M. Sc. DEGREE **BRANCH: PHYSICS**

SYLLABUS

(Effective for students admitted from the academic year 2017 - 18)

Semester – I (I Year)

Paper- I – 17MUM101- MATHEMATICAL PHYSICS

CREDITS: 4 TEACHING HOURS: 75 hours
Total Marks: 100 External: 75 + Internal: 25
(CORE COURSE, FIRST YEAR, FIRST SEMESTER, 4 CREDITS)

UNIT 1 - MATRIX AND TENSORS

Linear operators – Vector in n-dimensions – Matrix representation of vectors and operators in a basis – Linear independence, dimension – Inner product - Schwarz inequality- Orthonormal basis – Gram-Schmidt orthogonalization process – Eigenvalues and Eigenfunctions of operators/matrices – Hermitian and unitary operators/ matrices – Cayley-Hamilton theorem - Diagonalizing matrix.

Tensors: Coordinate transformation – Contravariant and covariant vectors – Tensor of higher rank – Einstein's summation convention – Kronecker delta – product rule – Quotient rule – Levi-Civita tensor in three dimensions.

UNIT 2 - LINEAR DIFFERENTIAL EQUATIONS AND GREEN'S FUNCTION

Second order linear differential equations – Wronskian - Sturm-Liouville Theory - Orthogonality of Eigen functions - Illustration with Legendre, Laguerre and Hermite differential equations.

One dimensional Green's function – Eigen function expansion of the Green's function - Reciprocity theorem.

UNIT 3 - COMPLEX VARIABLES

Functions of a complex variable - Single and multivalued functions - Analytic functions - Cauchy - Riemann conditions - Singular points - Cauchy's integral theorem and integral formulae - Taylor and Laurent expansions – Zeros, singularities and poles – Residue theorem and its applications.

UNIT 4 - SPECIAL FUNCTIONS

Gamma and Beta functions- Bessel, Hermite and Legendre functions – error function - Rodriguez formula – general expansion of polynomials - Generating functions - Orthogonality relations – Important recurrence relations.

UNIT 5 - GROUP THEORY

Basic definitions - Lagrange's Theorem – Invariant subgroup - Homomorphism and Isomorphism between groups - Representation of a group - unitary representations - Schur's lemmas - Orthogonality theorem – SU(n)- Special Unitary Group SU(2) .

BOOKS FOR STUDY

1. **P.K. Chattopadhyay,** 1990, Mathematic Physics,Wiley Eastern, Madras.
2. **G. Arfken and H.J. Weber**, 2001, Mathematical Methods for Physicists, 5th Ed. (Harcourt (India), New Delhi.
3. **A.W. Joshi**, 1997, Elements of Group Theory for Physicists, 4th Edition, New Age International, New Delhi.
4. **A.W. Joshi**, 2006, Matrices and Tensors in Physics, 3rd Edition, New Age International (P) Ltd.
5. **M.D. Greenberg**, 1998, Advanced Engineering Mathematics, 2nd Edition, International Ed., Prentice – Hall International, NJ.
6. **F.A.Cotton,** Chemical Application of Group Theory. 3rd edition, John Wiely and Sons, New York.
7. **Erwin Kreyszig,** 2006, Advanced Engineering Mathematics, 9th edition, John Wiely and Sons, Singapore.

BOOKS FOR REFERENCE

1. **E.Butkov**, 1968, Mathematical Physics Addition, Wesley, Reading, Massachusetts.
2. **P.R. Halmos,** 1965 Finite Dimensional Vector Spaces, 2nd Ed. Affiliated East-West, New Delhi.
3. **C.R. Wylie and L.C. Barrett,** 1995, Advanced Engineering Mathematics, 6th Ed., International Ed. McGraw-Hill, NY.
4. **W.W. Bell**, 1968, Special Functions for Scientists and Engineers, (Van Nostrand, London.
5. **M.A. Abramowitz and I. Stegun (Editors),** 1972, Handbook of Mathematical Functions, Dover, New York.
6. **F.W.Byron, R.W. Fuller,** 1992, Mathematics of Classical and Quantum Physics, Dover.
7. **David W. Lewis,** 2001, Matrix theory, World Scientific Publishing Co. Pvt. Ltd.
8. **Tulsi Dass and Satish K.Sharma,** 1998, Mathematical methods in classical and Quantum Physics, University Press, Hyderabad.
9. **H.K.Dass,** 2010, Mathematical Physics, S. Chand & Co. Ltd.

M. Sc. DEGREE **BRANCH: PHYSICS**

SYLLABUS

(Effective for students admitted from the academic year 2017 - 18)

Semester – I (I Year)

Paper- II – 17MUM102- QUANTUM MECHANICS - I

CREDITS: 4 TEACHING HOURS: 75 hours

Total Marks: 100 External: 75 + Internal: 25

(CORE COURSE, FIRST YEAR, FIRST SEMESTER, 4 CREDITS)

UNIT 1 - BASIC FORMALISM

The Schrodinger equation-Operator correspondence - Interpretation and Condition on wave function - Stationary states - Postulates of quantum mechanics - Linear operators and Self-Adjointness - Eigenvalue problem and degeneracy – Observables - Ehrenfest theorem - Completeness and normalization of eigen functions - Closure property - Physical interpretation of eigen values and eigen functions - Uncertainty relations and commuting observables.

UNIT 2 - EXACTLY SOLVABLE EIGENVALUE PROBLEMS

Particle in a square-well potential (bound states) - Square potential barrier and tunnelling - Simple harmonic oscillator-Ladder operator method - Angular momentum Operators - Spherical harmonics - Parity-Rigid rotator - Central potential - Hydrogen atom.

UNIT 3 - GENERAL FORMALISM

State vectors - Hilbert space - Dirac notation - Dynamical variables and linear operators - Representation theory - Coordinate and momentum representation-Unitary transformation involving time - Schrodinger, Heisenberg and interaction pictures - Translation and rotation - Symmetries and conservation laws - Time reversal.

UNIT 4 - ANGULAR MOMENTUM

Eigen value spectrum - Matrix representation - Spin Angular momentum - Pauli matrices - Non-relativistic Hamiltonian including spin - Addition of angular momenta - Clebsch-Gordan coefficients - Addition of spin and orbital angular momenta - Fine structure of alkali atoms.

UNIT 5 -APPROXIMATION METHODS:

Perturbation theory:-First and second order non-degenerate case-Degeneracy-Stark effect-Ground and first excited states of hydrogen atom-

The Variation method:-Upper bound on ground state energy-Trial function linear in variational parameters- Hydrogen molecule.

BOOKS FOR STUDY:

1. **P.M. Mathews and K. Venkaresan** , 2007, A Text Book of Quantum Mechanics-Tata McGraw-Hill.
2. **B.K. Agarwal and Hari Prakash** , 2004, Quantum Mechanics-Prentice-Hall of India Pvt. Ltd, New Delhi.
3. **A. Ghatak** , 2002, Introduction to Quantum Mechanics, MacMillan India Ltd., Madras.

BOOKS FOR REFERENCE:

1. **David J. Griffiths**, 2002, Introduction to Quantum Mechanics, Prentice-Hall of India, Pvt. Ltd, New Delhi.
2. **E. Merzbacher**, 1970, Quantum Mechanics, 2nd Edition, Wiley International Edition.
3. **J.L.,Powell and B. Craseman**, 1995, Quantum Mechanics Narosa Publishing, Madras.
4. **L.D. Landau** and **E.M. Lifshitz**, 1981, Quantum Mechanics, 3rd edition Elsevier.
5. **Y.K. Lim,** 2001, Problems and solutions on Quantum Mechanics, World Scientific Publishing Co. Pvt. Ltd, 2001.

