response of first and second order systems to STEP, RAMP and IMPULSE inputs – Frequency response of first and second order systems- Specification and testing of dynamic response.
Electrical transducer classification: Active and Passive transducers-resistive, inductive, capacitive, thermocouple and Piezoelectric transducers. Digital transducers.

UNIT - II

Amplifiers and Signal Conditioning: Instrumentation amplifiers- Isolation amplifiers- Chopper amplifiers- Voltage to frequency and frequency to voltage converters- Frequency multipliers- logarithmic amplifiers, S/H Circuits Active filters-Low pass, High pass, Band pass and Band stop filters – Butterworth filters- All Pass filters. Phase sensitive detectors (PSD) - Phase lock loop (PLL) – Lock-in-amplifier.

UNIT-III

Signal Generation: Frequency synthesized signal generator- Frequency divider generator-RF signal generator- Signal generator modulation- Sweep frequency generator- Function generator- Noise generator.

Signal Analysis: Wave Analyzers-Audio frequency Wave analyzer- Heterodyne wave analyzer- Harmonic distortion analyzers-Resonant harmonic distortion analyzer- Heterodyne harmonic distortion analyzer- Fundamental suppression harmonic distortion analyzer- Spectrum analyzer- Spectra of CW, AM, FM and PM waves.

UNIT–IV

Electronic Measuring Instruments: Q-meter- Vector impedance meter- Digital frequency meter – Digital voltmeter – Phase meter- RF power and voltage measurement – Power factor meter – Vector voltmeter.

Display and Recording: X-t, X-Y Recorders- Magnetic Tape recorders- Storage Oscilloscope.

Characteristics of digital displays: LED- LCD – Dot matrix and Seven Segment display systems.

RECOMMENDED BOOKS

1. Modern Electronic Instrumentation and Measurement Techniques – A.O. Hefnick and W.D. Cooper, Prentice Hall India Publications.
2. Instrumentation Devices and Systems – C.S. Rangan, G.R. Sharma and VSV Mani, Tata McGraw Hill Publications.
3. Introduction to Instrumentation and Control – A.K. Ghosh - Prentice Hall India Publications
4. Electrical & Electronics Measurement & Instrumentation - A.K. Sawhney

M.Sc. (Physics with Electronics) Semester III
Practical Paper–VI (PAE 351 &352): General Physics Lab

A) **Modern Physics Experiments**

1. Zeeman effect
2. Raman effect
3. Magnetic susceptiability
4. Verification of Beer's Law*
5. Electrical resistivity – Four Probe Method*
6. Electrical resistivity – Two Probe Method*
7. Hall effect*
8. X-Ray Diffraction Powder Method

B) **Nuclear Physics Experiments**

1. GM detector characteristics and determination of dead time.
2. Determination of Half life of 40_p (β decay)
3. Determination of Half life of 113_{In} .
4. Analysis of complex decay curves Half life of Radiated Silver.
5. Determination of linear absorption coefficiants of gamma rays in aluminium and lead.
6. Recording of gamma ray spectrum and determination of linearity of Scintillation Spectrometer
7. Fermi – Kurie plot (β-rays)

M.Sc. (Physics with Electronics) Semester III
Practical Paper –VII (PAE 351) : Analog, Digital & Simulation Lab

(A1) Analog Experiments

1. Power control by SCR using UJT.
2. PLL (IC 565) as FM Detector.
3. Active filters.
4. PLL (IC565) as frequency synthesizer.
5. Strain guage –Trainer kit.
6. LVDT -Trainer kit.
7. PLL (IC 565) as AM detector.

