BHARATHI WOMEN'S COLLEGE (AUTONOMOUS), CHENNAI – 108
M.Sc. PHYSICS
(CBCS Syllabus for PG students admitted from the academic year 2019-20)

SEMESTER I

Course Component	Code	Title of the paper	Credit	Hrs /week	ESE	CIA	Total
Core T-1	19MBA	Mathematical Physics - I	5	6	75	25	100
Core T-2	19MBB	Classical Mechanics and Relativity	5	6	75	25	100
Core T-3	19MBC	Quantum Mechanics - I	5	6	75	25	100
Core P-1	19MB1	Practical Paper - I	-	4	-	-	-
Core P-2	19MB2	Practical Paper - II	-	4	-	-	-
Core Elective-1 (Any one)	19EB1	Spectroscopy	4	4	75	25	100
	19EB2	Atmospheric Physics	4	4	75	25	100
	19EB3	Bio Physics	4	4	75	25	100
Soft Skill -1	19MS1	Essentials of Language and Communication skills	2	-	75	25	100

SEMESTER II

Course Component	Code	Title of the paper	Credit	Hrs /week	ESE	CIA	Total
Core T-4	19MBD	Mathematical Physics - II	5	5	75	25	100
Core T-5	19MBE	Quantum Mechanics - II	5	5	75	25	100
Core T-6	19MBF	Electromagnetic Theory and Plasma Physics	5	5	75	25	100
Core P-1	19MB1	Practical Paper – I	4	4	60	40	100
Core P-2	19MB2	Practical Paper - II	4	4	60	40	100
Core Elective-2 (Any one)	19EB4	Integrated Electronics	4	4	75	25	100
	19EB5	Crystal Growth and Thin Film Physics	4	4	75	25	100
	19EB6	Introduction to Spintronics	4	4	75	25	100
Supp. Course- 1	19SB1	Energy Physics	3	3	75	25	100
Soft Skill-2	19MS2	Life and Managerial Skills	2	-	75	25	100

SEMESTER III

Course Component	Code	Title of the paper	Credit	Hrs /week	ESE	CIA	Total
Core T-7	19MBG	Statistical Mechanics	5	5	75	25	100
Core T-8	19MBH	Nuclear and Particle Physics	5	5	75	25	100
Core T-9	19MBJ	Computational Methods and C Programming	5	5	75	25	100
Core P-3	19MB3	Practical Paper – III	-	4	-	-	-
Core P-4	19MB4	Practical Paper – IV	-	4	-	-	-
Core Elective -3 (Any one)	19EB7	Microprocessor and Microcontroller	4	4	75	25	100
	19EB8	Medical Physics	4	4	75	25	100
	19EB9	Non Linear Optics	4	4	75	25	100
Supp. Course- 2	19SB2	Astro Physics	3	3	75	25	100
Soft Skill-3	19MS3	Essentials of Spoken and Presentation Skills	2	-	75	25	100
Internship	19MS5	Internship	2	-	100		100

SEMESTER IV

Course Component	Code	Title of the paper	Credit	Hrs /week	ESE	CIA	Total
Core T-10	19MBK	Condensed Matter Physics	5	6	75	25	100
Project/ AOP	19MB5	Project	6	6	60	40	100
Core P-3	19MB3	Practical Paper - III	4	4	60	40	100
Core P-4	19MB4	Practical - IV	4	4	60	40	100
Core Elective-4 (Any one)	19EB10	Materials Science	5	5	75	25	100
	19EB11	Molecular Physics	5	5	75	25	100
	19EB12	Physics of Imaging	5	5	75	25	100
Core Elective-5 (Any one)	19EB13	Nanoscience and Technology	5	5	75	25	100
	19EB14	Reactor Physics	5	5	75	25	100
	19EB15	X – ray Crystallography	5	5	75	25	100
Soft Skill-4	19MS4	Computing Skills – Advanced	2	-	75	25	100

BHARATHI WOMEN'S COLLEGE (AUTONOMOUS), CHENNAI – 600 108.
M.Sc. – PHYSICS
CORE PAPER I - MATHEMATICAL PHYSICS I
(For the students admitted from the year 2019 – 20)

HOURS PER WEEK	**:6**	**SEMESTER**	**:I**
CREDITS	**:5**	**SUBJECT CODE**	**:19MBA**

OBJECTIVES:

- To develop knowledge in mathematical physics and its applications.
- To develop expertise in mathematical techniques required in physics.
- To enhance problem solving skills.
- To enable students to formulate, interpret and draw inferences from mathematical solutions.

UNIT-I: VECTOR ANALYSIS AND VECTOR SPACES

Concept of gradient, divergence and curl - Gauss's divergence theorem, Green's theorem and Stoke's theorem (Proof) - Orthogonal curvilinear coordinates - Expression for gradient, divergence, curl and Laplacian in cylindrical and spherical co-ordinates (Theory) - Linearly dependent and independent sets of vectors - Inner product (problems) - Schwartz inequality - Schmidt's orthogonalization process.

UNIT-II: MATRICES

Types of Matrices - Transpose of a Matrix- Symmetric and anti-symmetric matrices - Orthogonal Matrices - Hermitian and Skew-Hermitian Matrices - Unitary Matrices - Rank of a Matrix - Eigen values and Eigen vectors - Theorems on Matrices - Diagonalisation of matrices - Cayley-Hamilton's theorem - Problems.

UNIT-III: TENSOR ANALYSIS

Definition of Tensors - Contravariant, covariant and mixed tensors - addition and subtraction of Tensors - Summation convention - Symmetric and Anti-symmetric Tensor - Contraction and direct product - Quotient rule - Pseudo tensors, Levi-Civita Symbol - Dual tensors, irreducible tensors.

UNIT-IV: COMPLEX VARIABLE

Functions of complex variable - Analytic functions - Cauchy- Riemann equations - integration in the Complex plane - Cauchy's Integral theorem - Cauchy's integral formula - Taylor and Laurent expansions - Singular Points - Poles - Residues and evaluation of residues - Cauchy's residue theorem -evaluation of definite integrals.

UNIT-V: GROUP THEORY

Definition - Subgroups - Cyclic groups and Abelian groups - Homomorphism and Isomorphism of groups - Classes - Symmetry operations and symmetry elements - Representations of groups - Reducible and irreducible representations - Unitary representations - Schur's Lemmas -Orthogonality theorem - Character tables for simple molecular types (C_{2v} and C_{3v} point group molecules).

BOOKS FOR STUDY:

1. Mathematical Physics, B.D. Gupta, Vikas Publishing House Pvt. Ltd, 1995.
2. Mathematical Physics, B.S. Rajput, 20th Edition, Pragati Prakashan, 2008.
3. Applied Mathematics for Engineers and Physicists, L.A. Pipes and L.R. Havevill, McGraw Hill Publications Co., 3rd Edition, 1971.
4. Theory and Problems of Laplace Transforms, Murray R. Spigel, Schaum's outline series, McGraw Hill, 1986.
5. Matrices and Tensors in Physics, A.W. Joshi, Wiley Eastern limited, 3rd Edition, 1995.

BOOKS FOR REFERENCE:

1. Mathematical Physics, H.K. Dass and Rama Verma, S. Chand and Company Ltd, 2010.
2. Mathematical physics, P.K. Chattopadhyay, Wiley Eastern Limited, 1990.
3. Introduction to Mathematical physics, Charlie Ha Harper, Prentice Hall of India Pvt.Ltd, 1993.
4. M. Hamermesh, 1962, *Group Theory and Its application to Physical Problems*, Addison Wesley, Reading.
5. C. R. Wylie and L.C. Barrett, 1995, *Advanced Engineering Mathematics*, 6th Edition, International Edition, McGraw-Hill, New York.
6. W. W. Bell, 1968, *Special Functions for Scientists and Engineers*, Van Nostrand, London.
7. M. A. Abramowitz and I. Stegun (Editors), 1972, *Handbook of Mathematical Functions* Dover, New York.

BHARATHI WOMEN'S COLLEGE (AUTONOMOUS), CHENNAI – 600 108.
M.Sc. – PHYSICS
CORE PAPER II – CLASSICAL MECHANICS AND RELATIVITY
(For the students admitted from the year 2019 – 20)

HOURS PER WEEK	**:6**	**SEMESTER**	**:I**
CREDITS	**:5**	**SUBJECT CODE**	**:19MBB**

OBJECTIVES:

- To solve the equation of motion using Lagrangian, Hamilton and Hamilton-Jacobi equations.
- To study the kinematics of a rigid body through Euler equations.
- To get knowledge in central force field and relativity.

UNIT – I LAGRANGIAN AND HAMILTONIAN FORMULATIONS

System of particles-conservation laws-D'Alembert's principle of virtual work-Lagrange's equation of motion- Canonical momenta – Cyclic coordinates and conservation of corresponding momenta - Principle of least action - Hamilton's variational principle - Lagrange's equations of motion — Legendre transformation - Hamiltonian - Hamilton's equations of motion - Applications of Lagrange equations of motion: Atwood's machine, Two-body central force problem –Kepler Problem and Kepler's laws - Scattering by central potential - Two-particle scattering - Cross-section in laboratory frame.

UNIT – II 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 – III CANONICAL TRANSFORMATION

Canonical transformations and their generators – Simple examples - Poisson brackets – Equations of motion in Poisson bracket formalism - Symmetries and conservation laws - Hamilton-Jacobi theory - Application to harmonic oscillator problem.

UNIT – IV SMALL OSCILLATIONS

Equation of motion for coupled oscillators - Transformation to normal coordinates – Normal modes and Normal frequencies – Application to a linear triatomic molecule – Generalization to a system with n degrees of freedom.

UNIT – V RELATIVITY

Lorentz transformations - Four vectors - Lorentz invariance of four product of two four vectors - Invariance of Maxwell's equations - Relativistic Lagrangian and Hamiltonian for a free particle.

COURSE OUTCOME:

On completion of the course the students will

- Have a deep understanding of Lagrangian and Hamiltonian equations and its applications.
- Understand the Lagrangian formulation of general relativity.

BOOKS FOR STUDY:

1. **H. Goldstein,** 2002, *Classical Mechanics.* 3rd Edition, C. Poole and J. Safko, Pearson Education, Asia, New Delhi.
2. **S. N. Biswas,** 1998, *Classical Mechanics,* Books and Allied Ltd., Kolkata.
3. **J.C.Upadhyaya,** 1999, *Classical Mechanics* , Himalaya Publishing Co., New Delhi.

BOOKS FOR REFERENCE:

1. **L. D. Landau** and **E. M. Lifshitz,** 1969, *Mechanics,* Pergomon Press, Oxford.
2. **K. R. Symon,** 1971, *Mechanics,* Addison Wesley, London.
3. **J. L. Synge** and **B. A. Griffith,** 1949, *Principles of Classical Mechanics,* Mc Graw-Hill, New York.
4. **C. R. Mondal,** *Classical Mechanics,* Prentice-Hall of India, New Delhi.
5. **R. Resnick,** 1968, *Introduction to Special Theory of Relativity,* Wiley Eastern, New Delhi.
6. **R. P. Feynman,** 1962, *Quantum Electrodynamics,* Benjamin, Reading, MA.