M. Sc. DEGREE **BRANCH: PHYSICS**

SYLLABUS

(Effective for students admitted from the academic year 2017 - 18)

Semester – I (I Year)

Paper- III – 17MUM103- CLASSICAL MECHANICS

CREDITS: 4 TEACHING HOURS: 75 hours

Total Marks: 100 External: 75 + Internal: 25

(CORE COURSE, FIRST YEAR, FIRST SEMESTER, 4 CREDITS)

UNIT 1 - LAGRANGIAN AND HAMILTONIAN FORMULATIONS

Hamilton's variational principle - Lagrange's equations of motion – Canonical momenta – Cyclic coordinates and conservation of corresponding momenta – Legendre transformation and Hamiltonian - Hamilton's equations of motion - Two-body central force problem –Kepler Problem and Kepler's laws.

UNIT 2 - MECHANICS OF RIGID BODIES

Rigid body motion – Kinematics – Euler angles – Infinitesimal rotations – Rate of change of a vector – Coriolis force - Dynamics - Angular momentum and kinetic energy - Moment of inertia tensor - Euler's equations of motion - Torque-free motion - Symmetrical top.

UNIT 3 - POISSON'S BRACKETS & HAMILTON – JACOBI THEORY

Poisson's bracket – canonical transformations – invariance of Poisson bracket with respect to canonical transformations – Hamilton-Jacobi theory – Action and Angle variable – Kepler's problem – solution of Harmonic oscillator problem by Hamilton-Jacobi equation.

UNIT 4 - SMALL OSCILLATIONS

General theory of small oscillation – Equation of motion for small oscillation – solution of eigen value equation – normal co-ordinates and normal frequencies of vibration – vibration of a linear triatomic molecule.

UNIT 5 - RELATIVISTIC MECHANICS

Relativistic energy – relation between momentum and energy and conservation law – transformation of momentum and energy – Force in relativistic mechanics – Minkowski space and Lorentz transformations – Four vectors.

BOOKS FOR STUDY:

1. **J.C. Upadhyaya**, 2007, Classical Mechanics, Himalaya Publishing House, 2nd edition.

BOOKS FOR REFERENCE:

1. **H. Goldstein**, 2008, Classical Mechanics, Narosa Publishing, 2nd edition.
2. **N.C. Rana and P.S. Joag**, 1991, Classical Mechanics, Tata McGraw. Hill, 1st edition.
3. **M.G.Calkin**, 2000, Lagrangian and Hamiltonian mechanics, Allied Publishers Ltd.
4. **P.V. Panat**, 2005, Classical Mechanics, Narosa Publishers.
5. **K.N. Srinivasa Rao**, 2003, Classical Mechanics, Universities Press (India) Pvt. Ltd.
6. Schaum's Outline Series, Lagrangian dynamics, McGraw-Hill.
7. **David Morin**, 2008, Introduction to Classical Mechanics, Cambridge University Press, Uk.
8. **Stephan T. Thornton and Jerry. B. Marion**, 2004, Classical dynamics of system of Particles, Thomson learning, Singapore.

M. Sc. DEGREE **BRANCH: PHYSICS**

SYLLABUS

(Effective for students admitted from the academic year 2017 - 18)

Semester – I (I Year)

Paper- IV – 17MUM104- ELECTRONICS & EXPERIMENTAL METHODS

CREDITS: 4 TEACHING HOURS: 75 hours
Total Marks: 100 External: 75 + Internal: 25

(CORE COURSE, FIRST YEAR, FIRST SEMESTER, 4 CREDITS)

UNIT 1: SEMICONDUCTOR DEVICES

FET, MOSFET, UJT, SCR, TRIAC – Structure and constructional features – Working principle and I-V Characteristics – FET as Common Source and Common Drain amplifier - Biasing of FET and MOSFET- UJT relaxation oscillator – SCR, TRIAC for power control – Photo detectors and LEDs.

UNIT 2: OPERATIONAL AMPLIFIERS AND A/D & D/A CONVERTERS

Ideal Op - Amp - inverting, non - inverting, logarithmic, summing and difference amplifiers - integrator and differentiator - as a comparator - CMRR – differential amplifier - Applications: Solving simultaneous and differential equations - weighted resistor and R - 2R D/A converters - parallel, binary counter and successive approximation AID converters.

UNIT 3: DIGITAL ELECTRONICS

Boolean Algebra and logic gates – Logic gate IC – Digital flip flops – Digital Timer – Logic Circuit Designing – Karnaugh Maps - Design of random sequence counters – Serial parallel registers – Shift registers – Applications. Binary weighted resistor D/A convertor – R-2R ladder DAC – successive approximation and dual slope ADC.

UNIT 4: ANALOG AND DIGITAL INSTRUMENTS

PMMC Movement – DC Ammeter and Voltmeter – AC Ammeter and Voltmeter – Multirange Voltmeter - Electronic Voltmeter (Solid State m/V) – Sensitivity of Instruments - Digital Multimeter - Digital Frequency Meter – Digital measurement of time.

UNIT V: TRANSDUCERS

Classification of transducers – Potentiometer – unbounded strain gage – Bonded strain gage foil type strain gage – Linear variable differential transducer (LVDT) – Rotational variable differential transducer (RVDT)

BOOKS FOR STUDY:

1. **H.S.Kalsi**, 2002, Electronic Instrumentation, Learning Materials centre, New Delhi, Second edition.
2. **S Salivahanan, N Suersh Kumar & A Vallavaraj**, 2009, Electronic Devices and Circuits, Tata McGraw-Hill Publishing Company Limited, New Delhi,Second Edition.
3. **D. Roy Choudhury and Shail B.Jain**, 2012, Linear Integrated Circuits, New Age International Publishers,third edition.
4. **V.Vijayendran**, 2008, Introduction to Integrated electronics (Digital & Analog), S.Viswanathan Printers & Publishers Private Ltd, Reprint.

BOOKS FOR REFERENCE:

1. **John Douglas Ryder**, 1976, Electronic fundamentals and applications, 5th edition, Prentice – Hall.
2. **Donald P. Leach, Albert Paul Malvino**, 1986, Digital principles and applications, 4th edition, McGraw – Hill.
3. **V.K. Mehta and Rohit Mehta,** 2008, Principles of Electronics, S. Chand & Co, 12th Edition.
4. **D. Chattopadhyay** and **Rakshit,** 2010, Electronics – Fundamentals and Application, New Age Pulishers, 11th Edition.
5. **B.L. Theraja** and **A.K. Theraja,** 2004, A Textbook of Electrical technology, S. Chand & Co.

M. Sc. DEGREE **BRANCH: PHYSICS**

SYLLABUS

(Effective for students admitted from the academic year 2017 - 18)

Semester – I (I Year)

Practical – I (17MUMP101)

General Practicals:

1. Cornu's Method – Young's Modulus and Poisson's ratio by Elliptical fringes.
2. Michelson Interferometer – Wavelength, separation of wavelengths.
3. Susceptibility by Guoy's method
4. Stefan's Constant
5. Band gap Energy – Thermistor
6. Hydrogen Spectrum – Rydberg's Constant
7. Viscosity of liquid – Meyer's Disc
8. B-H loop using CRO

Electronics Practicals:

1. Op-Amp. – 4-bit Digital to Analog converter[R/2R ladder network]
2. Op-Amp. Active Filters: Low pass, High pass filters.
3. Op-Amp. Active Filters: Band pass filters (second order).
4. Solving simultaneous equations – IC 741/IC LM324
5. Design of a square wave oscillator using IC 741 – Triangular wave oscillator.
6. Construction of pulse generator using IC741- application as frequency divider.
7. Design of UJT relaxation oscillator for a frequency – Generation of positive and negative triggering pulses.
8. FET CS amplifier – Design, Frequency response, input impedance, output impedance.

