CHOICE BASED CREDIT SYSTEM - LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK
PG & RESEARCH DEPARTMENT OF PHYSICS

M.Sc Physics: Those who have joined in the Academic year 2023-24 onwards

Part		Course	Code	Cr.	Hrs
SEMESTER I					
A	CC – 1	Mathematical Physics	232104101	4	6
	CC – 2	Classical Mechanics and Relativity	232104102	4	6
	CC – 3	Linear and Digital ICs and Applications	232104103	4	6
	EC I- P	Practical - I	232104104	4	6
	EC –II (Generic/DS)	Energy Physics	232104105	2	2
B	SEC I	Material Science	232104106	2	2
	AECC 1 – Soft Skill	Medical Physics	232104107	2	2
	Total			**22**	**30**
SEMESTER II					
A	CC – 4	Statistical Mechanics	232104201	4	6
	CC – 5	Quantum Mechanics – I	232104202	4	6
	CC – 6	Practical - II	232104203	4	6
	EC – III	Nonlinear Dynamics	232104204	3	4
	EC - IV	Characterization of Materials	232104205	3	4
B	SEC – II	Advanced Optics	232104206	2	2
	AECC 2	Thin Films	232104207	2	2
	*Internship	**Internship / Industrial Activity**		-	-
				22	**30**
SEMESTER III					
A	CC – 7	Quantum Mechanics - II	232104301	4	5
	CC – 8	Condensed Matter Physics	232104302	4	6
	CC – 9	Electromagnetic Theory	232104303	4	5
	Core P Core Industry Module	Practical – III	232104304	3	6
	EC - V	Advanced Spectroscopy	232104305	3	4
B	SEC – III	Microprocessor 8085 & Microcontroller 8051	232104306	2	2
	AECC – 3	Crystal Growth Techniques	232104307	2	2
	Internship	**Internship / Industrial Activity**	232104308	2	-
				24	**30**
SEMESTER IV					
A	CC – 10	Nuclear and Particle Physics	232104401	4	6
	CC – 11	Spectroscopy	232104402	4	5
	CC - 12	Numerical Methods and Computer Programming	232104403	4	5
	EC VI – P	Practical - IV	232104404	3	6
	CC – 13	Project with Viva voce	232104405	3	4
B	SEC – IV	Physics of Nanoscience and Technology	232104406	2	2
	AECC – 4	Aptitude, Reasoning, Comprehension and Numerical Ability	232104407	2	2
C	EA	Extension Activity	232104408	1	-
	Total			**23**	**30**

* Internship will be carried out during the summer vacation of the first year and marks will be included in the Third Semester Marks Statement.

Title of the Course		**QUANTUM MECHANICS - II**						
Part		**A**						
Category	Core 7	**Year**	II	**Credits**	4	**Course Code**	**232104301**	
		Semester	III					
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**	**CIA**	**External**	**Total**
		5	-	--	5	25	75	100

Pre-Requisites

Knowledge of postulates of Quantum mechanics, properties of Hermitian operators, ladder operators, degeneracy, angular momentum techniques and commutation rules

Learning Objectives

- Formal development of the theory and the properties of angular momenta, both orbital and spin
- To familiarize the students to the crucial concepts of scattering theory such as partial wave analysis and Barn approximation.
- Time-dependent Perturbation theory and its application to study of interaction of an atom with the electromagnetic field
- To give the students a firm grounding in relativistic quantum mechanics, with emphasis on Dirac equation and related concepts
- To introduce the concept of covariance and the use of Feynman graphs for depicting different interactions

UNIT	Details	No. of Periods for the Unit
I	**SCATTERING THEORY** Scattering amplitude – Cross sections – Born approximation and its validity – Scattering by a screened coulomb potential – Yukawa potential – Partial wave analysis – Scattering length and Effective range theory for s wave – Optical theorem – Transformation from centre of mass to laboratory frame.	**15**
II	**PERTURBATION THEORY** Time dependent perturbation theory – Constant and harmonic perturbations – Fermi Golden rule – Transition probability Einstein's A and B Coefficients – Adiabatic approximation – Sudden approximation – Semi – classical treatment of an atom with electromagnetic radiation – Selection rules for dipole radiation	**15**
III	**RELATISTIC QUANTUM MECHANICS** Klein – Gordon Equation – Charge And Current Densities – Dirac Matrices – Dirac Equation – Plane Wave Solutions – Interpretation Of Negative Energy States – Antiparticles – Spin of Electron – Magnetic Moment Of An Electron Due To Spin	**15**
IV	**DIRAC EQUATION** Covariant form of 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 ideas only without propagation formalism)	**15**
V	**CLASSICAL FIELDS AND SECOND QUANTIZATION** Classical fields – Euler Lagrange equation – Hamiltonian formulation – Noether's theorem – Quantization of real and complex scalar fields – Creation, Annihilation and Number operators – Fock states – Second Quantization of K-G field.	**15**