(A2) Analog Simulation Experiments

8. Active filters Using Op-Amps
9. Frequency Modulation and detection
10. Amplitude modulation and detection
11. Solution of differential equations using analog computation (Using TUTSIM)

(B) Digital experiments (Hardware and Simulation)

1. Construct a synchronous up/down counter using IC74192 and display count using 7-segment display.
2. Implement Boolean functions using a multiplexer.
3. Construct a shift register using IC 7495.
4. Construct an 8-bit full adder using two 4-bit adders.
5. Implement Boolean functions using Dec/D
6. Simulating a four variable Boolean function using a 1 of 16 data Sel/Mu
7. Given a four variable Boolean function design and simulate the circuit using gates.
8. Simulate a 4-bit Bin/BCD decade counter
9. Simulate a full adder circuit using a Dec/Dem
10. Simulate a 4-bit shift register.
11. Design a counter with skipped counts & simulate
12. Simulate a Johnson Counter

DEPARTMENT OF PHYSICS
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M.Sc. (PHYSICS WITH ELECTRONICS)
SCHEME OF INSTRUCTION AND EXAMINATION
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SEMESTER IV

Paper	Code	Subject	Instruction Hrs/ Week	Duration of Exam In Hrs	Max. Marks
THEORY					
I	PAE 401	Nuclear Physics	4	3	100
II	PAE 402	Physics of Atoms and Molecules	4	3	100
III	PAE 403	Embedded Microsystems	4	3	100
IV	PAE 404	PC Architecture & Hardware	4	3	100
V	PAE 405	Instrumentation for measurement, control and data acquisition	4	3	100
PRACTICALS					
VI	PAE 451	General Physics Lab	6	5	50
VII	PAE 452	Microprocessors &Microcontrollers Lab	6	5	50
Seminar			2		
Total			32+2		
PRACTICALS SEMESTER III					
VI	PAE 351	General Physics Lab		#	50
VII	PAE 352	Analog, Digital & Simulation Lab		#	50
Total					700

Note : # Instruction during Semester III

M.Sc. (Physics with Electronics) Semester IV
Paper I – Nuclear Physics

UNIT-I: Nuclear decay processes & Elementary particles

α-Spectrum,Gamows theory of α-decay ;β-spectrum , Neutrino hypothesis, Fermi theory of β-decay, Fermi – Kuri plots – selection rules for β-decay, γ-emission –Multiple radiation – selection rules for γ- decay.

Classification of elementary particles – Fundamental interactions- conservation laws.

UNIT-II : Nuclear radiation & Detection

Interaction of charged particles with matter, Bohr's formula–Belthe's modification. Range- Energy relation; Stopping power–straggling Boremsstralung ; Interaction of γ - radiation with matter (photo electric effect, Compton effect, pair–production) scintillation and solid state delays for γ-rays and their characteristics or properties .

UNIT-III :- Nuclear forces and nuclear models

Nature of nuclear force, Deutron problem, Tensor force–Exchange forces (Majorna, Bartlett and Heisenberg forces). Meson theory of nuclear forces, Liquid drop model – Weizakers semiemperical mass formula; Shell model and its evidence and perditions (spin and particles of nuclear ground states, Magnetic moments and Electric Quadrupole Moments of nuclei.

UNIT-IV : Nuclear reactions & Reactor physics

Kinds of nuclear reactions -Conservation laws,Kinematics of nuclear reaction – Qvale, Nuclear cross section – Compound nucleas and Energy levels of nucleus. Basic properties of neutrons (mass, statistics, spin, half life).

Classification of neutrons – Slowing down of neutrons – Average logarithmic energy decrement, Moderating ratio –Nuclear Diffusion –Neutron current density and leakage rate, Fermi age equation. Bohr and Wheeler theory of fission, Four-fader formula.

REFERENCES

1. Nuclear Physics by D.C.Tayal
2. Introductory Nuclear Physics by S.B.Patel
3. Introductory Nuclear Physics by Kenneth S.Krane
4. Introductory Nuclear Physics by M.W.Wong
5. Nuclear Physics by Kaplan.

M.Sc. (Physics with Electronics) Semester IV
Paper II – Physics of Atoms and Molecules

UNIT-I : Atomic Spectra

One electron system spin – orbit coupling. Fine structure of spectral lines, Zeeman spectra, Patschen – Back and Strak effects.

Two electron system, Lndes ' g ' factor, Landes interval rule, equivalent and in-equivalent electronics states of two-electron system. Singlet and triplet series of two-electron system, Boron group of elements. Anomolous Zeeman splitting of energy levels for two-electron system.