M. Sc. DEGREE **BRANCH: PHYSICS**

SYLLABUS

(Effective for students admitted from the academic year 2017 - 18)

Semester – II (I Year)

Paper- VI – 17MUM205 – ELECTROMAGNETIC THEORY

CREDITS: 4 TEACHING HOURS: 75 hours
Total Marks: 100 External: 75 + Internal: 25

(CORE COURSE, FIRST YEAR, SECOND SEMESTER, 4 CREDITS)

UNIT 1: ELECTROSTATICS

Boundary value problems and Laplace equation – Boundary condition and uniqueness theorem – Laplace equation in three dimension – Solution in Cartesian and Spherical polar co-ordinates – Examples of solution for boundary value problems.
Polarization and displacement vectors – Boundary conditions – Dielectric sphere in a uniform field – Electrostatic energy in the presence of dielectric – Multipole expansion.

UNIT 2: MAGNETOSTATICS

Biot- Savart Law – Ampere's law – Magnetic vector potential and magnetic field of a localized current distribution – Magnetic moment distribution in an external field – Magnetostatic energy – Magnetic induction and magnetic field in microscopic media – Boundary conditions.

UNIT 3: MAXWELL EQUATIONS

Faraday's laws of Induction – Maxwell's displacement current – Maxwell's equations – Vector and Scalar potentials – Gauge invariance – Coulomb and Lorentz gauges – Energy and momentum of the field – Poynting's theorem – Lorentz force – Conservation laws for a system of charges and electromagnetic fields.

UNIT 4: WAVE PROPAGATION

Wave equation and Plane wave solutions – Plane waves in non-conducting media – Linear and circular polarization, refraction and reflection at a plane interface – Waves in a conducting medium – Propagation of waves in a rectangular wave guide.

Inhomogeneous wave equation and related potentials – Radiation from a localized source – Oscillating electric dipole.

UNIT 5: RELATIVISTIC ELECTRO DYNAMICS

Lorentz transformation for space and time in four vector – Invariance of D'Alembertian operator – Invariance of Maxwell's field equation in terms four vectors – electromagnetic field tensor – Maxwell's equation in covariance four tensor form – Lorentz transformations of electromagnetic fields – Invariance of electromagnetic field.

BOOKS FOR STUDY:

1. **D.J. Griffiths**, 2002, Introduction to Electrodynamics, 3rd Edition, Prentice-Hall of India, New Delhi.
2. **J.R. Reitz, F.J. Milford** and **R.W. Christy**, 1986, "Foundations of Electromagnetic Theory" 3rd Edition, Narosa Publication, New Delhi.
3. **J.D. Jackson,** 1975, "Classical Electrodynamics", Wiley Eastern Ltd. New Delhi.
4. **J.A. Bittencourt,** 1988, "Fundamentals of Plasma Physics", Pergamon Press, Oxford.
5. **Chopra and Agarwal**, Electrodynamics,
6. **Gupta, Kumar and Singh**, Electrodynamics, S.Chand & Co., New Delhi
7. **Jordan and K.G. Balmai,** 1968, Electromagnetic wave and radiating system, Prentice Hall.

BOOKS FOR REFERENCE:

1. **W. Panofsky** and **M. Phillips**, 1962, Classical Electricity and Magnetism, Addison Wesly, London.
2. **J.D. Kraus** and **D.A. Fleisch**, 1999, Electromagnetics with Applications, 5th Edition, WCB McGraw-Hill, New York.
3. **B. Chakraborty**, 2002, Principles of Electrodynamics, Books and Allied, Kolkata.
4. **F.P. Feynman, R.B. Leighton,** and **M. Sands**, 1998, The Feynman Lectures on Physics, Vols. 2, Narosa, New Delhi.
5. **Andrew Zangwill,** 2013, Modern Electrodynamics, Cambridge University Press, USA.
6. **Edward. M.Purcell,** 1985, Electricity and Magnetism, Berkeley Physics course, Vol 2, 2nd Edition, McGraw-Hill Book, New Delhi.

M. Sc. DEGREE **BRANCH: PHYSICS**

SYLLABUS

(Effective for students admitted from the academic year 2017 - 18)

Semester – II (I Year)

Paper- VII – 17MUM206 – QUANTUM MECHANICS - II

CREDITS: 4 TEACHING HOURS: 75 hours
Total Marks: 100 External: 75 + Internal: 25

(CORE COURSE, FIRST YEAR, SECOND SEMESTER, 4 CREDITS)

UNIT 1: SCATTERING THEORY

Scattering amplitude – Cross section – Born approximation – Effective range theory for S-wave – Transformation from centre of mass to Laboratory frame.

UNIT 2: PERTURBATION THEORY

Time dependent perturbation theory – Constant and harmonic perturbation – Transition probabilities – Adiabatic approximation – Sudden approximation – The density matrix – Semi classical treatment of an atom with electromagnetic radiation – Selection rules for dipole radiation.

UNIT 3: RELATIVISTIC QUANTUM MECHANICS

Klein-Gordon equation – Dirac equation – Plane-wave solution – Interpretation of negative energy states – Antiparticle – Spin of electron – Magnetic moment of an electron due to spin.

UNIT 4: DIRAC EQUATION

Covarient form of Dirac equation – Dirac equation – Properties of the gamma Matrices – Traces – Relativistic invariance of Dirac equation – Probability density – Current four vector – Bilinear covariant – Feynman's theory of positron (Elementary idea only without propagation formalism)

UNIT 5: SECOND QUANTIZATION

Second quantization of Klein-Gordon field – Creation and annihilation operators – Commutation relations – Quantization of electromagnetic field – Creation and annihilation operators – Commutation relations.

BOOKS FOR STUDY:

1. **P.M. Mathews** and **K. Venkatesan,** 1976, A Text Book of Quantum Mechanics, Tata McGraw-Hill, New Delhi.
2. **L.I. Schiff,** 1985, Quantum Mechanics, 3rd edition, International Student Edition, McGraw-Hill, New Delhi.
3. **E.Merzbacher,** 1970, Quantum Mechanics, 2nd edition, John Wiley and Sons, New York
4. **V.K.Thankappan,** 1985, Quantum Mechanics, 2nd Edition, Wiley Eastern Ltd, New Delhi.
5. **J.D. Bjorken** and **S.D.Drell** ,1964, Relativistic Quantum Mechanics, McGraw-Hill, New York.
6. **V.Devanathan,** 2005, Quantum Mechanics, Narosa Publishing House, New Delhi.
7. **D. J. Griffiths,** 2004, Introduction to Quantum Mechanics, 2nd Editio, Prentice-Hall of India.

BOOKS FOR REFERENCE:

1. **P.A.M. Dirac**, 1973, The Principles of Quantum Mechanics, 4th Oxford University Press, London.
2. **L.D. Landau** and **E. M. Lifshitz**, 1958, Quantum Mechanics, Pergomon Press, London
3. **S. N. Biswas**, 1999, Quantum Mechanics, Books and Allied, Kolkata.
4. **G. Aruldhas**, 2002, Quantum Mechanics, Prentice-Hall of India, New Delhi.
5. **J.S. Bell, Gittfried** and **M. Veltman**, 2001, The Foundations of Quantum Mechanics, World Science.
6. **V. Devanathan**, 1999, Angular Momentum Technique in Quantum Mechanics, Kluwer Academic Publishers, Dordrecht.
7. **Nouredine Zettli,** 2016, Quantum Mechanics, 2nd Edition, Wiley India Pvt. Ltd.
8. **J.J. Sakurai,** Modern Quantum Mechanics.