BHARATHI WOMEN'S COLLEGE (AUTONOMOUS), CHENNAI – 600 108.
M.Sc. – PHYSICS
CORE PAPER III – QUANTUM MECHANICS I
(For the students admitted from the year 2019 – 20)

HOURS PER WEEK	**:6**	**SEMESTER**	**:I**
CREDITS	**:5**	**SUBJECT CODE**	**:19MBC**

OBJECTIVES:

- To study the fundamentals of wave mechanics.
- To study the stationary state and eigen spectrum of systems using time dependent Schrodinger equation.
- To solve the exactly soluble eigen value problems.
- To know the matrix formulation of quantum theory and how it can be used to understand the equation of motion.
- To understand the theory of identical particles and Angular momentum.

UNIT – I BASIC FORMALISM

Schroedinger equation -(time independent and time dependent) Interpretation and conditions on the wave function- normalised and orthogonal wave functions - Postulates of quantum mechanics- Adjoint of an operator and self- Adjoin ness- Stationary states- – Hermitian operators for dynamical variables - Eigenvalues and eigen functions – Equation of continuity-Conservation of probability-Ehrenfest's theorem- Uncertainty principle

UNIT – II ONE DIMENSIONAL PROBLEMS AND THREE DIMENSIONAL PROBLEMS

Particle in a box - Square-well potential - Barrier penetration - Simple harmonic oscillator - Ladder operators method. Orbital angular momentum and spherical harmonics - Central forces and reduction of two-body problem - Particle in a spherical well - Hydrogen atom.

UNIT – III GENERAL FORMALISM

Hilbert space(-Linear independence,basis,inner product)- - Dirac notation - Representation theory - Co-ordinate and momentum representations - Time evolution - Schroedinger, Heisenberg and Interaction pictures- Symmetries and conservation laws - Unitary transformations associated with translations and rotations - Parity and time reversal.

UNIT – IV APPROXIMATION METHODS

Time-independent perturbation theory for Non-degenerate levels –1st and 2nd orders– application to an harmonic oscillator – Time-independent perturbation theory for Degenerate level –application to first order stark effect in Hydrogen atom - Variation method – Application to GS of Helium atom - WKB approximation - Principle of the method – connection formulae for barrier penetration(NO DERIVATION)- Application to barrier penetration.

BHARATHI WOMEN'S COLLEGE (AUTONOMOUS), CHENNAI - 600 108.

M.Sc. – PHYSICS

CORE PAPER III – QUANTUM MECHANICS I

(For the students admitted from the year 2019 – 20)

HOURS PER WEEK	:6	**SEMESTER**	:I
CREDITS	:5	**SUBJECT CODE**	:19MBC

OBJECTIVES:

- To study the fundamentals of wave mechanics.
- To study the stationary state and eigen spectrum of systems using time dependent Schrodinger equation
- To solve the exactly soluble eigen value problems.
- To know the matrix formulation of quantum theory and how it can be used to understand the equation of motion
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Schroedinger equation -(time independent and time dependent): Interpretation and conditions on the wave function- normalised and orthogonal wave functions - Postulates of quantum mechanics- Adjoint of an operator and self- Adjoint ness- Stationary states- Hermitian operators for dynamical variables - Eigenvalues and eigen functions - Equation of continuity-Conservation of probability Ehrenfest's theorem- Uncertainty principle

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Hilbert space(-Linear independence,basis,inner product)- - Dirac notation - Representation theory - Co-ordinate and momentum representations - Time evolution - Schroedinger, Heisenberg and Interaction pictures- Symmetries and conservation laws Unitary transformations associated with translations and rotations - Parity and time reversal.

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UNIT – V ANGULAR MOMENTUM AND IDENTICAL PARTICLES

Eigenvalue spectrum from angular momentum algebra - Matrix representation - Spin angular momentum - Non-relativistic Hamiltonian including spin - Addition of angular momenta - Clebsch - Gordan Coefficients. Symmetry and anti-symmetry of wave functions - Spin and Pauli matrices.

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**, *1968 Quantum Mechanics*, 3rd Edition, International Student Edition, MacGraw-Hill Kogakusha, Tokyo.
3. **V. Devanathan,** 2005, *Quantum Mechanics*, Nacosa Publishing House, New Delhi.
4. **Satya Prakash**-*Quantum Mechanics* , 2018,Kedar NathRam Nath and co publications.
5. **Gupta, Kumar and Sharma,** *Quantum Mechanics*, 11th edition, JaiPrakash Nath and co.Meerut.
6. **V. K. Thankappan**, *1985, Quantum Mechanics*, 2nd Edition, Wiley Eastern Ltd. New Delhi
7. **G.Aruldhas**,2000,, *Quantum Mechanics*,Prentice Hall of India.

BOOKS FOR REFERENCE:

1. **E. Merzbacher**, 1970, *Quantum Mechanics* 2nd edition, John Wiley and Sons, New York
2. **P. A. M. Dirac**, 1973, *The Principles of Quantum Mechanics*, Oxford University Press, London
3. **L. D. Landau** and **E. M. Lifshitz**, 1976, *Quantum Mechanics* Pergomon Press, Oxford.
4. **S. N. Biswas**, 1999, *Quantum Mechanics*, Books And Allied Ltd., Kolka.
5. **A. Ghatak and S. Lokanathan**, *Quantum Mechanics, Theory and Applications*, 4th Edition, Macmillan India.
6. **J. S. Bell, Gottfried** and **M.Veltman**, 2001, *The Foundations of Quantum Mechanics* World Scientific, Singapore.
7. **R. P. Feynman, R. B. Leighton, and M. Sands**, 1998, *The Feynman Lectures on Physics*, Vols. 3, Narosa, New Delhi.
8. **V. Devanathan,** 1990, *Angular Momentum Techniques in Quantum Mechanics* Kluwer Academic Publishers, Dordrech

BHARATHI WOMEN'S COLLEGE (AUTONOMOUS), CHENNAI – 600 108.
M.Sc. – PHYSICS
ELECTIVE PAPER I: Option I- SPECTROSCOPY
(For the students admitted from the year 2019 – 20)

HOURS PER WEEK	**:4**	**SEMESTER**	**:I**
CREDITS	**:4**	**SUBJECT CODE**	**:19EB1**

OBJECTIVES:

- To give advanced knowledge about the interactions of EM radiation with matter and their applications in spectroscopy like IR, RAMAN, NMR, ESR, NQR and Mossbauer spectroscopy.

UNIT-I: MICROWAVE SPECTROSCOPY

Rotation of Molecules – Rigid Rotator (Diatomic Molecules) – Expression for the Rotational Constant - Intensity of Spectral Lines – Effect of Isotopic Substitution - Molecular Parameters (Bond Length, Bond Angle, Dipole Moment) from Rotation Spectra – Techniques and Instrumentation.

UNIT II: INFRARED SPECTROSCOPY

Vibrating diatomic molecule- Infrared selection rules-Diatomic vibrating rotator-Vibrations of polyatomic molecules-Normal vibrations of CO_2 and H_2O molecules-More about Anharmonicity-Fermi resonance- Normal modes of vibration in a crystal-Solid state effects- Interpretation of vibrational spectra-Group frequencies-IR spectrophotometer-Instrumentation-Sample handling techniques-Fourier Transform Infrared spectroscopy-Principle and Interferometer arrangement-Applications: Identification of Molecular Constituents, Biological applications.

UNIT III: RAMAN SPECTROSCOPY

Introduction-Theory of Raman scattering-Rotational Raman spectra-Vibrational Raman spectra-Mutual Exclusion principle-Raman spectrometer-Sample handling techniques-Polarization of Raman scattered light-Structure determination using IR and Raman spectroscopy-Raman investigation of phase transitions-Resonance Raman scattering-Nonlinear Raman phenomena-Preliminaries-Hyper Raman effect-Stimulated Raman scattering-Inverse Raman effect-Coherent Anti-Stokes Raman scattering .

UNIT IV: NUCLEAR MAGNETIC AND ELECTRON SPIN RESONANCE SPECTROSCOPY

Basic principles – Quantum theory of NMR - resonance condition –Bloch Equations – chemical shift –NMR Instrumentation – Fourier Transform NMR-Applications.

Basic principles – Quantum theory - g-factor – Nuclear Interaction - Hyperfine structure –ESR Spectrum of Hydrogen atom – ESR spectrometer – Instrumentation – applications.

UNIT V: NUCLEAR QUADRUPOLE RESONANCE AND MOSSBAUER SPECTROSCOPY

Basic principle and theory – Energy levels of quadrupole transitions for Axially symmetric systems – Energy levels of quadrupole transitions for Nonaxially symmetric systems - NQR Instrumentation –Regenerative Continuous Wave Oscillator method - applications.

Principle and theory (recoilless emission and absorption) – Experimental Techniques- Source and Absorber- Mossbauer Spectrometer- Chemical isomer shift - magnetic hyperfine interactions–quadrupole interactions- applications.

COURSE OUTCOMES

Students who completed this course

- Should be able to have achieved advanced knowledge about the interaction of electromagnetic radiation with matter and their applications in spectroscopy.
- Should be able to recognize and to explain sample preparation in NMR Spectroscopy.
- Will be able to interpret elemental analysis technique.
- Should be able to solve problems related to the structure purity and concentration of chemicals and to study molecular interactions by choosing suitable spectroscopic methods with their interpreting corresponding data.
- Should be able to apply formalism based on molecular symmetry to predict spectroscopic properties.

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, *Moleclar Structure and Spectroscopy*, Prentice Hall of India Pvt. Ltd. New Delhi.
3. **D. N. Satyanarayana,** 2004, *Vibrational Spectroscopy and Applications*, New Age International Publication

BOOKS FOR REFERENCE:

1. **D. D. Tyagi** and **M. D Yadav** 1991, *Spectroscopy*, Amol Publications
2. **Atta ur Rahman,** 1986, *Nuclear Magnetic Resonance*, Spinger Verlag.
3. **D. A. Lang,** *Raman Spectroscopy*, Mc Graw-Hill International
4. **Raymond Chang,** 1980, *Basic Principles of Spectroscopy* Mc Graw-Hill Kogakusha, Tokyo.

BHARATHI WOMEN'S COLLEGE (AUTONOMOUS), CHENNAI – 600 108.
M.Sc. – PHYSICS
ELECTIVE PAPER I: Option Paper II – ATMOSPHERIC PHYSICS
(For the students admitted from the year 2019 – 20)

HOURS PER WEEK	**: 4**	**SEMESTERS**	**: I**
CREDITS	**: 4**	**SUBJECT CODE**	**: 19EB2**

OBJECTIVES:

- To know about the structure of atmosphere and clouds.
- To develop knowledgeinmicrophysical principles and phenomena.
- To learn the dynamics of Indian monsoons.
- To study the behavior of atmospheric pollutants.
- To enable students to apply principles of cloud microphysics to solve atmospheric problems.

UNIT-I: PHYSICAL &DYNAMIC METEOROLOGY

Physical Meteorology: Structure of Earth's Atmosphere and Composition- Law of Thermodynamics of the Atmosphere-Adiabatic Process - Potential Temperature-Clausius&ClapyeronEquation - Laws of Black Body Radiation-Solar and Terrestrial Radiation-Albedo - GreenHouse Effect-Heat Balance of Earth-atmosphere System.