Course Outcomes	
Course Outcomes	On completion of this course, students will;
CO1	Familiarize the concept of scattering theory such as partial wave analysis and Born approximation
CO2	Give a firm grounding in relativistic quantum mechanics, with emphasis on Dirac equation and related concepts
CO3	Discuss the relativistic quantum mechanical equations namely, Klein-Gordon and Dirac equations and the phenomena accounted by them like electron spin and magnetic moment
CO4	Introduce the concept of covariance and the use of Feynman graphs for depicting different interactions
CO5	Demonstrate an understanding of field quantization and the explanation of the scattering matrix.

TEXT BOOKS	
1.	P. M. Mathews and K. Venkatesan, A Text book of Quantum Mechanics,2nd Edition, Tata McGraw-Hill, New Delhi, 2010.
2.	G. Aruldhas, Quantum Mechanics, 2nd Edition, Prentice-Hall of India, NewDelhi,2009
3.	L. I. Schiff, Quantum Mechanics, 3rd Edition, International Student Edition, McGraw-Hill Kogakusha, Tokyo, 1968
4.	V. Devanathan, Quantum Mechanics, 1st Edition, Narosa Publishing House, New Delhi, 2005.
5.	Nouredine Zettili, Quantum mechanics concepts and applications, 2nd Edition, Wiley, 2017
REFERENCE BOOKS	
1	P. A. M. Dirac, The Principles of Quantum Mechanics, 4th Edition, Oxford University Press, London, 1973
2	B. K. Agarwal & Hari Prakash, Quantum Mechanics, 7th reprint, PHI Learning Pvt. Ltd., New Delhi, 2009.
3	Deep Chandra Joshi, Quantum Electrodynamics and Particle Physics,1stedition,I.K.International Publishing house Pvt. Ltd., 2006
4	Ghatak and S. Lokanathan, Quantum Mechanics: Theory and Applications, 4th Edition, Macmillan India, New Delhi.
5	E. Merzbacher, Quantum Mechanics, 2nd edition, John Wiley and Sons, New York, 1970
WEB SOURCES	
1.	https://ocw.mit.edu/courses/physics/8-05-quantum-physics-ii-fall-2013/lecture notes/MIT8_05F13_Chap_09.pdf
2.	http://www.thphys.nuim.ie/Notes/MP463/MP463_Ch1.pdf
3.	http://hep.itp.tuwien.ac.at/~kreuzer/qt08.pdf
4.	https://www.cmi.ac.in/~govind/teaching/rel-qm-rc13/rel-qm-notes-gk.pdf
5.	https://web.mit.edu/dikaiser/www/FdsAmSci.pdf

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) and LOW (1)**.**

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	3	3	3	3	3	3	3	3	3	3
CO2	3	3	2	3	3	3	3	3	3	3
CO3	3	2	2	3	3	2	3	3	3	3
CO4	2	1	1	3	3	1	2	2	3	3
CO5	2	1	1	3	3	2	2	2	3	3

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**	**PSO10**
CO1	3	3	3	3	3	3	3	3	3	3
CO2	3	3	2	3	3	3	3	3	3	3
CO3	3	2	2	3	3	2	3	3	3	3
CO4	2	1	1	3	3	1	2	2	3	3
CO5	2	1	1	3	3	2	2	2	3	3

Title of the Course		**CONDENSED MATTER PHYSICS**						
Category	Core - 7	**Year**	II	**Credits**	4	**Course Code**	**232104302**	
		Semester	III					
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**	**CIA**	**External**	**Total**
		6	-	--	6	25	75	100

Learning Objectives

- ✍ To describe various crystal structures, symmetry and to differentiate different types of bonding.
- ✍ To construct reciprocal space, understand the lattice dynamics and apply it to concept of specific heat.
- ✍ To critically assess various theories of electrons in solids and their impact in distinguishing solids.
- ✍ Outline different types of magnetic materials and explain the underlying phenomena.
- ✍ Elucidation of concepts of superconductivity, the underlying theories – relate to current areas of research.