M. Sc. DEGREE **BRANCH: PHYSICS**

SYLLABUS

(Effective for students admitted from the academic year 2017 - 18)

Semester – II (I Year)

Paper- VIII – 17MUM207 – ATOMIC AND MOLECULAR SPECTROSCOPY

CREDITS: 4 TEACHING HOURS: 75 hours
Total Marks: 100 External: 75 + Internal: 25

(CORE COURSE, FIRST YEAR, SECOND SEMESTER, 4 CREDITS)

UNIT 1: MICROWAVE SPECTROSCOPY

Rotational spectra of diatomic molecule – Polyatomic molecules – Linear and symmetric top molecules – Hyperfine structure and quadrupole moment of linear molecules – Experimental techniques – Stark effect.

UNIT 2: NORMAL CO-ORDINATE ANALYSIS

Selection rules for Raman and IR vibrational normal modes – Normal for Raman and IR activity C_2V and C_3V point groups – Representation of molecular vibrations in symmetry co-ordinates – Normal coordinates analysis for H_2O molecules

UNIT 3: INFRARED SPECTROSCOPY

Vibration of diatomic and simple polyatomic molecule – Anhormonicity – Fermi Resonance – Hydrogen bonding – Normal modes of vibration in a crystal – solid state Effects – Interpretation of vibrational spectra – instrumentation techniques – FTIR spectroscopy

UNIT 4: RAMAN SCATTERING

Vibrational and rotational Raman spectra – Mutual Exclusion principle – Raman spectrometer – polarization of Raman scattering light – structure determination through IR and Raman spectroscopy – Phase transition – Resonance Raman scattering

UNIT 5: NMR AND ESR SPECTROSCOPY

Quantum theory of NMR – Bloch equation – Design of CW NMR Spectrometer – Principle and block diagram of PT NMR – Chemical Shift – Application to molecular structure.

Quantum theory of ESR – Design of ESR Spectrometer – Hyperfine Structure – Anisotropic system – Triplet state study of ESR – Application – Crystal defects – Biological studies.

BOOKS FOR STUDY

1. **C.N. Banwell** and **E.M. McCash**, 1994, "Fundamentals of Molecular Spectroscopy", 4th Edition, TMH, New Delhi.
2. **G. Aruldhas**, 2001, Molecular Structure and Spectroscopy, Prentice-Hall of India, New Delhi.
3. **D.N. Satyanarayana**, 2004, Vibrational Spectroscopy and Application, New Age International Publication.

BOOKS FOR REFERENCE

1. **D.D. Jyaji** and **M.D Yadav** 1991, Spectroscopy, Amol Publications
2. **Attaur Rahman**, 1986, Nuclear Magnetic Resonance, Springer Verlag.
3. **D. A. Lang**, Raman Spectroscopy, McGraw- Hill International
4. **Raymond Chang**, 1980, "Basic Principles of Spectroscopy", McGraw- Hill Kogakusha Tokyo.

M. Sc. DEGREE **BRANCH: PHYSICS**

SYLLABUS

(Effective for students admitted from the academic year 2017 - 18)

Semester – II (I Year)

Paper- IX – 17MUM208 – ENERGY PHYSICS

CREDITS: 4
Total Marks: 100

TEACHING HOURS: 75 hours
External: 75 + Internal: 25

(CORE COURSE, FIRST YEAR, SECOND SEMESTER, 4 CREDITS)

UNIT -1 INTRODUCTION TO ENERGY SOURCES

Energy sources and their availability – prospects of renewable energy sources – energy from other sources – chemical energy – nuclear energy – energy storage and distribution.

UNIT – 2 : TIDAL ENERGY

Energy from oceans – energy utilization – energy from tides – basic principle of tidal power – utilization of tidal energy

UNIT -3 : WIND ENERGY

Basic principles of wind energy conversion – power in the wind – forces in the blades – Wind energy conversion – advantages and disadvantages of wind energy conversion systems-(WECS) energy storage – Application of wind energy storage.

UNIT -4: ENERGY FROM BIOMASS

Biomass conversion technologies- wet and dry process- photosynthesis

Biogas generation: Introduction - basic process and energetic – advantages of anaerobic digestion – factors affecting bio digestion and generation of gas - biogas from waste fuel – properties of biogas – utilization of biogas

UNIT 5 : SOLAR ENERGY

solar radiation and its measurements – solar cells for direct conversion of solar energy to electric powers – solar cell parameter – solar cell electrical characteristics – efficiency – solar water heater – solar distillation – solar cooking – solar greenhouse.

BOOKS FOR STUDY:

1. **G.D. Rai**, 1996, Non – convention sources of, 4th edition, Khanna publishers, New Delhi.
2. **S. Rao and Dr. Paru Lekar**, Energy technology.

BOOKS FOR REFERENCE:

1. **John Twidell and Tony weir**, Renewable energy resources, Taylor and Francis group, London and New York.

M. Sc. DEGREE **BRANCH: PHYSICS**

SYLLABUS

(Effective for students admitted from the academic year 2017 - 18)

Semester – II (I Year)

Paper- X – 17MUM209 – MATERIAL SCIENCE

CREDITS: 4
Total Marks: 100

TEACHING HOURS: 75 hours
External: 75 + Internal: 25

(CORE COURSE, FIRST YEAR, SECOND SEMESTER, 4 CREDITS)

UNIT 1: INTRODUCTION

Classification of materials – materials for Engineering applications – Different types of chemical bonds –Crystals structures of important engineering materials – Crystal imperfection and types of imperfection

UNIT 2: PHASE DIAGRAM

System – Components – Phases – solutions – Hume-Rothery's rule and Gibb's phase rule – Lever rule – Construction of phase diagram eutectic, peritectic, eutectoid and peritectoid systems

UNIT 3: PHASE TRANSFORMATION

Mechanism – Nucleation and Growth – Application of Phase transformation – Cooling, casting, solidification and heat treatment – TTT diagram – Martensitic transformation

UNIT 4: ELECTRON THEORY OF METALS

Classical free electron theory – Density of states –Electron energies in metal – Energy band and Fermi energy in solids – Distinction between metals, insulators and semi-conductors on the basis of Fermi level – Effect of temperature on Fermi level

UNIT 5: ELECTRICAL AND MAGNETIC PROPERTIES OF METALS

Electrical resistivity and conductivity of materials – Dielectric materials – Electrical polarization – Piezo, Pyro, and Ferro electric materials – electrostriction – classification of magnetic materials – Domain structure – Magnetostriction – Soft and hard magnetic materials.

BOOKS FOR STUDY:

1. **V. Raghavan,** 2003, Materials Science and Engineering, 4th Edition, Prentice- Hall India, New Delhi(For units 2,3,4 and 5)
2. **G.K. Narula, K.S. Narula**and **V.K. Gupta,** 1988, Materials Science, Tata McGraw-Hill
3. **M. Arumugam,** 2002, Materials Science, 3rd revised Edition, Anuratha Agencies.

BOOKS FOR REFERENCE:

1. **LawrencH.VanVlack**, 1998. Elements of Materials Science and Engineering, 6th Edition, Second ISE reprint, Addison-Wesley.
2. **H.Iabch** and **H.Luth**, 2002, Solid State Physics – An Introduction to Principles of Materials Science, 2nd Edition, Springer.

M. Sc. DEGREE **BRANCH: PHYSICS**

SYLLABUS

(Effective for students admitted from the academic year 2017 - 18)

Semester – II (I Year)

Practical – II (17MUMP202)

Microprocessor 8085:

1. 8 – bit addition and subtraction, multiplication and division.
2. Sum of a set of N data.(8 –bit numbers).
3. Sorting in ascending and descending order. Picking up the smallest and largest number in an array.
4. Code conversion (8 –bit numbers) – a) Binary to BCD b) BCD to Binary
5. Addition of multibyte numbers, Factorial
6. Interfacing of seven segment display.
7. Interfacing R/2R ladder DAC (IC 741) – waveform generation.
8. Interfacing of DC stepper motor – Clockwise, Anti-clockwise.
9. Interfacing of Temperature controller and Measurement.