UNIT-II: DYNAMIC METEOROLOGY

Fundamental Forces-Structure of Static Atmosphere-Momentum, Continuity and Energy Equations-Thermodynamics of the Dry Atmosphere-Elementary Applications of the Basic Equations-Circulation Theorem-Vorticity- Potential Vorticityand potential VorticityEquations.

UNIT-III: CLIMATE &MONSOON DYNAMICS

Climate Classification-Polar, Artic, Antarctic, Temperate & Tropical Climates - Wind, Temperature &Pressure Distribution over India in the Lower, Middle and Upper Atmosphere during Pre- Post- and Mid-Monsoon seasons-Dynamics of Monsoon, Depression and Easterly Waves - Intra Seasonal and Inter-annual variability of Monsoon - Quasi,Bi-weekly and 30-60 Day Oscillations - Walker Circulation, Southern Oscillations & El Nino.

UNIT-IV: ATMOSPHERIC POLLUTION

Role of Meteorology in atmospheric pollution - Atmospheric boundary layer - Air Stability – Local Wind Structure - Ekman Spiral-Turbulence &Boundary Layer

Scaling - Residence Time and Reaction Rates of Pollutants – Sulphur compounds - Carbon compounds-Organic compounds – Aerosol – Toxic gases and Radioactive particles-Trace gases.

UNIT-V: RADAR METEOROLOGY

Basic Meteorology - Radar Principles and technology - Radar Signal processing &Display-Weather Radar – Observation of Precipitating Systems – Estimation of Precipitation - Radar observation of Tropical Storms &Cyclones – Use of Weather Radar in Aviation – Clear Air Radars - Observation of a Clear Air Phenomena.

COURSE OUTCOME:

On completion of the course the students will

- be able to identify different layers of atmosphere and types of clouds.
- have knowledge on the dynamics of Indian monsoons.
- know the atmospheric pollutants and their hazardous effects.
- be able to apply principles of cloud microphysics to solve atmospheric problems.

BOOKS FOR STUDY:

1. The Atmosphere – Frederick K. Lutgensand Edward J. Tarbuk

BOOKS FOR REFERENCE:

1. Dynamic Meteorology - J.R.Holton– Academic Press - NY
2. The Physics of Monsoons - R.N. Keshavamurthy& M. Shankar Rao- Allied Publishers
3. Principles of Air Pollution Meteorology-Tom Lyons &Prillscott- CBS Publishers.
4. Radar Meteorology – Henry Saugageot.

BHARATHI WOMEN'S COLLEGE (AUTONOMOUS), CHENNAI – 600 108.
M.Sc. – PHYSICS
ELECTIVE PAPER I: Option Paper III –BIO PHYSICS
(For the students admitted from the year 2019 – 20)

HOURS PER WEEK	**: 4**	**SEMESTERS**	**: I**
CREDITS	**: 4**	**SUBJECT CODE**	**: 19EB3**

OBJECTIVES:

- To understand the Organization of cell and Internal architecture of cells.
- To understand the applications of various microscopic tools in cell biology.
- To understand the fundamentals of macromolecular structure and the analytical techniques in characterizing biomolecular interactions and its structure.

UNIT-I: CELL ORGANIZATION

Cell as the basic structural unit- Origin & organization of Prokaryotic and Eukaryotic cell- Cell size & shape- Fine structure of Prokaryotic & Eukaryotic cell organization (Bacteria, Cyanobacteria, plant & Animal cell)- Internal architecture of cells- cell organelles- compartment & assemblies membrane system- Ribosome- Polysomes- Lysosomes- Peroxisomes- Connection between cell & its environment- Extracellular Matrix.

UNIT-II: TOOLS IN CELL BIOLOGY

Light microscope- Resolving Power- Phase contrast microscope- Detection of small differences in refractive indices- Interference microscope-, Dark field microscope- Polarization microscope- Fluorescence microscope- Cytophotometry methods- Flowcytometry& cell sorting- Electron microscopy- specimen preparation- Scanning Electron Microscopy (SEM)- Transmission Electron Microscopy (TEM)-Applications.

UNIT-III: MACROMOLECULAR STRUCTURE

Nucleic acid structure: Chemical structure of the nucleic acid - Conformational possibilities of monomers and polymers- Double helix structure of DNA- Polymorphism of DNA- DNA nanostructures and the structure of transfer RNA.

Proteins structure: Amino acids and the primary structures of proteins – Secondary – Tertiary - Quaternary structure and virus structure.

UNIT-IV: SEPERATION TECHNIQUES

Centrifugation: Principle of centrifugation –Analytical ultracentrifugation – Differential centrifugation – Density gradient centrifugation.

Chromatography: Principles of chromatography– Paper chromatography – Thin layer chromatography (TLC) – Gas liquid chromatography (GLC) – High performance liquid chromatography (HPLC).

Electrophoresis:Principles – Factors affecting the migration of substances – Supporting media in electrophoresis – Gel electrophoresis – Polyacrylamide gel

electrophoresis (PAGE) – Sodium dodecyl sulphate polyacrylamide gel electrophoresis (SDS-PAGE).

UNIT-V: OPTICAL & DIFFRACTION TECHNIQUES

Circular Dichroism and optical rotator dispersion-: Plane, circular and elliptical polarization of light- Absorption by oriented molecules- Dichroic ratio of proteins and nucleic acids- Circular dichroism (CD) - optical rotatory disperson (ORD) - Relation between CD and ORD- Application of ORD in conformation and interactions of biomolecules.

Crystallization of proteins- preparation of heavy metal derivatives- Patterson synthesis- isomorphous replacement methods- structure factors of centro-symmetric and non-centrosymmetric crystals- General remarks on Protein-Structure determination from X-ray diffraction data-Neutron diffraction-, Electron diffraction-, Synchrotron diffraction, Application in Biomolecular structural studies.

COURSE OUTCOME:

On completion of the course the students will

- be able to understand the organization of cell and Internal architecture of cells.
- be able to understand the applications of various microscopic tools in cell biology.
- be able to understand the fundamentals of macromolecular structure and the analytical techniques in characterizing biomolecular interactions and its structure.

BOOKS FOR STUDY

1. Biophysics, VasanthaPattabhi, N. Gautham, Narosa Publishing, 2009.

2. Biophysics, M.A. Subramanian, MJP Publishers, 2005.

BOOKS FOR REFERENCE:

1. The Cell: A Molecular Approach, Geoffrey M.Cooper, ASM Press, 2013.

2. Biophysics P.S. Mishra, VK Enterprises, 2010.

3. Bioinstrumentation, L.Veerakumari, MJP Publishers, 2006.

4. Fundamentals of Biochemistry, A.C. Deb, New central book agency, 2011.

BHARATHI WOMEN'S COLLEGE (AUTONOMOUS), CHENNAI – 600 108.
PG - SOFT SKILL
PAPER-I ESSENTIALS OF LANGUAGE AND COMMUNICATION SKILLS
(For the students admitted from the year 2019-20)

HOURS : 30 Hrs	**SEMESTER : I**
CREDITS : 2	**SUBJECT CODE : 19MS1**

Objectives

- Enable students to convert the conceptual understanding of communication into everyday practice
- Train students to ground concepts/ ideas in their own experience
- Create a learner – language interface enabling students to exercise control over language use
- Sensitize students to the nuances of the four basic communication skills – Listening, Speaking, Reading and Writing

UNIT I: Twinning Functions of Listening and Speaking – Recap of active and passive listening exercises – Analytical listening – syllable/word stress; clear enunciation – Qualities of a good listener and a good speaker.

UNIT II: Twinning Functions of Reading and Writing – Discriminatory reader thoughtful writer – Spotting, correcting errors; critique – Skimming, scanning, structuring – language, tone, ordering, etiquette and perspective.

UNIT III: Individual Communication – Self advertising – Over stating and under stating – Overcoming shyness – Writing curriculum vitae, Statement of Purpose – Talking about oneself; interview.

UNIT IV: Intermediary Communication – Overcoming mental blocks, prejudices and hotspots of the addressee – telephone, teleconferencing, web chat – greeting, introducing – memos, reports, minutes, business correspondence.

UNIT V: Social Communication – Etiquette in LSRW – polite yet assertive, tackling questions, seeking permission, expressing gratitude – gender fair language – discourse and transactional analysis – empathy.

Practicals:

Unit 1: Listening Comprehension using audio programmes + creating audio files for speaking.
Unit 2: In class and take home exercises
Unit 3: and Unit 4: Group games and role play
Unit 5: Create archives from different media for LSRW.

BHARATHI WOMEN'S COLLEGE (AUTONOMOUS), CHENNAI – 600 108.
M.Sc. – PHYSICS
CORE PAPER IV - MATHEMATICAL PHYSICS II
(For the students admitted from the year 2019 – 20)

HOURS PER WEEK	**:5**	**SEMESTER**	**:II**
CREDITS	**:5**	**SUBJECT CODE**	**:19MBD**

OBJECTIVES:

- To develop knowledge in mathematical physics and its applications.
- To develop expertise in mathematical techniques required in physics.
- To enhance problem solving skills.
- To enable students to formulate, interpret and draw inferences from mathematical solutions.

UNIT-I: DIFFERENTIAL EQUATIONS

Homogeneous linear equations of second order with constant coefficients and their solutions - ordinary second order differential with variable coefficients and their solution by power series and Frobenius methods - extended power series method for indicial equations - Wronskian - Sturm-Liouville theory - Orthogonality of eigen functions.

UNIT-II: SPECIAL FUNCTIONS - I

Gamma and Beta function - Legendre's differential equation - Legendre polynomials - Generating function - Rodrigue's formula - Orthogonality - Recurrence relations; Bessel's differential equation - Bessel polynomials - Generating function – Bessel's Integral - Orthogonality - Recurrence relations.

UNIT-III: SPECIAL FUNCTIONS - II

Hermite differential equation - Hermite polynomials - Generating function - Rodrigue's formula - Orthogonality - Recurrence relations ; Laguerre differential equations - Laguerre polynomials - Generating functions - Rodrigue's formula - Orthogonality - Recurrence relations.

UNIT-IV: PARTIAL DIFFERENTIAL EQUATIONS

Laplace's Equation - Solution of Laplace's Differential Equation using Cartesian and spherical co-ordinates - Diffusion equation (Fourier equation of heat flow) - Solutions of two and three dimensional heat flow in Cartesian co- ordinates - Wave equations - Solution of wave equation - Transverse vibrations of a stretched string (Theory).

UNIT - V: INTEGRAL TRANSFORMS

Fourier transforms - Cosine and Sine transforms - Linearity theorem - Convolution theorem - Parseval's theorem - Solution of differential equation; Laplace transforms - Definition - Linearity, shifting and change of scale properties - Inverse Laplace transforms - Definition - Problems - Solution of differential equation (problems using the above methods).