UNIT	Details	No. of Periods for the 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). Structure and properties of liquid crystals. 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).	**18**
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 - Umkalapp processes.	**18**
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.	**18**
IV	**MAGNETISM** Diamagnetism - Quantum theory of paramagnetism - Rare earth ion - Hund's rule - Quenching of orbital angular momentum - 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 ferrimagnets - Theory of antiferomagnetism - Neel temperature.	**18**

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 – Bardeen Cooper Schrieffer (BCS) Theory – Single particle tunneling - Josephson tunneling - DC and AC Josephson effects - High temperature Superconductors – SQUIDS.	**18**

Course Outcomes	
Course Outcomes	On completion of this course, students will;
CO1	Student will be able to list out the crystal systems, symmetries allowed in a system and also the diffraction techniques to find the crystal structure
CO2	Students will be able to visualize the idea of reciprocal spaces, Brillouin Zone and their extension to band theory of solids.
CO3	Student will be able to comprehend the heat conduction in solids
CO4	Student will be able to generalize the electronic nature of solids from band theories.
CO5	Student can compare and contrast the various types of magnetism and conceptualize the idea of superconductivity.

Text Books (Latest Editions)
1. C. Kittel, 1996, *Introduction to Solid State Physics,* 7th Edition, Wiley, New York
2. Rita John, Solid State Physics, Tata Mc-Graw Hill Publication
3. A. J. Dekker, *Solid State Physics*, Macmillan India, New Delhi.
4. M. Ali Omar, 1974, *Elementary Solid State Physics – Principles and Applications,* Addison - Wesley
5. H. P. Myers, 1998, *Introductory Solid State Physics,* 2nd Edition, Viva Book, New Delhi.
References Books **(Latest editions, and the style as given below must be strictly adhered to)**
1. J. S. Blakemore, 1974 , *Solid state Physics,* 2nd Edition, W.B. Saunder, Philadelphia.
2. H. M. Rosenburg, 1993, *The Solid State,* 3rd Edition, Oxford University Press, Oxford
3. J. M. Ziman, 1971, Principles *of the Theory of Solids*, Cambridge University Press, London.
4. C. Ross-Innes and E. H. Rhoderick, 1976, *Introduction to Superconductivity,* Pergamon, Oxford
5. J. P. Srivastava, 2001, *Elements of Solid State Physics,* Prentice-Hall of India, New Delhi.
WEB SOURCES
http://www.physics.uiuc.edu/research/electronicstructure/389/389-cal.html
http://www.cmmp.ucl.ac.uk/%7Eaph/Teaching/3C25/index.html
https://www.britannica.com/science/crystal
https://www.nationalgeographic.org/encyclopedia/magnetism/
https://www.brainkart.com/article/Super-Conductors_6824/

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) and LOW (1)**.**

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	3	2	3	2	2	2	2	2	2	2
CO2	3	2	3	2	3	2	3	3	2	3
CO3	3	3	3	2	3	2	3	3	2	3
CO4	2	2	2	2	2	2	2	2	2	3
CO5	2	2	2	2	2	2	2	2	2	3

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**	**PSO10**
CO1	3	2	3	2	2	2	2	2	2	2
CO2	3	2	3	2	3	2	3	3	2	3
CO3	3	3	3	2	3	2	3	3	2	3
CO4	2	2	2	2	2	2	2	2	2	3
CO5	2	2	2	2	2	2	2	2	2	3

Title of the Course		**ELECTROMAGNETIC THEORY**						
Category	Core - 9	**Year**	II	**Credits**	4	**Course Code**	**232104303**	
		Semester	III					
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**	**CIA**	**External**	**Total**
		5	-	--	5	25	75	100

Pre-Requisites

Different coordinate systems, Laplace's equation, conducting & non-conducting medium, basic definitions in magnetism, propagation of electromagnetic waves, plasma

Learning Objectives

- ✍ To acquire knowledge about boundary conditions between two media and the technique of method of separation of variables
- ✍ To understand Biot – Savart's law and Ampere's circuital law
- ✍ To comprehend the physical ideas contained in Maxwell's equations, Coulomb & Lorentz gauges, conservation laws
- ✍ To assimilate the concepts of propagation, polarization, reflection and refraction of electromagnetic waves
- ✍ To grasp the concept of plasma as the fourth state of matter