Microprocessor 8086:

10. 8 – bit addition and subtraction, multiplication and division.
11. Multibyte addition and subtraction (64 and 128 bit numbers)
12. Sum of a set of N data (8 –bit numbers), average of N numbers.
13. Square and square root of 8 bit number.
14. Sorting in ascending and descending order.
15. Picking up the smallest and largest number in an array.
16. Generation of Fibonacci series.

M. Sc. DEGREE **BRANCH: PHYSICS**

SYLLABUS

(Effective for students admitted from the academic year 2017 - 18)

Semester – III (II Year)

Paper- XII – 17MUM310 – THERMODYNAMICS AND STATISTICAL MECHANICS

CREDITS: 4
Total Marks: 100

TEACHING HOURS: 75 hours
External: 75 + Internal: 25

(CORE COURSE, SECOND YEAR, THIRD SEMESTER, 4 CREDITS)

UNIT 1: PHASE TRANSITION

Thermodynamic potentials - Phase Equilibrium - Gibb's Phase rule - Phase transitions and Ehrenfest's classifications - Third Law of Thermodynamics.

Order parameters - Landau theory of phase transition - Critical indices - Scale transformations and dimensional analysis.

UNIT 2: STATISTICAL MECHANICS AND THERMODYNAMICS

Foundations of statistical mechanics - Specification of states of a system - Microcanonical ensemble - Phase space - Entropy - Connection between statistics and thermodynamics - Classical ideal gas - Entropy of an ideal gas using the microcanonical ensemble - Entropy of mixing and Gibb's paradox.

UNIT 3: CANONICAL AND GRAND CANONICAL ENSEMBLES

Trajectories and density of states - Liouville's theorem - Canoncial and grand canonical ensembles - Partition function – Calculation of statistical quantities.

UNIT 4: CLASSICAL AND QUANTUM STATISTICS

Density matrix - Statistics of ensembles - Statistics of indistinguishable particles - Maxwell - Boltzman statistics - Fermi-Dirac statistics – Ideal Fermi gas – Degeneracy - Bose-Einstein statistics - Plank radiation formula - Ideal Bose gas - Bose-Einstein condensation.

UNIT 5: REAL GAS, ISING MODEL AND FLUCTUATIONS

Cluster expansion for a classical gas - Viral equation of state - Ising model - Exact solutions in one dimension – Mean field theory of the Ising model in two dimension.

Correlation of space-time dependent fluctuations - Fluctuations and transport phenomena – Brownian motion - Langevin theory.

BOOKS FOR STUDY

1. **S. K. Sinha,** 1990, Statistical mechanics, Tata McGraw – Hill, New Delhi.
2. **B.K. Agarwal and M. Eisner**, Statistical Mechanics, Second Edition (New Age International, New Delhi.
3. **J.K. Bhattarcharjee,** 1996, Statistical Mechanics: An Introductory Text, Allied Publication, New Delhi.
4. **C. Kittel**, 1987, Thermal Physics. 2nd edition, CBS Publication, New Delhi.
5. **M. K. Zemansky,** 1968, Heat and Thermodynamics, 5th edition, McGraw-Hill, New York.
6. **R.K. Pathria**, Statistical Mechanics. 1996, 2nd edition, Butter Worth-Heinemann, New Delhi.

BOOKS FOR REFERENCES

1. **L.D. Landau and E.M. Lifshitz**, 1969, Statistical Physics, Pergomon Press, Oxford.
2. **W. Greiner, L. Neise and H. Stoecker**, Thermodynamics and Statistical Mechanics, Springer Verlang, New York.
3. **A.B. Gupta, H. Roy**, 2002, Thermal Physics - Books and Allied, Kolkatta, 2002.
4. **C. Kalidas, M.V. Sangaranarayanan**, Non-Equilibrium Thermodynamics, Macmillan India, New Delhi.
5. **M. Glazer and J. Wark**, Statistical Mechanics (Oxford University Press, 2001).
6. **L.P. Kadanoff**, 2001, Statistical Physics - Statics, Dynamics and Renormalization, World Scientific, Singapore.
7. **F.W. Sears and G.L. Salinger**, 1998, Thermodynamics, Kinetic Theory and Statistical Thermodynamics, 3rd Edition, Narosa, New Delhi.
8. **Kerson Hung,** 1987, Statistical Mechanics, 2nd Edition, John Wiley & Sons, Singapore.

M. Sc. DEGREE **BRANCH: PHYSICS**

SYLLABUS

(Effective for students admitted from the academic year 2017 - 18)

Semester – III (II Year)

Paper- XIII – 17MUM311 – NUCLEAR AND PARTICLE PHYSICS

CREDITS: 4
Total Marks: 100

TEACHING HOURS: 75 hours
External: 75 + Internal: 25

(CORE COURSE, SECOND YEAR, THIRD SEMESTER, 4 CREDITS)

UNIT 1: NUCLEAR INTERACTIONS

Nucleon - nucleon interaction - Tensor forces – Meson theory of nuclear forces – Yukawa potential – Nucleon – Nucleon scattering – Effective range theory – Spin dependence of nuclear forces – Charge independence and charge symmetry of nuclear forces – Isospin formalism.

UNIT 2: NUCLEAR REACTIONS

Types of reactions and conservation laws - Energetics of nuclear reactions – Dynamics of nuclear reactions- Q-value equation – Scattering and reaction cross sections – Compound nucleus reactions – Direct reactions – Resonance scattering – Breit – Wigner one-level formula.

UNIT 3: NUCLEAR MODELS

Liquid drop model – Bohr – Wheeler theory of fission – Experimental evidence for shell effects – Shell model – Spin- Orbit coupling – Magic numbers – Angular momenta and parities of nuclear ground states – Qualitative discussion and estimates of transition rates.

UNIT 4: NUCLEAR DECAY

Beta decay – Fermi theory of beta decay – Shape of the beta spectrum – Total decay rate – Mass of the neutrino – Comparative half-lives – Neutrino physics – Non-conservation of parity – Gamma decay - Multipole transitions in nuclei – Angular momentum and parity selection rules – Internal conversion – Nuclear isomerism.

UNIT 5: ELEMENTARY PARTICLE PHYSICS

Types of interaction between elementary particles – Hadrons and leptons – Symmetry and conservation laws – Elementary ideas of CP and CPT invariance – Classification of hadrons –

Lie algebra, SU (2) – SU (3) multiplets – Quark model – Gell – Mann – Okuba mass formula for octet and decaplet hadrons – Chamm, button and top quarks.

BOOKS FOR STUDY

1. **K.S. Krane,** 1987, Introductory Nuclear Physics, Wiley, New Delhi, 1987.
2. **D. Griffiths,** 1987, Introduction to Elementary Particles, Harper and Row, New York.
3. **R.R. Roy and B.P. Nigam**, 1983, Nuclear Physics, New age Intl. New Delhi.

BOOK FOR REFERENCES

1. **H. A. Enge**, 1983, Introduction Nuclear Physics, Wiley, New York.
2. **Y.R. Waghmare**, 1981, Introductory Nuclear Physics, Oxford – IBH, New Delhi.
3. **Ghoshal**, Atomic and Nuclear Physics, Vol. 2.
4. **J.M. Longo**, 1971, Elementary Particles, McGraw-Hill, New York.
5. **M.K. Pal**, 1982, Theory of Nuclear Structure, Affiliated East -West, Madras.
6. **R.D. Evans**, 1955, Atomic Nucleus, McGraw-Hill, New York.
7. **I. Kaplan**, 1989, Nuclear Physics, 2nd Ed. Narosa, New Delhi.
8. **B.L. Cohen**, 1971, Concepts of Nuclear Physics, TMCH, New Delhi.
9. **D.C. Tayal**, 2008, Nuclear Physics, 5th Edition, Himalaya Publishing house, Mumbai.
10. **A. Das and T.Ferbel,** 2007, Introduction to Nuclear and Particle Physics, 2nd World Scientific, Singapore.