BOOKS FOR STUDY:

1. Mathematical Physics, B.D. Gupta, Vikas Publishing House Pvt. Ltd, 1995.
2. Mathematical Physics, B.S. Rajput, 20th Edition, Pragati Prakashan, 2008.
3. Applied Mathematics for Engineers and Physicists, L.A. Pipes and L.R. Havevill, McGraw Hill Publications Co., 3rd Edition, 1971.
4. Theory and Problems of Laplace Transforms, Murray R. Spigel, Schaum's outline series, McGraw Hill, 1986.
5. Matrices and Tensors in Physics, A.W. Joshi, Wiley Eastern limited, 3rd Edition, 1995.

BOOKS FOR REFERENCE:

1. Mathematical Physics, H.K. Dass and Rama Verma, S. Chand and Company Ltd, 2010.
2. Mathematical physics, P.K. Chattopadhyay, Wiley Eastern Limited, 1990.
3. Introduction to Mathematical physics, Charlie Ha Harper, Prentice Hall of India Pvt.Ltd, 1993.
4. **M. Hamermesh,** 1962, *Group Theory and Its application to Physical Problems*, Addison Wesley, Reading.
5. **C. R. Wylie** and **L.C. Barrett,** 1995, *Advanced Engineering Mathematics*, 6th Edition, International Edition, McGraw-Hill, New York.
6. **W. W. Bell,** 1968, *Special Functions for Scientists and Engineers*, Van Nostrand, London.
7. **M. A. Abramowitz** and **I. Stegun (Editors),** 1972, *Handbook of Mathematical Functions* Dover, New York.

BHARATHI WOMEN'S COLLEGE (AUTONOMOUS), CHENNAI – 600 108.
M.Sc. – PHYSICS
CORE PAPER V – QUANTUM MECHANICS II
(For the students admitted from the year 2019 – 20)

HOURS PER WEEK	**:5**	**SEMESTER**	**:II**
CREDITS	**:5**	**SUBJECT CODE**	**:19MBE**

OBJECTIVES:

- To learn about the approximation methods for time independent and time dependent perturbation theory.
- To understand the kinematics of scattering process and partial wave analysis.
- To study the theory of relativistic quantum mechanics and field quantization.
- To study the quantum theory of atomic and molecular structures.

UNIT – I SCATTERING THEORY

Scattering amplitude – differential and total Cross sections - Born approximation - validity of Born approximation - Screened Coulombic potential scattering using Born approx. - Partial wave analysis –phase shifts- –optical theorem - Scattering by an attractive square well potential using partial wave analysis-scattering length and Effective range– Ramsaur –Townsend effect (Definition).

UNIT – II PERTURBATION THEORY

Time dependent perturbation theory -first order - Constant perturbations – Fermi Golden ruleTransition probabilities – Harmonic perturbation, Adiabatic approximation - Sudden approximation –application of time dependent perturbation theory to semi classical theory of radiation - Einstein's coefficients-absorption -induced emission –spontaneous emission-Einstein's transition probabilities –Selection rules for dipole radiatio

UNIT – III RELATIVISTIC QUANTUM MECHANICS

Klein-Gordon equation –Interpretation of Klein-Gordon equation- Charge and current densities Klein-Gordon equation in electromagnetic field -Hydrogen like atom-non relativistic limit-Dirac's equation -Properties of Dirac and gamma Matrices – Traces.

UNIT – IV DIRAC EQUATION – Covariant form of Dirac equation - Relativistic invariance of Dirac equation- Probability density- Plane-wave solutions - Interpretation of negative energy states - Antiparticles - Spin of electron - Magnetic moment of an electron due to spin – Feynman's theory of positron (Elementary ideas only without propagation formalism).

UNIT – V SECOND QUANTIZATION

Quantisation of fields - second quantisation-classical Lagrangian equation -classical Hamiltonian fomulation – Quantum field equations-Quantization of non-relativistic Schroedinger equation- Creation ,annihilation and number operators- quantization of Klein-Gordon field – Quantization of electromagnetic field.

BOOKS FOR STUDY:

1. **P. M. Mathews** and **K. Venkatesan**. *1976, A Text book of Quantum Mechanics,* Tata McGraw-Hill, New Delhi.
2. **Satya Prakash-***Quantum Mechanics* , 2018,Kedar NathRam Nath and co publications.
3. **L. I. Schiff**, *1968, Quantum Mechanics,* 3rd Edition, International Student Edition, MacGraw-Hill Kogakusha, Tokyo.
4. **Gupta, Kumar and Sharma,** *Quantum Mechanics*, 11th edition, JaiPrakash Nath .and co.Meerut.
5. **V. K. Thankappan**, *1985, Quantum Mechanics*, 2nd Edition, Wiley Eastern Ltd, New Delhi
6. **V. Devanathan,** 2005, *Quantum Mechanics,* Narosa Publishing House, New Delhi
7. **G.Aruldhas,**2009,. *Quantum Mechanics,*Prentice Hall of India.

BOOKS FOR REFERENCE:

1. **P. A. M. Dirac**, 1973, *The Principles of Quantum Mechanics*, 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, Gottfried** and **M.Veltman**, 2001, *The Foundations of Quantum Mechanics*, World Scientific.
6. **V. Devanathan,** 1999, *Angular Momentum Techniques in Quantum Mechanics,* Kluwer Academic Publishers, Dordrecht.

BHARATHI WOMEN'S COLLEGE (AUTONOMOUS), CHENNAI – 600 108.
M.Sc. – PHYSICS
CORE PAPER VI – ELECTROMAGNETIC THEORY AND PLASMA PHYSICS
(For the students admitted from the year 2019 – 20)

HOURS PER WEEK	**:5**	**SEMESTER**	**:II**
CREDITS	**:5**	**SUBJECT CODE**	**:19MBF**

OBJECTIVES:

- To develop theoretical knowledge in electromagnetism.
- To develop skills on solving analytical problems in electromagnetism.
- To give basics of defining the complete electromagnetic response of complex systems.

UNIT – I ELECTROSTATICS

Electrostatic potential- Multipole expansion – Poisson and Laplace's equation - uniqueness theorem I – Laplace equation in three dimension – Solution in Cartesian coordinates – Application to potential within a conducting box with one side grounded – Solution in spherical polar coordinates – Application to charged conducting sphere in a uniform field.

Dielectrics - Polarization and displacement vectors - Boundary conditions - Dielectric sphere in a uniform field – Electrostatic energy in the presence of dielectric.

UNIT – II MAGNETOSTATICS

Biot-Savart Law - Ampere's law – Magnetic scalar potential - Magnetic vector potential and magnetic field of a localised current distribution - Magnetic moment, force and torque on a current distribution in an external field - Lorentz force - Magnetostatic energy - Magnetic induction and magnetic field in macroscopic media - Boundary conditions - Uniformly magnetised sphere.

UNIT – III MAXWELL EQUATIONS

Faraday's laws of Induction – Equation of continuity - Maxwell's displacement current - Maxwell's equations - Vector and scalar potentials - Gauge invariance - Lorentz and Coulomb gauges – Energy in electromagnetic fields - Poynting's theorem - Poynting vector - Momentum in electromagnetic fields - Wave equation and plane wave solution.

UNIT – IV WAVE PROPAGATION

Plane waves in free space - Propagation of Electromagnetic waves in Isotropic dielectrics - Waves in a conducting medium- Reflection and refraction at a plane interface - Propagation of waves in a rectangular wave guide.

Retarded potentials - Radiation from a localized source - Oscillating electric dipole.

UNIT – V ELEMENTARY PLASMA PHYSICS

The Boltzmann Equation - Simplified magneto-hydrodynamic equations - Electron plasma oscillations - The Debye shielding problem - Plasma confinement in a magnetic field - Magneto-hydrodynamic waves - Alfven waves and magnetosonic waves.

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.

BOOKS FOR REFERENCE:

1. **W. Panofsky** and **M. Phillips, 1962,** Classical Electricity and Magnetism, Addison Wesley, 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. **R. P. Feynman, R. B. Leighton** and **M. Sands,** 1998, The Feynman Lectures on Physics, Vol. 2, Narosa, New Delhi.

UNIT – V ELEMENTARY PLASMA PHYSICS

The Boltzmann Equation - Simplified magneto-hydrodynamic equations - Electron plasma oscillations - The Debye shielding problem - Plasma confinement in a magnetic field - Magneto-hydrodynamic waves - Alfven waves and magnetosonic waves.

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.

BOOKS FOR REFERENCE:

1. **W. Panofsky** and **M. Phillips, 1962,** Classical Electricity and Magnetism. Addison Wesley. Lodon.
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. **R. P. Feynman, R. B. Leighton** and **M. Sands**. 1998, The Feynman Lectures on Physics, Vol. 2, Narosa, New Delhi.

BHARATHI WOMEN'S COLLEGE (AUTONOMOUS), CHENNAI – 600 108.
M.Sc. – PHYSICS
PRACTICAL I
(For the students admitted from the year 2019 – 20)

HOURS PER WEEK	**:4**	**SEMESTER**	**:I & II**
CREDITS	**:4**	**SUBJECT CODE**	**:19MR1**

Any **TWELVE** Experiments;

1. Cornu's method – Young's modulus by Elliptic fringes.
2. Stefan's constant.
3. Band gap energy - Thermistor / Semiconductor
4. Hydrogen spectrum - Rydberg's constant.
5. Thickness of the enamel coating on a wire – by diffraction.
6. Coulficient of linear expansion – Air wedge method.
7. Permittivity of a liquid using an RFO.
8. L-G Plate.
9. Lasers: Study of Laser Beam Parameters
10. Arc Spectrum - Copper.
11. Impedance measurement using LCR bridge
12. Young's modulus – Hyperbolic fringes.
13. Determination of strain hardening coefficients.
14. Viscosity of liquid - Meyer's disc.
15. F. P. Etalon using spectrometer.
16. Solar constant.
17. Solar spectrum - Hartmann's formula.
18. Arc spectrum – Iron.
19. Edser and Butler fringes – Thickness of air film.
20. B – H loop using Anchor ring.
21. Specific charge of an electron – Thomson's method.
22. FFT & DFT of certain signals

BOOK FOR REFERENCE:

1. **D. Chattopadhyay**, **P. C. Rakshit**, and **B. Saha**. 2002. *An Advanced Course in Practical Physics*, 6th Edition, Books and Allied, Kolkata.