UNIT	Details	No. of Periods for the Unit
I	**Electrostatics:** Boundary value problems and Laplace equation – Boundary conditions and uniqueness theorem – Laplace equation in three dimension – Solution in Cartesian and spherical polar coordinates – Examples of solutions for boundary value problems. Polarization and displacement vectors - Boundary conditions - Dielectric sphere in a uniform field – Molecular polarizability and electrical susceptibility – Electrostatic energy in the presence of dielectric – Multipole expansion.	**15**
II	**Magnetostatics:** Biot-Savart's Law - Ampere's law - Magnetic vector potential and magnetic field of a localized current distribution - Magnetic moment, force and torque on a current distribution in an external field - Magneto static energy - Magnetic induction and magnetic field in macroscopic media - Boundary conditions - Uniformly magnetized sphere.	**15**
III	**Maxwell's Equations:** Faraday's laws of Induction - Maxwell's displacement current - Maxwell's equations - Vector and scalar potentials - Gauge invariance - Wave equation and plane wave solution- 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.	**15**
IV	**Electromagnetic Waves:** Plane waves in non-conducting media - Linear and circular polarization, reflection and refraction at a plane interface - Waves in a conducting medium - Propagation of waves in a rectangular wave guide. Inhomogeneous wave equation and retarded potentials - Radiation from a localized source - Oscillating electric dipole	**15**
V	**Magnetohydrodynamics:** The Boltzmann Equation - Simplified magnetohydrodynamic equations - Electron plasma oscillations - The Debye shielding problem - Plasma confinement in a magnetic field - Magnetohydrodynamic waves - Alfven waves and magnetosonic waves.	**15**

TEXT BOOKS	
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 Publishing House, 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	Gupta, Kumar and Singh, Electrodynamics, S. Chand & Co., New Delhi
REFERENCE BOOKS	
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	P. Feynman, R. B. Leighton and M. Sands, 1998, *The Feynman Lectures on Physics*, Vols. 2, Narosa Publishing House, New Delhi.
5	Andrew Zangwill, 2013, Modern Electrodynamics, Cambridge University Press, USA.
WEB SOURCES	
1	http://www.plasma.uu.se/CED/Book/index.html
2	http://www.thphys.nuim.ie/Notes/electromag/frame-notes.html
3	http://www.thphys.nuim.ie/Notes/em-topics/em-topics.html
4	http://dmoz.org/Science/Physics/Electromagnetism/Courses_and_Tutorials/
5	https://www.cliffsnotes.com/study-guides/physics/electricity-and-magnetism/electrostatics

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Solve the differential equations using Laplace equation and to find solutions for boundary value problems
CO2	Use Biot-Savart's law and Ampere circuital law to find the magnetic induction & magnetic vector potential for various physical problems
CO3	Apply Maxwell's equations to describe how electromagnetic field behaves in different media
CO4	Apply the concept of propagation of EM waves through wave guides in optical fiber communications and also in radar installations, calculate the transmission and reflection coefficients of electromagnetic waves
CO5	Investigate the interaction of ionized gases with self-consistent electric and magnetic fields

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) and LOW (1)**.**

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	3	3	3	1	2	2	3	3	1	3
CO2	3	3	3	1	2	2	3	3	1	3
CO3	3	3	3	1	2	2	3	3	1	3
CO4	3	3	3	1	2	2	3	3	1	3
CO5	3	3	3	1	2	2	3	3	1	3

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**	**PSO10**
CO1	3	3	3	1	2	2	3	3	1	3
CO2	3	3	3	1	2	2	3	3	1	3

CO3	3	3	3	1	2	2	3	3	1	3
CO4	3	3	3	1	2	2	3	3	1	3
CO5	3	3	3	1	2	2	3	3	1	3

Title of the Course		**PRACTICAL – III**						
		Core Industry Module						
Category	Core Industry Module -P	**Year**	II	**Credits**	3	**Course Code**	**232104304**	
		Semester	III					
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**	**CIA**	**External**	**Total**
		--	--	6	6	25	75	100

Pre-Requisites

Basic knowledge in differential equation and linear algebra
Basic knowledge of operating system and computer fundamentals.