UNIT–II: Molecular Symmetry

Symmetry elements. Algebra of symmetry operations. Multiplication table. Molecular point groups and symmetry groups with more than one symmetry axis. T, T_h, T_d, O and O_h. Matrix representation of symmetry operations.

Reducible irreducible representations. The great Orthogonality theorem. Character table for C_{2v} amd $C_{3\sigma}$ point groups. Symmetry species of point groups. Distribution of fundamentals among the symmetry species.

UNIT – III: Rotation and Vibration spectra of molecules

Interaction of radiation with rotating molecules. Isotopic effect of rotational levels. Vibration rotation, spectra of Diatomic molecules.

Rotation spectra of homo-nuclear diatomic molecule and their alter-nating intensities of spectra lines. Classical and quantum theory of Raman effect. Raman spectrometer. Polarization of Raman scattered light. Normal vibrations of CO_2 and H_2O molecules.

UNIT – IV: Molecular Orbital theory and Electronics Spectra

Molecular orbital method. MO treatment of H_2 ion. MO treatment of H_2 molecule. Electronics configuration of molecules in MO concept. Heitler London theory for Hydrogen molecule.

Electronics spectra of Diatomic molecules – Vibrational course structure. Vibration analysis of Band system, Deslandre's table. Progressions and sequences. Franck Condon principle intensities of vibration – electronic spectra. Fine structure of electronics rotation spectra. Fortrat parabola Dissociation and pre-dissociation of molecules.

REFERENCES

1. Atomic Spectra – H.E. white.
2. Molecular Spectroscopy – G. aruldhas, Prentice Hall of Inida Pvt. Ltd. New Delhi.
3. Fundamentals of Molecular spectroscopy – C.N. Banwell
4. Physics of Atoms and Molecules – B.H.Bransdena nd C.J. Jaochim
5. Quantum Mechanics and Modern Physics – Arderson.

M.Sc. (Physics with Electronics) Semester IV
Paper III – Embedded Microsystems

UNIT – I: Embedded Microcontrollers

Microprocessors and Microcontrollers, a Survey on Microcontrollers. The detailed Architecture of 8051 – Block diagram, Programming Model, Pin Assignments, PSW, Internal RAM Organization, Special Function Registers, I/O ports, and Circuits, External Memory, Counters and Timers, Serial Data I/O, Interrupts. Addressing Modes - Immediate, Register, Direct and Indirect Modes.
(Text-1, Chapters- 1, 3)

UNIT – II: Programming the 8051

Instruction Set – Moving Data – Internal and External Data Moves, Push and Pop Opcodes, Data Exchanges; Logical – Byte and Bit Level Operations, Rotate and Swap Operations; Arithmetic – Flags, Increment, Decrement, Add, Sub, Multi and Div; Jump and Call instructions – Jumps, Calls, Subroutines, Interrupts, Returns, -- with programming examples. (Text-1, Chapters- 5 to 8)

UNIT – III: Interfacing and Applications of 8051

Interfacing an LCD, ADC and Sensors with the 8051; Interfacing a Stepper Motor, Keyboard and DAC to generate waveforms on CRO with the 805.
(Text-2, Chapters- 12,13)

UNIT – IV: Other Microcontrollers and Software

8051 Programming, Dallas Semiconductor DS 87000 Programmer, Atmel AT 89Cx051 Programmer circuits Software - Development Tools/Environments, 8051 Assembly Language Programming Styles, Interpreters, High-Level Languages, Intel Hex Format Object Files, Debugging Hints. Emulators – Types of Emulators, Monitor Programs. Real-Time Operating Systems-Basics of RTOS, 8051 Example RTOS, Full RTOS, LCD Digital Clock / Thermometer using Full RTOS. (Text-3., Chapters 7,8,10,11)