BHARATHI WOMEN'S COLLEGE (AUTONOMOUS), CHENNAI – 600 108.
M.Sc. – PHYSICS
PRACTICAL II
(For the students admitted from the year 2019 – 20)

HOURS PER WEEK	:4	**SEMESTER**	:I & II
CREDITS	:4	**SUBJECT CODE**	:19MB2

Any FIFTEEN Experiments:

Electronics:

1. OPAMP – solving simultaneous equations
2. OPAMP – 4-bit D/A & A/D converters using R-2R ladder network
3. IC 555 timer – Astable & monostable multivibrator
4. IC 555 timer – Schmitt trigger
5. IC 7476 – shift register, ring counter & Johnson counter
6. IC 7490 as scalar and seven segment display using IC 7447
7. FET characteristics and CS amplifier – frequency response, input impedance, output impedance
8. Study of attenuation characteristics of Wien bridge network & Wien bridge oscillator using OPAMP.
9. Study of attenuation characteristics of phase shift network & phase shift oscillator using OPAMP.
10. OPAMP – Schmitt trigger
11. OPAMP – Astable & monostable multivibrators
12. Study of R-S, clocked R-S & D flip-flops using NAND / NOR gates
13. Study of J-K, D & T flip-flops using IC 7476 / 7473
14. Clock generators using IC 7400 and 7413

Microprocessor 8085:

1. Microprocessor 8085 – addition & subtraction of 8- & 16-bit numbers
2. Microprocessor 8085 – multiplication (8-bit & 16-bit) & division (8-bit)
3. Square & square root of 8- & 16-bit numbers
4. Picking up the smallest & largest number in an array & sorting in ascending & descending order
5. LED interface – single LED on / off, binary, BCD, ring & Johnson Counters
6. Interfacing of seven segment display
7. D/A conversion & waveform generation using OPAMP.
8. Code conversion (8 & 6 bit numbers): a) binary to BCD b) BCD to binary
9. DAC 0800 interface & waveform generation
10. ADC 0809 interface
11. Hex keyboard and Stepper motor interface

BOOK FOR REFERENCE:

D. Chattopadhyay, P. C. Rakshit, and **B. Saha**, 2002, *An Advanced Course in Practical Physics*, 6th Edition, Books and Allied, Kolkata.

BHARATHI WOMEN'S COLLEGE (AUTONOMOUS), CHENNAI – 600 108

M.Sc. – PHYSICS

ELECTIVE PAPER II: Option I- INTEGRATED ELECTRONICS

(For the students admitted from the year 2019 – 20)

HOURS PER WEEK	**:4**	**SEMESTER**	**:II**
CREDITS	**:4**	**SUBJECT CODE**	**:19EB4**

OBJECTIVES:

The objective of the course is to impart in depth knowledge about Semiconductors, diodes, Transistors, Operational Amplifiers, Memories and converters etc., to the students. The theoretical knowledge gained in the class room can be experimented in the practical classes.

UNIT I: SEMICONDUCTOR DEVICES AND THEIR APPLICATIONS

Introduction to semiconductor-Tunnel diodes energy band diagrams - characteristics - application of tunnel diode as switches- Gunn Diode and IMPATT diode. Construction, operation and Characteristics of FET, UJT,SCR and TRIAC FET-biasing common source amplifier at low frequencies - MOSFETS - depletion and enhancement modes – MOSFETS as switches and resistors.

UNIT II: DIGITAL ELECTRONICS

Logic families- RTL, DTL, TTL, ECL, I^2L, and CMOS. Flip-flops: RS, D- type, JK and Master - Slave Flip–flop - Counters Asynchronous Synchronous - Modulus counters BCD Counter - Registers - Shift right, shift left registers - ring counter - Johnson's ring Counter. Semiconductor memories ROM, EPROM, EEPROM – RAM – Static and Dynamic RAM.

UNIT-III: OP-AMP AND ITS APPLICATIONS

The ideal Op Amp-inverting, non inverting and differential amplifiers-CMRR; Op-Amp characteristics-open-loop input output characteristics, frequency response and slew rate. Op-Amp applications-adder, sub tractor integrator, differentiator, voltage-to-current converter, current-to-voltage converter, comparators- Solving simultaneous equations and Differential equations Instrumentation amplifier using transducer bridge,temperature indicator,analog weight scale – Logarithmic and Antilog amplifiers – Analog Multiplication and Division.

Unit IV : Active Filters and Waveform Generators

Active Filters – Introduction – Butterworth - First order LPF and Second order LPF -- Band pass filters – Waveform generation - Generation of square, triangular and sine waves - Schmitt Trigger IIMER 555: Internal architecture and working - Timer 555 as Schmitt trigger, astable and monostable Multivibrator - Phase locked loops

Unit V: A/D and D/A Converters

Sampling theorem(-time division multiplexing–) Binary weighted DAC – R/2R Ladder DAC accuracy and resolution - A/D converter – simultaneous conversion - counter method - continuous method – Successive approximation - dual slope A/D converters accuracy and resolution.

BOOKS FOR STUDY:

1. **S. M. Sze**, 1985, *Semiconductor Devices - Physics and Technology*, Wiley, New York.
2. **Millman** and **Halkias**, *Integrated Electronics*.
3. **R. A. Gaekwad**, 1994. *OpAmps and integrated circuits* EEE
4. **Taub** and **Shilling**, 1985, *Digital Integrated Electronics*, Mc Graw-Hill, New Delhi.
5. Malvino and Leach, ***Digital Electronics,***
6. **J. Millman**, 1979, *Digital and Analog Circuits and Syst ems*, Mc Graw-Hill, London
7. R. S. Gaonkar, **1997, *Microprocessor Architecture, Programming and Application with the 8085*, 3rd Edition, Penram International Publishing, Mumbai.**

BOOKS FOR REFERENCE:

1. **R. F. Coughlin** and **F. F. Driscol**, 1996 *OpAmp and linear integrated circuits* Printice Hall of India, New Delhi.
2. **M. S. Tyagi**, *Introduction to Semiconductor Devices* Wiley, New York
3. **P. Bhattacharya**, 2003, *Semiconductor Optoelectronic Devices*, 2nd Edition, Printice-Hall of India, New Delhi.
4. **B. Somnath Nair**, 2002, *Digital Electronics And Logic Design*, Printice-Hall of India, New Delhi.
5. **R. L. Boylestad** and **L. Nashelsky**, *Electronic Devices and Circuit Theory*, 8th Edition, Pearson Education
6. B. Ram, ***Fundamentals of Microprocessors and Micro Computers*, Dhanpat Rai Publications, New Delhi.**
7. V. Vijayendran, **2002, *Fundamentals of Microprocessor 8085 – Architecture, Programming and Interfacing*, Viswanathan, Chennai**

UNIT V: CHARACTERIZATION TECHNIQUES

X–ray diffraction – Powder and single crystal – Fourier transform infrared analysis – Elemental dispersive X-ray analysis – Transmission and scanning electron microscopy – UV-vis-NIR spectrometer – Chemical etching – Vickers micro hardness – Basic principles and operations of AFM and STM – X-ray photoelectron spectroscopy for chemical analysis – Ultraviolet photoemission spectroscopy analysis for work function of the material – Photoluminescence – Thermoluminescence

COURSE OUTCOME:

On completion of the course the students will

- be able to understand the theoretical basis for crystal growth and thin films.
- be able to grow crystals.
- be familiar with characterization techniques.
- be able to characterize the grown crystals

TEXT BOOKS FOR STUDY:

1. I.V. Markov, Crystal Growth for Beginners: Fundamentals of Nucleation, Crystal Growth and Epitaxy(2004) 2nd edition.
2. P. Santhanaragavan and P. Ramasamy, Crystal Growth Process and Methods (KRU Publications, Kumbakonam, 2001).
3. A. Goswami, Thin Film Fundamentals (New Age, New Delhi, 2008).
4. H.H. Willard, L.L. Merritt, J.A. Dean, F.A. Settle, Instrumental Methods of Analysis (CBS Publishers, New Delhi, 1986).
5. S. Zhang, L. Li and A. Kumar, Materials Characterization Techniques (CRC Press, Boca Raton, 2009).

TEXT BOOKS FOR REFERENCE:

1. J.C. Brice, Crystal Growth Process (John Wiley, New York, 1986).
2. M. Ohring, Materials Science of Thin Films (Academic Press, Boston, 2002) 2nd Edition.

BHARATHI WOMEN'S COLLEGE (AUTONOMOUS), CHENNAI – 600 108.

M.Sc. – PHYSICS

ELECTIVE PAPER II: Option Paper III – INTRODUCTION TO SPINTRONICS

(For the students admitted from the year 2019 – 20)

HOURS PER WEEK	**: 4**	**SEMESTER**	**: II**
CREDITS	**: 4**	**SUBJECT CODE**	**: 19EB6**

OBJECTIVES:

- To get a basic understanding of various topics in spin electronics with a special focus on spintronics.
- To understand the principle and operation of spin-electronic devices as well as conventional silicon based devices.
- To know the applications of spintronics in biomedical field.

UNIT-I: BASICS OF MAGNETISM

Definition and Units - Experimental Methods - Diamagnetism and Paramagnetism – Antiferromagnetism Ferrimagnetisms Ferromagnetism - Magnetization and the magnetic moment - Magnetic hysteresis loop - magnetic ordering and the Curie temperature - Different types of magnetic anisotropy - Magnetostriction and the effect of stress - Nano-magnetic materials thermal stability - Size effect of fine particles and thin films - Domains and Domains walls - soft Magnetic and Hard Magnetic Materials

UNIT-II: SPIN VALVES

Giant magnetoresistance effect - semiclassical theory of CIP giant magnetoresistance - current perpendicular to plane giant magnetoresistance – basic properties of spin valves - magnetic properties exchange anisotropy – interlayer coupling - CIP transport properties - spin valves optimization - improved spinvalve design (dual spin valves, spin filter spin valves) - spin valves in magnetoresistive read heads

UNIT-III: SPIN-POLARIZED TUNNELING

Spin-filter effect - Ferromagnetic-Ferromagnetic tunneling - bias voltage dependence - exchange biasing of tunnel junctions - temperature effect - temperature stability and annealing effect - Half-metallic ferromagnets, observation of resonant effects in MTJs - Tunneling role of the interface.

UNIT-IV: MAGNETORESISTIVE RANDOM ACCESS MEMORIES

History of MRAM - pseudo-spin valve MRAM - Magnetic tunnel junction MRAM - MRAM developments - extending density-reducing write currents – spin momentum switch - new spintronics effects - potential MRAM enhancements.

UNIT-V: MAGNETIC TUNNEL JUNCTION BASED MAGNETORESISTIVE RANDOM ACCESS MEMORY

MTJ – MRAM. basic cell operation - MTJ material for MRAM – magnetic switching - high speed switching behavior - single MTJ-single transistor(1TMTJ) MRAM cell - 1MB MRAM circuit

Magnetoelectronics application: spin injected FET - spin injected semiconductor - spin diodes - spin bipolar transistor.

Magnetoresistive DNA Chips: Magnetoresistive biochips - sensor characteristics - MR biochips prototype fabrication - Biological applications – Surface functionalization - DNA- cDNA hybridization detection.

COURSE OUTCOME:

On completion of the course the students will

- get sufficient knowledge in magnetic material and Nano-magnetic material.
- have knowledge on spin valves and magneto resistance
- know the Ferro magnetic characteristics and Ferro magnetic tunnelling.
- be able to applyprinciples of MRAM and magneto electronics in DNA applications.

TEXT BOOKS FOR STUDY:

[1] Introduction to Magnetism and Magnetic Materials, 2nd edition, David Jiles, Chapman & Hall/CRC

[2] Modern Magnetic Materials. Principles and Applications. Robert C. O'Handley, John Wiley & sons.Inc

[3] Nanomagnetism and spintronics. Edited by Teruyashinjo, 2009. Elsevier

[4] Magnetoelectronics. Edited by Mark Johnson, Elsevier Academic Press. 2004

[5] Introduction to spintronics. SupriyoBandyopadhyay and Marc Cahay. Taylor & Francis, CRC press.