M. Sc. DEGREE **BRANCH: PHYSICS**

SYLLABUS

(Effective for students admitted from the academic year 2017 - 18)

Semester – III (II Year)

Paper- XIV – 17MUM312 – NUMERICAL METHODS AND PROGRAMMING

CREDITS: 4 TEACHING HOURS: 75 hours
Total Marks: 100 External: 75 + Internal: 25

(CORE COURSE, SECOND YEAR, THIRD SEMESTER, 4 CREDITS)

UNIT 1: SOLUTIONS OF EQUATIONS

Determination of zeros of polynomials - Roots of nonlinear algebriac equations and transcendental equations - Bisection and Newton-Raphson methods - Convergence of solutions.

UNIT 2: LINEAR SYSTEMS

Solution of simultaneous linear equations - Gaussian elimination - Matrix inversion Eigenvalues and eigenvectors of matrices - Power and Jacobi Methods.

UNIT 3: INTERPOLATION AND CURVE FITTING

Interpolation with equally spaced and unevenly spaced points (Newton forward and backward interpolations, Lagrange interpolation) - Curve fitting - Polynomial leastsquares fitting - Cubic spline fitting.

UNIT 4: DIFFERENTIATION, INTEGRATION AND SOLUTION OF DIFFERENTIAL EQUATIONS

Numerical differentiation - Numerical integration - Trapezoidal rule - Simpson's rule - Error estimates - Gauss- Legendre quadratures - Numerical solution of ordinary differential equations - Euler and Runge Kutta methods.

UNIT 5: PROGRAMMING USING C

Basic program structure-Simple data types, variables, constants, operators, comments-Control Flow; if, while, for, do-while, switch-Functions;- Subroutines and functions – Arrays - Programs for the following computational methods: (a) Zeros of polynomials by the bisection method, (b) Zeros of polynomials/non-linear equations by the Newton-Raphson method, (c) Lagrange Interpolation, (d) Trapezoidal and Simpson's Rules, (a) Solution of first order differential equations by Euler's Method.

BOOKS FOR STUDY

1. **V. Rajaraman,** 1993, Computer Oriented Numerical Methods, 3rd Ed. Prentice-Hall of India, New Delhi.
2. **M.K. Jain, S.r. Iyengar and R.K. Jain,** 1995, Numerical Methods for Scientific and Engineering Computation, 3rd Ed. New Age International, New Delhi.
3. **S.S. Sastry,** Introductory Methods of Numerical Analysis, PHI, New Delhi.
4. **F. Scheid,** 1998, Numerical Analysis, 2nd Edition, Schaum's Series McGraw-Hill, New York.
5. **W.H. Press, S.A. Teukolsky, W.T. Vetterling** and **B.P. Flannery,** 1992, Numerical Recipes in FORTRAN, 2nd Edition, Cambridge University Press.
6. **W.H. Press, S.A. Teukolsky, W.T. Vetterling** and **B.P. Flannery,** 1992, Numerical Recipes in C, 2nd Edition, Cambridge University Press.
7. **V.Rajaraman,** Programming in FORTRAN/ Programming in C, PHI, New Delhi.
8. **E.Balagurusamy,** 1998, Numerical methods, TMH.

BOOKS FOR REFERENCES

1. **S.D. Conte** and **C. de Boor**, 1981, Elementary Numerical Analysis, An Algorithmic Approach, 3rd Ed., International Ed. (McGraw-Hill).
2. **B.F. Gerald** and **P.O. Wheately,** 1994, Applied Numerical Analysis, 5th Edition, Addision Wesley, Reading, MA.
3. **B. Carnahan, H.A. Luther** and **J.O. Wikes**, 1969, Applied Numerical Methods (Wiley, New York.
4. **S.S. Kuo,** 1996, **Numerical Methods and Computers,** Addison - Wesley, London.

M. Sc. DEGREE **BRANCH: PHYSICS**

SYLLABUS

(Effective for students admitted from the academic year 2017 - 18)

Semester – III (II Year)

Paper- XV – 17MUM313 – CRYSTAL GROWTH

CREDITS: 4 TEACHING HOURS: 75 hours
Total Marks: 100 External: 75 + Internal: 25

(CORE COURSE, SECOND YEAR, THIRD SEMESTER, 4 CREDITS)

Unit 1: Nucleation and Crystal Growth Theories

Nucleation concept – Kinds of nucleation – Classical theory of nucleation – Spherical nucleus – Induction period – Measurement - Heterogeneous nucleation – Equilibrium concentration of embryos – Energy of formation of a critical nucleus - Free energy of formation of a critical heterogeneous cap shaped and disc shaped nuclei –Nucleation rate - Surface energy theory – Diffusion theory

Unit 2: Crystal Growth from Solution

Low temperature solution growth – Solution and Solubility – Preparation of solution - Principle of low temperature solution growth - Mier's solubility diagram – Measurement of solubility – Measurement of Ostwald-Mier's metastable zone width – Achievement of super-saturation.

Crystal Growth methods – Slow cooling method – Holden's rotary crystallizer – Mason Jar method – Slow evaporation method – Johnson's rotating crystal method – Temperature gradient method – Kruger and Fink U tube method.

Unit 3: Melt Growth and Vapor Growth

Growth of crystal from melt – Bridgman method – Czochralski method – Verneuil method – Phase diagram principle of zone refining - Zone melting method.

Physical vapour deposition – Chemical vapour deposition – Open and closed systems – Physical and thermo - chemical factors affecting growth process.

Unit 4 : Gel Growth and Flux Growth

Gel growth – Different gel medium – Silica gel – Agar gel – Basic growth procedure – Single diffusion technique – Double diffusion technique – Reaction method – Chemical reduction method.

High temperature solution growth (Flux growth) – Principle of flux growth – Slow cooling method – Slow evaporation method – Top seeded solution growth.

UNIT- V : CRYSTAL CHARACTERIZATION

Single crystal XRD -UV-Visible-NIR spectroscopy-Experimental set ups for Fourier Transform Infrared analysis -Nonlinear optical phenomenon (qualitative)-Kurtz powder SHG method-photoconductivity and schematic set up for measurements-negative photoconductivity.

BOOKS FOR STUDY

1. **M. Ohora** and **R. C. Reid**, "Modeling of Crystal Growth Rates from Solution"
2. **J. C. Brice,** 1986, " Crystal Growth Processes"
3. **J. C. Brice**, "The Growth of Crystals from Melt"
4. **D. Elwell** and **H. J. Scheel,** "Crystal Growth from High Temperature Solution"
5. **Heinz K. Henish**, 1973, "Crystal Growth in Gels", Cambridge University Press. USA.
6. **V G Dmitriev, G.G. Gurzadyan, D.N. Nikigosyan,** 1991, 'Handbook of Nonlinear optical crystals' Springer- Verlag.
7. **Douglas A. Skoog, F. James Holler and Stanley R. Crouch,** 2006, 'Principles of Instrumental analysis', 6^{th} edition, Brooks cole Cenage learning, 2006.
8.

BOOK FOR REFERENCES

1. **P. Ramasamy** and **F. D. Gnanam,** 1983, "UGC Summer School Notes".
2. **P. SanthanaRaghavan** and **P. Ramasamy,** "Crystal Growth Processes", KRU Publications.
3. **P. Santhanaraghavan and P. Ramasamy**, 2001, Crystal growth Process and Methods, KRU Publications, Kumbakonam.
4. **H.E. Buckley,** 1951, Crystal Growth, John Wiley and Sons, NewYork .
5. **B.R. Pamplin,** 1980, Crystal Growth, Pergman Press, London.