REFERENCES

1. The 8051 Microcontroller - architecture, programming & applications – By Kenneth J. Ayala, Penram International Publishing, 1995
2. The 8051 Microcontrollers and Embedded Systems – By Muhammad Ali Mazidi and Janice Gillispie Mazidi, Pearson Education Asia, 4th Reprint, 2002.
3. Programming and Customizing the 8051 Microcontroller – By Myke Predko, TMH, 2003

Additional References

1. Embedded Microcontrollers Handbook, Intel Applications
2. Advanced Microprocessors and Peripherals, Architecture, Programming and Interface - By A. K. Ray and K. M. Bhurchandi, TMH, 2000
3. Design with Microcontrollers By - J B Peatman, MH.
4. The 8051 Microcontroller - programming, interfacing and applications – By Howard Boyet and Ron Katz, (MII) Microprocessors Training Inc.
5. The concepts & features of Microcontrollers by Rajkamal, Wheeler Pub.
6. The Microcontroller Idea Book Circuits, Programs, & Applications featuring the 8052-BASIC Microcontroller by : Jan Axelson, Penram International

M.Sc. (Physics with Electronics) Semester IV
Paper IV– PC Architecture & Hardware

UNIT - I:

BASIC COMPUTER ORGANIZATION: Instruction codes, computer instructions, timing and Control, memory referred instructions, I/O and interrupts, complete computer description and design.

PROGRAMMING THE COMPUTER: Assembly language, assembler, program loops, Arithmetic and logical operations, subroutines and I/O programming.

UNIT –II:

MICROPROGRAMMED CONTROL: Control memory, address sequencing and micro program Examples.

CENTRAL PROCESSING UNIT: Introduction to CPU, general register organization, Stack organization, instruction formats, Addressing modes, Data transfer and manipulation, Program control and RISC.

UNIT - III:

PIPELINE AND VECTOR PROCCESSING: Parallel processing, pipelining, Arithmetic pipeline, Instruction pipeline and RISC pipeline, vector processing and Array processors.

COMPUTER ARITHMETIC: Addition and subtraction Multiplication algorithms, Division Algorithms, Floating point Arithmetic operations, Decimal arithmetic Unit, and Decimal Algorithmatic operations.

UNIT- IV:

INPUT-OUTPUT ORGANIZATION: Peripheral Devices, Input-output interface, Asynchronous Data transfer, Modes of transfer, priority interrupt, Direct memory access(DMA), input-output processor(IOP), Serial communication.

MEMORY ORGANIZATION: Memory Hierarchy, Main memory, Auxiliary memory, Auxiliary memory, Associate memory, cache Memory, Virtual memory, Memory management Hard ware.

REFERENCES

1. Computer system architecture by Moris mano, PHI(2000)

Additional References

1. An introduction to digital computer design by V. Rajaraman and T.Radhakrishna
2. Computer Architecture and parallel processing by K. Hang and F.A bigg, Mc graw-Hill
3. Computer Architecture and logic design by Thomas C. Bartee, Mcgraw-Hill Computer fundamentals, Architecture and Organization by B. Ram 3rd Edition. New Age International.

M.Sc. (Physics with Electronics) Semester IV
Paper V– Instrumentation for measurement, control and data acquisition

UNIT-I:

Displacement Measurement: Variable resistance devices-Variable inductance devices (LVDT)-Variable capacitance devices.

Strain Measurement: Theory of operation of resistance strain gauge-Types of electrical strain gauges- strain gauge circuits- Temperature compensation-Dynamic measurements-strain gauge load cell- Calibration of strain gauges.

Pressure Measurement: Elastic transducers- Bourdon Tube – Bellows- Diaphrams-Transduction methods- Force balance-pressure transducer-Digital pressure transducer-Pressure calibration (dead weight tester) – Mc Leod gauge.

UNIT-II:

Temperature Measurement: Resistance type temperature sensors –platinum resistance thermometer- thermistors-thermocouples-solid state sensors-pyrometers – resistance thermometer circuits.

Flow Measurement: Classification of flow meters- head type flow meters – rota meter-electromagnetic flow meter- anemometers- ultrasonic flow meter.

Process Control: Open loop and closed loop control – block diagram algebra of a closed loop system – Temperature control – liquid level control.