[6] Spin Electronics. David D. Awschalom, Kluwer Academic Publisher

TEXT BOOKS FOR REFERENCE:

[1] Thin film Magnetoresistive Sensors, S. Tumarski, IOP publishing

[2] Spin dependent Transport in Magnetic Nanostructures. SadamichiMaekawa and Teruya shinjo, Taylor & Francis

[3] Spintronic Materials and Technology. Y B Xu and S. M. Thompson. Taylor & Francis

BHARATHI WOMEN'S COLLEGE (AUTONOMOUS), CHENNAI – 600 108.

M.Sc. – PHYSICS

SUPPORTIVE ELECTIVE I – ENERGY PHYSICS

(For the students admitted from the year 2019 – 20)

HOURS PER WEEK	:3	**SEMESTER**	:II
CREDITS	:3	**SUBJECT CODE**	:19SB1

OBJECTIVES:

- To comprehend various forms of renewable energy sources.
- To learn the advantages and disadvantages in using the different alternate energy sources.

UNIT – I NON CONVENTIONAL ENERGY SOURCES

Wind energy – introduction - wind power - determination -wind mills - types and performance

UNIT – II BIO MASS ENERGY

Introduction - bio gas generation - digesters and their design - application of biogas.

UNIT – III OCEAN THERMAL ENERGY

Ocean - thermal electric conversion - introduction - method and working - principle of generating plants.

UNIT – IV SOLAR ENERGY

Solar radiation - Pyroheliometers - Pyranometers – estimation of average solar radiation - estimation of direct and diffused radiation – solar collectors physical principles of the conversion of solar radiation into heat - flat plate collectors - description and characteristics - evaluation of overall loss coefficient of thermal energy – thermal analysis of flat plate collector and useful heat gained by the fluids.

UNIT – V APPLICATION OF SOLAR ENERGY

Solar photo voltaics - semi conductor principles - photo voltaic principles - types of solar cells - applications of solar photo voltaic systems.

COURSE OUTCOME:

On completion of the course the students will

- Understand various forms of renewable energy sources.
- Learn the advantages and disadvantages of various alternate energy sources.

BOOKS FOR STUDY

1. Non Conventional Energy Sources – G. D. Rai, 4th edition, 1997.
2. Solar energy utilization - G. D. Rai, Khanna Publishers Delhi.
3. Alternate Energy - S. Vandana, A.P.H. Publishing Co, Delhi.
4. Solar - Energy The Infinite Source - G. K. Ghosh.
5. Solar Drying systems - B. K. Bala.

BOOKS FOR REFERENCE:

1. Solar Energy - G. N. Tiwari, Narosa Publishing House.
2. Solar Energy - S. P. Sukhatme,
3. Energy Technology - S. Rao and Dr. B. B. Parulekar, II edition, 1997.
4. Power Plant Technology - A. K. Wahil, 1993.
5. Renewable Energy Power for a Sustainable future - Godfrey Boyle and Alden.

BHARATHI WOMEN'S COLLEGE (AUTONOMOUS), CHENNAI – 600 108.
PG - SOFT SKILL
PAPER-II LIFE AND MANAGERIAL SKILLS
(For the students admitted from the year 2019-20)

HOURS : 30 Hrs
CREDITS : 2

SEMESTER : II
SUBJECT CODE : 19MS2

OBJECTIVES

- To make students understand the concept and components of personality, thereby to apply the acquired knowledge to themselves and to march towards excellence in their respective academic careers.
- To enable students to keep themselves abreast of general knowledge and current information.
- To bring out creativity and other latent talents with proper goal setting so that self-esteem gets enhanced.
- To sharpen memory skills and other study skills, which are vital for academic excellence.
- To give training for positive thinking which will keep the students in a good stead at the time of crisis.

Unit I – Introduction

- Definition of Personality
- Determinants of Personality – biological, psychological and socio – cultural factors
- Misconceptions and clarifications
- Need for personality development

Unit II – Self – Awareness and Self -Motivation

- Self analysis through SWOT and Johari window
- Elements of motivation
- Seven rules of motivation
- Techniques and strategies for self motivation
- Motivation checklist and Goal setting based the on principle of SMARTNESS
- Self motivation and life
- Importance of self – esteem and enhancement of self – esteem

Unit III – Memory and study skills

- Definition and importance of memory
- Causes of forgetting
- How to forget (thought stopping), how to remember (techniques for improving memory)
- The technique of passing exams – management of examination fear

Unit IV: Power of positive thinking

- Nurturing creativity, decision - making and problem solving
- Thinking power -- seven steps for dealing with doubt
- Traits of positive thinkers and high achievers
- Goals and techniques for positive thinking
- Enhancement of concentration through positive thinking
- Practicing a positive life style
-

UNIT V: General Knowledge and Current affairs:

- Regional, national and international events
- Geographical, political and historical facts
- Information on sports and other recreational activities
- Basic knowledge with regard to health and health promotion

PRACTICAL TRAINING

The course would include the following practical exercises
Ice – breaking
Brainstorming and simulation exercises
Thought stopping
Memory and study skills training

BHARATHI WOMEN'S COLLEGE (AUTONOMOUS), CHENNAI – 600 108.

M.Sc. – PHYSICS

CORE PAPER VII – STATISTICAL MECHANICS

(For the students admitted from the year 2019 - 20)

HOURS PER WEEK	:5	**SEMESTER**	:III
CREDITS	:5	**SUBJECT CODE**	:19MBG

OBJECTIVES:

- To provide a phenomenological introduction to thermodynamics through thermodynamics postulates, quantities and relations
- Studying the micro and macroscopic properties of the mater through the statistical probability laws and distribution of particles.
- Understanding the classical and quantum distribution laws and their relations.
- Studying transport properties, different phases of maters, equilibrium and non-equilibrium process.

UNIT – I THERMODYNAMICS-AN OUTLINE

Thermodynamic Equilibrium – Intensive and extensive variables-Laws of thermodynamics-Fundamental equation-chemical potential-Thermodynamic potentials-Third law of thermodynamics and its consequence-Phase equilibrium-Gibb's phase rule-Phase transitions and Ehrenfest's classifications order parameters-Landau theory of phase transition-Critical indices-scale transformations and dimensional analysis

UNIT – II CLASSICAL STATISTICAL MECHANICS.

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

UNIT - III CANONICAL AND GRAND CANONICAL ENSEMBLES

Trajectories and density of states - Canonical and grand canonical ensembles - Partition function - Calculation of statistical quantities - Energy and density fluctuations.

UNIT – IV CLASSICAL AND QUANTUM STATISTICS

Density matrix - Statistics of ensembles - Statistics of indistinguishable particles - Maxwell-Boltzmann statistics - Fermi-Dirac statistics – Ideal Fermi gas Degeneracy - Bose-Einstein statistics - Pauli's spin paramagnetism- Ideal Bose gas - Bose-Einstein condensation-Black body radiation.

UNIT – V REAL GAS, ISING MODEL AND FLUCTUATIONS

Cluster expansion for a classical gas - Virial equation of state - Calculation of the first virial coefficient in the cluster expansion - Ising model - Mean-field theories of the Ising model in three, two and one dimensions - Exact solutions in one-dimension Correlation of space-time dependent fluctuations - Fluctuations and transport phenomena - Brownian motion - Langevin theory - Fluctuation-dissipation theorem The Fokker-Planck equation

BOOKS FOR STUDY:

1. **S.K.Sinha**, 1990, *Statistical Mechanics*. Tata Mc Graw – Hill. New Delhi.
   B. K. Agarwal and M. Eisner. 1998. *Statistical Mechanics*. Second Edition New Age International. New Delhi.
2. **J. K. Bhattacharjee.** 1996. *Statistical Mechanics: An Introductory Text*. Allied Publication, New Delhi.
3. **F. Reif**, 1965. *Fundamentals of Statistical and Thermal Physics*. Mac Graw-Hill. New York
4. **C. Kittel, 1987**, *Thermal Physics*. 2nd edition, CBS Publication, New Delhi.
5. **M. K. Zemansky**, 1968, *Heat and Thermodynamics*. 5th edition, Mc Graw-Hill New York.

BOOKS FOR REFERENCE:

1. **R. K. Pathria**, 1996. *Statistical Mechanics*. 2nd edition, Butter Worth-Heinemann. New Delhi.
2. **L. D. Landau and E. M. Lifshitz.** 1969. *Statistical Physics*. Pergamon Press,Oxford.
3. **K. Huang**. 2002. *Statistical Mechanics*. Taylor and Francis. London
4. **W. Greiner, L. Neise** and **H. Stoecker**, *Thermodynamics and Statistical Mechanics*. Springer Verlang. New York
5. **A. B. Gupta, H. Roy**. 2002. *Thermal Physics*. Books and Allied. Kolkata.
6. **A. Kalidas, M. V. Sangaranarayanan**. *Non-Equilibrium Thermodynamics*. Macmillan India, New Delhi.
7. **M. Glazer** and **J. Wark**. 2001, *Statistical Mechanics*. Oxford University Press. Oxford.
8. **L. P. Kadanoff**, 2001, *Statistical Physics - Statics, Dynamics and Renormalization*. World Scientific. Singapore.
9. **F. W. Sears** and **G. L. Salinger**. 1998. *Thermodynamics, Kinetic Theory and Statistical Thermodynamics*. 3rd Edition. Narosa. New Delhi.

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M.Sc. – PHYSICS

CORE PAPER VIII – NUCLEAR AND PARTICLE PHYSICS

(For the students admitted from the year 2019 – 20)

HOURS PER WEEK	:5	**SEMESTER**	:III
CREDITS	:5	**SUBJECT CODE**	:19MBH

OBJECTIVES:

- To know fundamental principles and concepts governing nuclear and particle physics.
- To understand the interaction among the elementary particles.
- To learn about the nuclear models.

UNIT – I – NUCLEAR INTERACTIONS

Characteristics of nuclear forces -Tensor forces-charge independence , charge symmetry and spin dependence of nuclear forces-Meson theory of nuclear forces- Yukawa potential -Ground state of Deuteron -Nucleon -Nucleon scattering-Scattering length – Effective range theory of n-p scattering at low energies.

UNIT – II – NUCLEAR REACTIONS

Types of reactions and conservation laws - Energetics of nuclear reactions – Q-value equation - Direct reactions -Scattering and reaction cross sections using partial wave analysis – Compound nucleus formation- energy levels of compound nucleus and resonance – Resonance scattering – Breit-Wigner one level formula.

UNIT – III – 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 estimate of transition rates – Magnetic moments and Schmidt lines – Collective model of Bohr and Mottelson.