M. Sc. DEGREE **BRANCH: PHYSICS**

SYLLABUS

(Effective for students admitted from the academic year 2017 - 18)

Semester – III (II Year)

Paper- XVI – 17MUM314 – REACTOR PHYSICS

CREDITS: 4 TEACHING HOURS: 75 hours
Total Marks: 100 External: 75 + Internal: 25

(CORE COURSE, SECOND YEAR, THIRD SEMESTER, 4 CREDITS)

Unit 1 : Nuclear energy

Nuclear mass - Binding energy - Radioactivity - Nuclear reactions - Nuclear fission - Mechanism of fission – Fuels - Products of fission - Energy release from fission - Reactor power - Fuel burn up - Consumption.

Unit 2 : Neutron diffusion

Multiplication factor - Neutron balance and conditions for criticality - Conversion and breeding – Classification of reactors.

Diffusion of neutrons: Flux and current density - Equation of continuity - Fick's law - Diffusion equation - Boundary conditions and solutions - Diffusion length - Reciprocity theorem.

Unit 3 : Neutron moderation

Energy loss in elastic collision - moderation of neutrons in Hydrogen - lethargy - Space dependent slowing down - Fermi's age theory -Moderation with absorption.

Fermi theory of Bare thermal reactor: Criticality of an infinite reactor - One region finite thermal reactor - Critical equation - Optimum reactor shape.

Unit 4 : Reactor kinetics

Infinite reactor with and without delayed neutrons - Stable period - Prompt jump - Prompt criticality - Negative reactivity - Changes in reactivity - Temperature coefficient - Burn up and conversion.

Unit 5 : Control and shielding

Reactor control: Road worth - One control rod - modified one group, two group theory - ring of rods.

Radiation shielding: Reactor safeguards - Reactor properties over life - core life estimation.

BOOKS /WEBSITES FOR STUDY AND REFERENCE:

1. **John R. Lamarsh**, 2002, Introduction to Nuclear Reactor Theory ,American Nuclear Society.
2. **Samuel Glasstone, Milton C. Edlund**, 1965, The Elements of Nuclear Reactor Theory, Van Nostrand.

BOOKS /WEBSITES FOR REFERENCE:

1. **H. S. Isbin**, 1963, Introductory Nuclear Reactor Theory, **Reinhold,** New York.
2. www.ans.org/PowerPlants
3. npcil.nic.in/main/AllProjectOperationDisplay.aspx
4. www.world-**nuclear**.org/info/inf53.html

M. Sc. DEGREE **BRANCH: PHYSICS**

SYLLABUS

(Effective for students admitted from the academic year 2017 - 18)

Semester – III (II Year)

Practical – III (17MUMP303)

Numericals Methods (C PROGRAM):

1. Lagrange interpolation with Algorithm, Flow chart and output.
2. Newton forward interpolation with Algorithm, Flow chart and output.
3. Newton backward interpolation with Algorithm, Flow chart and output.
4. Curve-fitting: Least squares fitting with Algorithm, Flow chart and output.
5. Numerical integration by the trapezoidal rule with Algorithm, Flow chart and output.
6. Numerical integration by Simpson's rule with Algorithm, Flow chart and output.
7. Numerical solution of ordinary first-order differential equations by the Euler method with Algorithm, Flow chart and output.
8. Numerical solution of ordinary first-order differential equations by the Runge- Kutta method with Algorithm, Flow chart and output.

Microcontroller 8051:

9. 8 – bit addition and subtraction, multiplication and division.
10. Sum of a series of 8 –bit numbers, average of N numbers.
11. Factorial numbers, Fibonacci series of N terms.
12. Sorting in ascending and descending order. Picking up the smallest and largest number in an array.
13. LED interface – Binary up/down counter.
14. LED interface – BCD up/down counter.
15. Interfacing seven segment display.
16. Stepper motor interfacing.

M. Sc. DEGREE **BRANCH: PHYSICS**

SYLLABUS

(Effective for students admitted from the academic year 2017 - 18)

Semester – IV (II Year)

Paper- XVIII – 17MUM415 – CONDENSED MATTER PHYSICS

CREDITS: 4 TEACHING HOURS: 75 hours
Total Marks: 100 External: 75 + Internal: 25

(CORE COURSE, SECOND YEAR, FOURTH SEMESTER, 4 CREDITS)

UNIT 1 - CRYSTAL PHYSICS

Types of lattices - Miller indices - Simple crystal structures - Crystal diffraction - Bragg's law – Reciprocal Lattice (sc, bcc, fcc) - Laue equations - Brillouin zone - Structure factor - Atomic form factor - Inert gas crystals - Cohesive energy of ionic crystals - Madelung constant.

UNIT 2 - LATTICE DYNAMICS

Lattice with two atoms per primitive cell - First Brillouin zone - Group and phase velocities - Quantization of lattice vibrations - Phonon momentum - Inelastic scattering by phonons - Debye's theory of lattice heat capacity – Thermal Conductivity - Umkalapp processes.

UNIT 3 - THEORY OF METALS AND SEMICONDUCTORS

Free electron gas in three dimensions - Electronic heat capacity - Wieldemann - Franz law - Hall effect - Band theory of metals and semiconductors - Bloch theorem - Kronig - Penney model - Semiconductors - Intrinsic carrier concentration - Mobility - Impurity conductivity – Fermi surfaces and construction - Experimental methods in Fermi surface studies - de Hass-van Alphen effect.

UNIT 4 – MAGNETISM

Diamagnetism - Quantum theory of paramagnetism - Rare earth ion - Hund's rule- Quantum theory of ferromagnetism - Curie point- Neel temperature. - Exchange interaction-Heisenberg's interpretation of Weiss field - Ferromagnetic domains - Bloch wall – Spin waves and Magnons – 1D ferromagnet - - Theory of anti ferromagnetism

UNIT 5 - SUPERCONDUCTIVITY

Experimental facts: Occurence - Effect of magnetic fields - Meissner effect - Entropy and heat capacity - Energy gap - Microwave and infrared properties - Type I and II Superconductors.

Theoretical Explanation: Thermodynamics of super conducting transition - London equation - Coherence length - BCS Theory - Single particle tunneling – Josephson tunneling - DC & AC Josephson effects - High temperature Superconductors - SQUIDS.

BOOKS FOR STUDY

1. **C. Kittel**, 1996, Introduction of Soild State Physics, 7th Ed. Wiley Eastern Ltd, NewYork.
2. **M. Ali Omar**, 1974, Elementary Solid State Physics – Principles and Applications, Addison – Wesley.
3. **H.P. Myers**, 1998, Introductory Solid State Physics, 2nd Ed.

BOOKS FOR REFERENCE

1. **J.C. Anderson, K.D. Leaver, R.D. Rawlings and J.M.Alexander**, 1990, Materials Science, 4th Edition, Chapman Hall, London.
2. **J.S. Blakemore**, Solid State Physics, 1974, 2nd Edition (W.B.Saunder, Philadelphia, 1974).
3. **A.J. Dekker**, Solid State Physics (Macmillan India).
4. **H.M. Rosenburg**, 1993, The Solid State, 3rd Edition, Oxford University Press, Oxford.
5. **C.M. Kachhava**, 1990, Solid State Physics, Tata McGraw- Hill, New Delhi.
6. **S.O. Pillai**, 1997, Solid State Physics, New Age International, New Delhi.
7. **M.A. Wahab,** 2005, Structure and Properties of Materials, 2nd edition, Narosa Publishing house.
8. **R.L. Singhal,** 1998, Solid State Physics, 6th Edition, Kedar Nath Ram Nath & Co. Meerut.