UNIT-III :

Analog and Digital Data Acquisition Systems: Interfacing transducers to electronic control and measuring systems-Digital to analog multiplexer-Analog to digital multiplexer- Computer controlled test systems- Testing an audio amplifier- Testing a radio receiver -IEEE 488 bus – Synthesized signal generator interfaced with IEEE488 bus – Computer interfaced Spectrum Analyzer- Adjustable ac supply using IEEE 488 bus.

UNIT-IV:

Data Transmission and Telemetry: Methods of data transmission-General telemetry system- functional blocks of telemetry system- types of telemetry systems- Land line telemetering system- voltage telemetering system- current telemetering system-position telemetering system-land-line telemetry feedback system- radio frequency telemetry-PAM, PCM telemetry- multiplexing in telemetering system- transmission channels-Digital data transmission.

REFERENCES

1. Modern Electronic Instrumentation and Measurement Techniques – A.O. Hefnick and W.D. Cooper., Prentice Hall India Publications.
2. Instrumentation Devices and Systems – C.S. Rangan, G.R. Sharma and VSV Mani, Tata Mc Graw Hill Publications.
3. Introduction to Instrumentation and Control – A.K. Ghosh - Prentice Hall India Publications
4. Electrical and Electronics Measurement and Instrumentation - A.K.Sawhney

M.Sc. (Physics with Electronics) Semester IV
Practical Paper–VI (PAE 451): General Physics Lab

A) **Modern Physics Experiments**

9. Zeeman effect
10. Raman effect
11. Magnetic susceptibility
12. Verification of Beer's Law*
13. Electrical resistivity – Four Probe Method*
14. Electrical resistivity – Two Probe Method*
15. Hall effect*
16. X-Ray Diffraction Powder Method

B) **Nuclear Physics Experiments**

8. GM detector characteristics and determination of dead time.
9. Determination of Half life of 40_p (β decay)
10. Determination of Half life of 113_{In} .
11. Analysis of complex decay curves Half life of Radiated Silver.
12. Determination of linear absorption coefficients of gamma rays in alluminium and lead.
13. Recording of gamma ray spectrum and determination of linearity of Scintillation Spectrometer
14. Fermi – Kurie plot (β-rays)

M.Sc. (Physics with Electronics) Semester IV
Practical Paper-VII (PAE 452): Microprocessors &Microcontrollers Lab

(A1) Programming and interfacing using Microprocessor (8086)

1. Addition of fifty 16-bit numbers stored in consecutive memory location
2. Divide a 28 bit unsigned number by 8 .
3. Convert a 2-digit unsigned BCD number to binary.
4. To add two words, each word containing four packed BCD digits.
5. Write a subroutine, to multiply a signed 16-bit number and a signed 8-bit number that can be called by a main program in a different code segment and stores the result in consecutive memory locations.
6. Simple programs on PC using Macro Assembler MASM 86
7. To interface the analog-to-digital converter (ADC) kit with PC and to develop suitable programs to convert the analog signal into digital value.
8. To interface the digital-to analog converter (DAC) kit with PC and to develop suitable programs to generate various waveforms to display it on CRO.
9. To interface the given stepper motor and to develop suitable program to rotate it at various stepping angles

(A2) Experiments using Microcontroller (8051)

1. To test the 8051 system and its ports.
2. To interface an ADC to the 8051.
3. To program the 8051 timer. To generate a square wave using the 8051 timer.
4. To interface a DAC to the 8051. To generate a sine wave on the scope using the DAC.
5. To interface a stepper motor to the 8051.To write a program to control the angle and direction of stepper motor rotation by the user
6. To examine and use an 8051 Assembler. To examine and use an 8051 simulator
7. To code a program to add hex numbers. To code a program to add BCD numbers. To code a program to add two multi-byte BCD numbers.
8. To practice converting data from decimal to binary and hexadecimal systems.
9. To write a program to convert data from hex to ASCII. To write a program to find the average of a set of hex data. To examine the 8051 division and multiplication instructions.