UNIT – IV – NUCLEAR DECAY

Beta decay - Fermi theory of beta decay - Shape of the beta spectrum - Total decay rate - Mass of the neutrino – Angular momentum and parity selection rules - Allowed and forbidden decays – 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 – V – ELEMENTARY PARTICLE PHYSICS

Types of interaction between elementary particles - Hadrons and leptons – Symmetries and conservation laws - Elementary ideas of CP and CPT invariance – Classification of hadrons – SU(2) and SU(3) multiplets – Quark model - Gell-Mann-Okubo mass formula for octet and decuplet hadrons – Charm, bottom and top quarks

BOOKS FOR STUDY

1. **K. S. Krane.** 1987. *Introductory Nuclear Physics*. Wiley, New York.
2. **D. Griffiths.** 1987, *Introduction to Elementary Particle Physics*. Harper & Row, New York
3. **R. R. Roy** and **B.P. Nigam**, 1983. *Nuclear Physics*. New age Intl. New Delhi.
4. **R.C.Sharma**,2007, *Nuclear Physics* K Nath and co,Meerut.
5. **M.L.Pandya** and **R.P.S.Yadav**, 2017 ,*Elemenents of nuclear physics*.Kedar Nath RamNath publications.

BOOKS FOR REFERENCE:

1. **H. A. Enge**, 1983. *Introduction to Nuclear Physics*, Addison-Wesley, Tokyo
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, *Elemenmory particles*. McGraw-Hill, New York
5. **R. D. Evans**, 1955, *Atomic Nucleus*, McGraw-Hill. New York.
6. **I. Kaplan**, 1989. *Nuclear Physics*. Narosa. New Delhi
7. **B. L. Cohen**, 1971, *Concepts of Nuclear Physics*, TMH, New Delhi
8. **M. K. Pal**, 1982, *Theory of Nuclear Structure*, Affl. East-West. Chennai.
9. **W. E. Burcham** and **M. Jobes**. 1995, *Nuclear and Particle Physics*. Addison Wesley, Tokyo.

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M.Sc. – PHYSICS

CORE PAPER IX– COMPUTATIONAL METHODS AND C PROGRAMMING

(For the students admitted from the year 2019 – 20)

HOURS PER WEEK	:5		
CREDITS	:5	**SEMESTER**	:III
		SUBJECT CODE	:19MBJ

OBJECTIVES:

- To obtain knowledge of programming in C.
- To learn the methods of finding roots of equation, interpolation, curve fitting, Numerical differentiation, numerical integration and numerical solution of ordinary differential equations.

UNIT – I SOLUTIONS OF EQUATIONS

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

UNIT – II LINEAR SYSTEMS

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

UNIT – III INTERPOLATION AND CURVE FITTING

Interpolation with equally spaced and unevenly spaced points - Newton forward and backward interpolations, Lagrange interpolation – Curve fitting – Polynomial least – squares fitting.

UNIT – IV DIFFERENTIATION, INTEGRATION AND SOLUTION OF DIFFERENTIAL EQUATIONS

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

UNIT – V PROGRAMMING WITH C:

Flow-charts - Integer and floating point arithmetic expressions – Built-in functions – Executable and non-executable statements – Subroutines and functions - 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. (e) Solution of first order differential equations by Euler's method.

COURSE OUTCOME:

On completion of the course the students will

- Illustrate flow chart and algorithm to the given problem.
- Understand basic structure of the C-Programming, declaration and usage of variables.
- Write C-Programme using operators and arrays.
- Using appropriate numerical methods, determine approximate solution to ordinary differential and integral equations
- Analyze the errors obtained in the numerical solution of problems

BOOKS FOR STUDY:

1. **V. Rajaraman**, 1993, *Computer oriented Numerical Methods*, 3 rd Edition. PHI, New Delhi
2. **M. K Jain, S. R. Iyengar** and **R. K. Jain**, 1995, *Numerical Methods for Scientific and Engineering Computation*, 3 rd Edition, New Age Intl., New Delhi
3. **S. S. Sastry**, *Introductory Methods of Numerical analysis*, PHI, New Delhi
4. **F. Scheid**, 1998, *Numerical Analysis*, 2 nd 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*, 2 nd Edition, Cambridge Univ. Press
6. **W. H. Press, S. A. Teukolsky, W. T. Vetterling** and **B. P. Flannery**, 1992, *Numerical Recipes in C*, 2 nd Edition, Cambridge Univ. Press
7. **V. Rajaraman**, *Programming in FORTRAN / Programming in C*, PHI, New Delhi
8. **E. Balagurusamy**, 1998, *Numerical Methods*, TMH

BOOKS FOR REFERENCE:

1. **S. D. Conte** and **C. de Boor**, 1981, *Elementary Numerical analysis-an algorithmic approach*, 3 rd Edition, McGraw Hill,)
2. **B. F. Gerald**, and **P. O. Wheatley**, 1994, *Applied Numerical analysis*, 5th Edition., Addison-Wesley, MA.
3. **B. Carnagan, H. A. Luther** and **J. O. Wilkes**, 1969, *Applied Numerical Methods*, Wiley, New York.
4. **S. S. Kuo**, 1996, *Numerical Methods and Computers*, Addison-Wesley.

BHARATHI WOMEN'S COLLEGE (AUTONOMOUS), CHENNAI – 600 108.
M.Sc. – PHYSICS
ELECTIVE PAPER III –Option paper –I- MICROPROCESSOR & MICROCONTROLLER
(For the students admitted from the year 2019 - 20)

HOURS PER WEEK	:4	**SEMESTER**	:III
CREDITS	:4	**SUBJECT CODE**	:19ER7

- To study the architecture, addressing mode & instruction set of 8085 and μc 8051.
- To understand the need of interrupts 8085 & μc 8051
- To develop skill in simple applications development with programming 8085 and 8051.
- To introduce commonly used peripheral interfacing.

UNIT-I: 8085 PROCESSOR

Hardware Architecture- Pinouts-Functional Building Blocks of processor-Memory Organization, I/O ports and Data transfer concepts- Timing Diagram-Interrupts.

UNIT –II: PROGRAMMING OF 8085 PROCESSOR

Instruction set, Addressing modes, Assembly language programs- addition, multiplication, division, square and square root of 8 and 16 bit numbers, picking up the smallest and largest number in array and sorting in ascending and descending order, code conversion- Hex to BCD, BCD to Hex.

UNIT-III: 8051 MICROCONTROLLER

Introduction- 8bit & 16 bit Microcontroller families. Hardware Architecture, Pinout, Functional Building Blocks of processor- Internal register, Interfacing I/O ports, External memory, Counters & Timers, Serial data input/output, Interrupts.

UNIT-IV: MICROCONTROLLER PROGRAMMING

Instruction set, Addressing modes, Assembly language programs- addition, multiplication, division and sorting in ascending and descending order.

UNIT-V: PERIPHERAL INTERFACING

Interfacing 8085 with ADC, DAC, and stepper motor interface. Interfacing 8051 with LED, keyboard interfacing and stepper motor interfacing.

COURSE OUTCOME:

On completion of the course the students will

- Understand the basic building blocks of a microprocessor and microcontroller device.
- Know the architecture and silent features of microprocessor and microcontroller.
- Gain depth knowledge of interrupts and their uses.
- Understand how the peripheral connected to the processor/ controller and their interactions
- Write program to run on microprocessor and microcontroller

BOOKS FOR STUDY

1. **Douglas V. Hall** : - Microprocessors and Interfacing programming and Hardware (Tata Mc Graw Hill) (Unit 1)
2. Microprocessor Architecture, Programming and Applications with 8085/8080, Ramesh S.Gaonkar, New Age International 6th edition, 2013.
3. Microprocessors and Microcontrollers by A.P.Godse and D.A.Godse, Technical Publications, Pune.
4. Advanced Microprocessors and Interfacing, Badri Ram, Tata McGraw Hill, 2001.
5. The 8051 Microcontroller Architecture, Programming and Applications. Kenneth J. Ayala. Penram International publishing Pvt. Ltd., second edit, 1996.
6. **W.A. Triebel** and **Avatar Singh**, *The 8086 /8088 Microprocessors- Programming, Software, Hardware and application,* Prentice Hall of India, New Delhi. (Unit 2)
7. **Kenneth J. Ayala** *The 8051 Micro Controller Architecture, Programming and Applications.* 3rd Edition , Penram International, (Unit 3)
8. **John B. Peatman,** 2004, *Design with PIC Microcontrollers,* 7th Indian reprint, Pearson Education. (Unit 4 & 5)

BOOKS FOR REFERENCE

1. **B. Brey**. 1995, *Intel Microprocessors 8086/8088, 80186,80286,80486,80486,* Architecture, Programming and Interfacing
2. **Yu – Cheng** and **Glenn A. Gibson**, *The 8086 / 8088 family Architecture, Programming and Design*, Prentice-Hall of India.
3. **Muhammed Ali Mazidi** and **Janice Gillespie Mazidi**, 2004, *The 8051 Microcontroller and Embedded Systems*, Fourth Indian Reprint, Pearson Education.
4. **V. Vijayendran,** 2002, *Fundamentals of Microprocessor -8086- Architecture, Programming (MASM) and interfacing*, Viswanathan, Chennai.

BHARATHI WOMEN'S COLLEGE (AUTONOMOUS), CHENNAI - 600 108.
M.Sc. – PHYSICS
ELECTIVE PAPER III: Option Paper II –MEDICAL PHYSICS

(For the students admitted from the year 2019 – 20)

HOURS PER WEEK	: 4	**SEMESTER**	: III
CREDITS	: 4	**SUBJECT CODE**	: 19EB8

OBJECTIVES:

1. To understand the general concepts in radiation and its interaction and dose measurement.
2. To apply the physics concepts in clinical trials.
3. To educate scientifically the principles of radiation and its effect in the medical field.
4. To emphasize the significance of various medical techniques and therapy

UNIT – I

Basic concepts in Radiation Dosimetry: Definitions of Dosimetric Quantities-units and relationship between DQ-linear energy transfer- tissue weighting factor-charged particle equilibrium-biological effects of radiation.

UNIT –II

Interaction of gamma rays and X-rays with matter Introduction-types of interaction with matter -over all interaction of photons with matter.

UNIT – III

Treatment planning in radiation therapy: photon beam treatment planning-electron beam treatment planning.

UNIT – IV

Image-Guided radiation therapy: Introduction – Rationale of IGRT - current available IG techniques–traditional IGR Technologies -real time tracking systems–image registration and correction strategies - image guided Adaptive treatment (IG-ART) - management of respiratory motion.

UNIT -V

Magnetic Resonance Imaging (MRI): MRI - contrasts in MRI– Physiological and functional MRI- MRI safety – future MRI applications CT and MRI Radiotherapy: CT based treatment simulation and planning - MRI in Radiotherapy

COURSE OUTCOME

On completion of course the students will be able to

(i) Understand the basics of radiation interaction for radiation dosimetry.

(ii) Have knowledge on methods for measuring the effects of radiation on these models.

(iii) Know the techniques for radiation therapy of cancer and diagnostic use of magnetic resonance tomography

(iv) Understand how computed tomography (CT) works and how to use CT in disease diagnosis, minimally invasive intervention procedures and image guided radiation therapy

(v) Understand about the safety measurements for patients to undergo an MRI exam.