M. Sc. DEGREE **BRANCH: PHYSICS**

SYLLABUS

(Effective for students admitted from the academic year 2017 - 18)

Semester – IV (II Year)

Paper- XIX – 17MUM416 – MICROPROCESSOR AND MICROCONTROLLER

CREDITS: 4 TEACHING HOURS: 75 hours

Total Marks: 100 External: 75 + Internal: 25

(CORE COURSE, SECOND YEAR, FOURTH SEMESTER, 4 CREDITS)

UNIT 1: INTEL 8085 MICROPROCESSOR: ARCHITECTURE, INSTRUCTIONS AND PROGRAMMING

INTEL 8085 - Architecture – Pin diagram – Instruction Cycle – Fetch and Execute operations - Timing diagram – Op-code Fetch – Memory read and write – I/O read and write– interrupts Instruction set– Addressing modes – Intel 8085 instructions – Assembly language program for addition, subtraction, Multiplication and division–sum of a series of 8-bit numbers – Arrange an array of data in ascending and descending order – block transfer.

UNIT 2: INTEL 8086 ARCHITECTURE AND INSTRUCTION SET

CPU architecture-addressing modes-instruction formats-instruction set-execution timing. Assembly language program for addition, subtraction, Multiplication and division–sum of a series of 8-bit numbers – Arrange an array of data in ascending and descending order – block transfer.

UNIT 3: INTERFACING PERIPHERAL I/O SYSTEMS

Programmable peripheral device 8255 – Interfacing keyboard – Matrix Scanning – Interfacing multiplexed 7 segment display – DAC and ADC Interface – Waveform generation using DAC interface – Stepper motor interface – clockwise, anticlockwise.

UNIT 4: 8051 MICROCONTROLLER HARDWARE

Introduction – features of 8051 – 8051 microcontroller hardware : Pin – out of 8051, central processing unit (CPU), Internal RAM, Internal ROM, Register set of 8051 – Memory organizing of 8051 – input/output pins, ports and circuits – external data memory and program memory : external program memory , external data memory.

UNIT 5: 8051 INSTRUCTION SET AND ASSEMBLY LANGUAGE PROGRAM

Addressing modes – data moving (data transfer) instructions: instructions to access external data memory, external ROM/ program memory, PUSH and POP instructions , data exchange instructions – logical instruction: byte and bit level logical operations, rotate and swap operations – Arithmetic instructions: Flags , incrementing and decrementing , addition , subtraction , multiplication and division, decimal arithmetic – jump and CALL instructions: Jump and CALL program range, Jump, CALL and subroutines – programming.

BOOKS FOR STUDY:

1. **V. Vijayendran**, 2005, Fundamentals of Microprocessor-8085", 3rd Edition S.Visvanathan Pvt, Ltd.
2. **Douglas V. Hall**, 2005, Microprocessor interfacing, Programming and Hardware, Tata McGraw-Hill.
3. **Muhammad Ali Mazidi, Janice Gillipsie Mazidi**, 2006, The 8051 Microcontroller and Embedded Systems, Pearson Prentice Hall, First Impression.

BOOKS FOR REFERENCES:

1. **Barry B. Brey**, 1995, The Intel Microprocessors 8086/8088, 80186, 80286, 80386 and 80486, 3rd Edition, Prentice- Hall of India, New Delhi.
2. **J. Uffrenbeck**, "The 8086/8088 Family-Design, Programming and Interfacing, Software, Hardware and Applications", Prentice-Hall of India, New Delhi.
3. **W. A. Tribel, Avtar Singh**, "The 8086/8088 Microprocessors: Programming, Interfacing, Software, Hardware and Applications", Prentice-Hall of India, New Delhi.

M. Sc. DEGREE **BRANCH: PHYSICS**

SYLLABUS

(Effective for students admitted from the academic year 2017 - 18)

Semester – IV (II Year)

Paper- XX – 17MUM417 – MEDICAL PHYSICS AND ULTRASONICS

CREDITS: 4
Total Marks: 100

TEACHING HOURS: 75 hours
External: 75 + Internal: 25

(CORE COURSE, SECOND YEAR, FOURTH SEMESTER, 4 CREDITS)

UNIT 1: DIAGNOSTIC DEVICES

Blood Pressure and its Measurement – Eye Pressure Measurement - Electrical Signals from Heart: Electrocardiography (ECG) – Electrical Signals from brain: Electroencephalogram (EEG) - Electrical Signal from muscles: Electromyogram (EMG) – Magnetic Resonance Imaging (MRI).

UNIT 2: THERAPEUTIC DEVICES

Microprocessor based ventilators – AC and DC defibrillator – Pacemaker – Versatile Electro Therapeutic Stimulator – Anesthesia Machine – Ventilator – Dialysis Process – Comparison between Hemodialysis and Peritoneal Dialysis - Peritoneal Dialysis unit.

UNIT 3: MEDICAL APPLICATIONS OF LASERS

Laser Based Blood Cell Counter – Laser Doppler Blood Flow meter – Laser in Angioplasty – Principle and theory of fluorescence – Reflectance and Light Scattering Spectroscopy – Laser Spectroscopy Cancer Detection

UNIT 4: ULTRASONIC STUDY OF LIQUID MIXTURES AND SOLUTIONS

Preparation of multi component liquid mixtures: Mole fraction – Weight fraction – Volume fraction. Measurement techniques: Ultrasonic Interferometer – Continuous wave method – Density – Viscosity

Pure liquids and binary Mixtures :Free Length Theory – Collision Factor Theory – Nomoto's Relation Acoustical Parameters – Adiabatic Compressibility – Acoustic Impedance – Intermolecular Free Length – Molar Volume – Free Volume – Internal Pressure.

UNIT 5: Applications of Ultrasound

Low Frequency – High Intensity Applications: Ultrasonic Welding – Ultrasonic Cleaning – Applications – Food Industry – Length Meters.
High Frequency – Low Intensity Applications: Level Meters – Thickness Measurements – Ultrasonic Microscopy – Acoustic Holography (Transmission Acoustic Holography)

BOOK FOR STUDY:

1. **Dr .M. Arumugam**, 2005, Biomedical Instrumentation, Anuradha publications, Chennai.
2. **S. Svanberg**, 2010, Atomic & Molecular Spectroscopy (Basic aspects & Practical applications), 4^{th} Edition, WILY Publications.
3. **Baldevraj, V.Rajendran and P.Palanichamy**, 2009, Science and Technology of Ultrasonics, 4^{th} Edition, Narosa Publications, New Delhi.

BOOK FOR REFERENCE:

1. **John R. Cameron and James G. Skofronick**, 2009, Medical Physics, John Wiley Interscience Publication, Canada, 2^{nd} edition.

M. Sc. DEGREE **BRANCH: PHYSICS**

SYLLABUS

(Effective for students admitted from the academic year 2017 - 18)

Semester – IV (II Year)

Practical – IV (17MUMP404)

General Practicals:

1. Cornu's Method – Young's Modulus and Poisson's ratio by Hyperbolic fringes.
2. Michelson Interferometer – Thickness of mica sheet.
3. Susceptibility by Quincke's method.
4. GM Counter – Characteristics, inverse square law, absorption coefficient.
5. Hall Effect.
6. F. P. Etalon using spectrometer.
7. Edser and Butler fringes – Thickness of air film.
8. Laser: Study of laser beam parameters.
9. Conductivity measurement using four probe method.

Electronics Practicals:

9. Study of R-S, clocked R-S and D- Flip flops using NAND/NOR gates.
10. Study of J-K, D and T- Flip flops using IC 7476/ IC 7473.
11. IC 7490 as a scalar and display using IC 7447.
12. Construction of square wave generator using IC 555 – study of VCO.
13. Construction of pulse generator using IC741- application as frequency divider.
14. IC 7476/ IC7473 – Study of binary up/down counters.
15. IC 7476 – Shift register, ring counter and Johnson counter (twisted ring counter).
16. Arithmetic operations using IC 7483 – 4 bit binary addition and subtraction.