TEXT BOOKS FOR STUDY:

1. Introduction to Medical Physics Muhammad Maqbool–Springer International Publishing (2017).

TEXT BOOKS AND PUBLICATIONSFORREFERENCES:

1. Attix FH(1986)An introduction to radiological physics and radiation dosimetry, Wiley.
2. BortfeldT, BürkelbachJ, BoseckeR, SchlegelW(1990a) Methods of image reconstructionfromprojectionsappliedtoconformationalRotherapy.PhysMedBiol 135(10):1423–1434.
3. Adler JRJretal(1997)The Cyber knifeta frameless robotic system for radio SurgeryStereotactFunctNeurosurg69:124–128.
4. Antonuk LEetal(1996)Megavoltageimagingwithalarge-area flat-panel,amorphous silicon imager. Int JRadiatOncolBiolPhys 36:661–672.
5. BaitzerPA,DietzelM,KaiserWA(2012)MR-spectroscopyat1.5tesla and3 tesla. Asystematicreviewandmeta-analysis.EurJRadiol81(Suppl 1):S6–59
6. HendeeWR,RitenourER(2002)Medicalimagingphysics.4thedn.Wiley-Liss,xix, New York.

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M.Sc. – PHYSICS

ELECTIVE PAPER III : Option Paper III NON-LINEAR OPTICS

(For the students admitted from the year 2019 – 20)

HOURS PER WEEK	: 4	**SEMESTER**	: III
CREDITS	: 4	**SUBJECT CODE**	: 19E89

OBJECTIVES:

- To learn the basic principles and working of lasers.
- To know basic processes and features of nonlinear optical materials.
- To attain knowledge on principle and working of fiber optics.

UNIT-I: LASERS

Gas lasers – He-Ne, Argon ion lasers Solid state lasers - Ruby – Nd:YAG, Ti sapphire - Organic dye laser Rhodamine - Semiconductor lasers – Diode laser, p-n-junction laser and GaAs laser

UNIT-II: BASICS OF NONLINEAR OPTICS

Wave propagation in an anisotropic crystal - Polarization response of materials to light–Harmonic generation – Second harmonic generation – Sum and difference frequency generation Phase matching - Third harmonic generation – Terahertz -- Bistability – Self-focusing.

UNIT-III: MULTIPHOTON PROCESSES

Two photon process - Theory and experiment -- Three photon process – Parametric generation of light – Oscillator Amplifier - Stimulated Raman scattering Intensity dependent refractive index -- Optical Kerr effect -- Foucault effect – Photorefractive, electronic and optic effects

UNIT-IV: NONLINEAR OPTICAL MATERIALS

Basic requirements - Inorganics Borates – Organics Urea, Nitroaniline – Semiorganics Thiourea complex - Laser induced surface damage threshold.

UNIT-V: FIBER OPTICS

Step – Graded index fibers Wave propagation - Fiber modes – Single and multimode fibers -Numerical aperture Dispersion – Fiber bandwidth – Fiber losses - Scattering, absorption, bending, leaky mode and mode coupling losses - Attenuation coefficient -- Material absorption.

COURSE OUTCOME:

On completion of the course the students will

- be able to know linear and non-linear nature of light.
- gain knowledge on principle of lasers and its applications.
- know about wave propagation in fibres.

BOOKS FOR STUDY:

1. K.R. Nambiar, Lasers: Principles, Types and Applications (New Age International
   Publishers Ltd. New Delhi, 2014).
2. B.B. Laud, Lasers and Nonlinear Optics, 3rd Edn. (New Age, New Delhi, 2011).
3. R.W. Boyd, Nonlinear Optics, 2nd Edn. (Academic Press, New York, 2003).
4. G.P. Agarwal, Fiber-Optics Communication Systems, 3rd Edn. (John Wiley, Singapore, 2003).

BOOKS FOR REFERENCE:

4. 1. W.T. Silvast, Laser Fundamentals (Cambridge University Press, Cambridge, 2003).
5. 2. D.L. Mills, Nonlinear Optics – Basic Concepts (Springer, Berlin, 1998).

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M.Sc. – PHYSICS

SUPPORTIVE ELECTIVE II – ASTRO PHYSICS

(For the students admitted from the year 2019 – 20)

HOURS PER WEEK	:3		
CREDITS	:3	**SEMESTER**	:III
		SUBJECT CODE	:19SB2

OBJECTIVES:

- To understand the universe and its constituent galaxies and solar systems.
- To learn about astronomical telescopes.
- To study the evolution of stars.

UNIT – I ASTRONOMICAL INSTRUMENTS

Optical telescopes-refracting telescope-reflecting telescope-types of reflecting telescopes.

UNIT – II SOLAR SYSTEM

The Sun - photosphere – chromosphere - corona - solar prominences - sunspot - solar flares - sources of solar energy - solar wind.

UNIT – III MEMBERS OF THE SOLAR SYSTEM

Mercury – Venus – Earth – Mars - Jupiter – Saturn – Uranus – Neptune - Pluto – Moon –asteroids – comets - meteors.

UNIT – IV STELLAR EVOLUTION

Birth and death of a star - brightness of a star - stellar distance – White dwarfs - Neutron stars - black holes - supernovae.

UNIT – V THEORIES OF THE UNIVERSE AND GALAXIES

Origin of the Universe - the big bang theory - the steady state theory - the oscillating universe theory - Hubble's law – Galaxies - types of galaxies - Milky way.

COURSE OUTCOME:

On completion of the course the students will

- Understand the universe and its galaxies and solar system.
- Learn about astronomical telescopes.
- Study the evolution of stars.

BOOKS FOR STUDY

1. Astrophysics – A modern perspective by K. S. Krishnaswamy, New Age International (P) Ltd., New Delhi (2002).
2. An introduction to Astrophysics by Baidyanath Basu, Prentice Hall of India (P) Ltd., New Delhi (2001).

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PG - SOFT SKILL

PAPER-III ESSENTIALS OF SPOKEN AND PRESENTATION SKILLS

(For the students admitted from the year 2019-20)

HOURS : 30 Hrs
CREDITS : 2

SEMESTER : III
SUBJECT CODE : 19MS3

Objectives:

- *Coach* students to identify, classify and apply relevant skill sets
- *Illustrate* role of skills in real - life work situations with case studies, role play, etc.
- *Translate* performance of skills into efficient habits
- *Enable* students to perceive cultural codes involved in presentation and design language performance according.

UNIT I: General Language Knowledge and Presentation - STAR strategy - MOM plan.

UNIT II: Special Language knowledge and Presentation – tone, humor, poise – listener/speaker sensitivity and articulation.

UNIT III: General Communication Skills for Presentation – content matching and language matching for specific audience - etiquette, clarity – delivery – use and abuse of hi-tech aids.

UNIT IV: Professional Communication Skills for Presentation – technical presentations – too much or too little use of technology - Turn taking – Effective not offensive or defensive handling of questions.

UNIT V: Social Communication Skills for Presentation - socializing – ice breakers; small talk – dialogue, debate, discussion – selling, advertising and persuading – overcoming shyness, hesitation – understanding cultural codes.

Practicals :

UNIT I: Case Studies

UNITS 2, 3,4 and 5: Role play and record work – combination of print, audio and video wherever possible.

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PG - SOFT SKILL

PAPER-V INTERNSHIP (Training Programme)

(For the students admitted from the year 2019-20)

CREDITS : 2

SUBJECT CODE : 19MS5

Internship is intended to gain practical knowledge related to the course of study. The duration is for 2 weeks for 2 credits and it should be carried out in an organization recommended by the Department during the summer vacation (or) Semester holidays of the first year.

A report must be prepared and submitted to the HOD concerned for evaluation and grading.

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M.Sc. – PHYSICS

CORE PAPER X – CONDENSED MATTER PHYSICS

(For the students admitted from the year 2019 – 20)

HOURS PER WEEK	:6		
CREDITS	:5	**SEMESTER**	:IV
		SUBJECT CODE	:19MBK

OBJECTIVES:

- To learn about the crystal structure, X-ray diffraction and lattice dynamics.
- To give strong foundation in the conceptual understanding of the development of solid state physics with appropriate theoretical background.
- To get knowledge about the properties and applications of materials like conductors, semiconductors, magnetic materials and superconductors.
- To study the theory underlying the behavior of these materials.

UNIT – I CRYSTAL PHYSICS

Types of lattices - Miller indices – Symmetry elements and allowed rotations - Simple crystal structures -- Atomic Packing Factor- Crystal diffraction - Bragg's law – Scattered Wave Amplitude - Reciprocal Lattice (sc, bcc, fcc) – Diffraction Conditions - Laue equations - Brillouin zone - Structure factor - Atomic form factor - Inert gas crystals - Cohesive energy of ionic crystals - Madelung constant – Types of crystal binding (general ideas).

UNIT – II 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 - Umklapp processes.

UNIT – III THEORY OF METALS AND SEMICONDUCTORS

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

UNIT – IV MAGNETISM

Diamagnetism – Quantum theory of paramagnetism - Rare earth ion - Hund's rule - Quenching of orbital angular momentum - Adiabatic demagnetization - Quantum theory of ferromagnetism - Curie point - Exchange integral - Heisenberg's interpretation of Weiss field - Ferromagnetic domains - Bloch wall - Spin waves - Quantization - Magnons - Thermal excitation of magnons - Curie temperature and susceptibility of ferromagnets - Theory of antiferomagnetism - Neel temperature.

UNIT – V SUPERCONDUCTIVITY

Experimental facts: Occurrence - Effect of magnetic fields - Meissner effect – Critical field – Critical current - 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 -- Isotope effect - Cooper pairs - BCS Theory - Single particle tunneling - Josephson tunneling - DC and AC Josephson effects - High temperature Superconductors - SQUIDS.

COURSE OUTCOME:

On completion of the course the students will be able to

- To identify the crystal structure and Brillouin zones.
- Understand the behavior of solids such as conductors, dielectrics, superconductors, etc.
- Explain the theory of superconducting materials

BOOKS FOR STUDY:

1. **C. Kittel**, 1996, *Introduction to Solid State Physics*. 7th Edition, Wiley, New York.
2. **M. Ali Omar**, 1974, *Elementary Solid State Physics - Principles and Applications*, Addison - Wesley
3. **H. P. Myers**, 1998, *Introductory Solid State Physics*, 2nd Edition, Viva Book, New Delhi.

BOOKS FOR REFERENCE:

1. **N. W. Aschroft** and **N. D. Mermin**, *Solid State Physics*, Rhinehart and Winton, New York.
2. **J. S. Blakemore**, 1974 . *Solid state Physics*, 2nd Edition, W B. Saunder, Philadelphia
3. **A. J. Dekker**, *Solid State Physics*, Macmillan India, New Delhi.
4. **H. M. Rosenburg**, 1993, *The Solid State*, 3rd Edition, Oxford University Press, Oxford.
5. **S. O. Pillai**, 1997, *Solid State Physics*, New Age International, New Delhi.
6. **S. O. Pillai**, 1994, *Problems and Solutions in Solid State Physics*, New Age International, New Delhi.
7. **S. L. Altmann**, *Band Theory of Metals*, Pergamon, Oxford.
8. **J. M. Ziman**, 1971, Principles *of the Theory of Solids*, Cambridge University Press, London.
9. **C. Ross-Innes and E. H. Rhoderick**, 1976, *Introduction to Superconductivity*, Pergamon, Oxford.
10. **M. Tinkham**, *Introduction to Superconductivity*, McGraw-Hill, New York.
11. **J. P. Srivastava**, 2001, *Elements of Solid State Physics*, Prentice-Hall of India, New Delhi.