Learning Objectives

- ✍ The aim and objective of the course on Computational Practical is to familiarize the of M.Sc. students with the numerical methods used in computation and programming using any high level language such as C/FORTRAN
- ✍ To equip the computational skill using various mathematical tools.
- ✍ To apply the software tools to explore the concepts of physical science.
- ✍ To approach the real time activities using physics and mathematical formulations

Course Details

(Any Eight Experiments)

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.
9. Finding Roots of a Polynomial - Bisection Method
10. Finding Roots of a Polynomial - Newton Raphson Method
11. Solution of Simultaneous Linear Equation by Gauss elimination method.
12. Solution of Ordinary Differential Equation by Euler
13. Runge Kutta Fourth Order Method for solving first order Ordinary Differential Equations
14. Newton's cotes formula
15. Trapezoidal rule
16. Simpson's 1/3 rule
17. Simpson's 3/8 rule
18. Boole's rule
19. Gaussian quadrature method (2 point and 3 point formula)
20. Giraffe's root square method for solving algebraic equation

TEXT BOOKS	
1	Numerical methods using Matlab – John Mathews & Kurtis Fink, Prentice Hall, New Jersey 2006
2	Numerical methods in Science and Engineering - M.K. Venkataraman, National Publishing Co. Madras, 1996
3	V. Rajaraman, 1993, Computer Oriented Numerical Methods, 3rd Ed. (Prentice-Hall, New Delhi.
4	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.
5	S.S. Sastry, Introductory Methods of Numerical Analysis, PHI, New Delhi.
REFERENCE BOOKS	
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, Addison 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.
5	V. Rajaraman, Programming in FORTRAN/ Programming in C, PHI, New Delhi.

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Program with the C Program/ FORTRAN with the C or any other high level language
CO2	Use various numerical methods in describing/solving physics problems.
CO3	Solve problem, critical thinking and analytical reasoning as applied to scientific problems.
CO4	To enhance the problem-solving aptitudes of students using various numerical methods.
CO5	To apply various mathematical entities, facilitate to visualise any complicate tasks.
K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 – Evaluate	

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) and LOW (1)**.**

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	2	2	2	3	3	2	2	2	3	3
CO2	2	2	3	3	3	2	2	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3
CO4	3	2	3	3	3	3	2	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**	**PSO10**
CO1	2	2	2	3	3	2	2	2	3	3
CO2	2	2	3	3	3	2	2	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3
CO4	3	2	3	3	3	3	2	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3

Title of the Course		**ADVANCED SPECTROSCOPY**						
Category	EC - V	**Year**	II	**Credits**	3	**Course Code**	**232104305**	
		Semester	III					
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**	**CIA**	**External**	**Total**
		4	-	--	4	25	75	100

Learning Objectives

- ✍ Helps students understand and appreciate spectroscopy as a sufficiently broad field in which many sub disciplines exist.
- ✍ Make them appreciate each of these specific techniques with numerous implementations.
- ✍ To realize the progress in this field that is rapid, resulting in improved instrument capabilities and an ever-widening range of applications.
- ✍ To apply group theory in spectroscopy to shed light on molecular symmetry and determine important physical parameters.

UNIT	Details	No. of Periods for the Unit
I	**GROUP THEORY** Group axioms – subgroup, simple group, Abelian group, cyclic group, Order of a group, class- Lagrange's theorem statement and proof- Symmetry operations and symmetry elements - Application: construction Of group multiplication table (not character table) for groups of order 2,3, Cyclic group of order 4, non cyclic group of order 4	**12**
II	**MOLECULAR REPRESENTATION OF GROUP THEORY** Reducible irreducible representations - Unitary representations – Schur's lemmas – Great orthogonality theorem - point group -Simple applications :Symmetry operations of water and ammonia – Construction of character table for C_{2v}(water) and C_{3v}(ammonia) molecules	**12**
III	**MOSSBAUER SPECTROSCOPY** Basic idea of Mossbauer spectroscopy - Principle- Mossbauer effect-instrumentation-Recoilless emission and absorption- isomer shift –Effect of electric and magnetic fields–hyperfine interactions Applications: understanding molecular and electronic structures	**12**
IV	**LASER SPECTROSCOPY** Nonlinear optical effects-Frequency Generation by Nonlinear optical Techniques-Sources for laser spectroscopy-LASER Induced Fluorescence-LASER Magnetic Resonance - LASER stark spectroscopy – Photo acoustic Spectroscopy – Doppler Free Two-photon spectroscopy - Opto Galvanic Spectroscopy	**12**
V	**X-RAY PHOTOELECTRON SPECTROSCOPY** Principle – XPS spectra and its interpretation- ECSA-EDAX- other forms of XPS – chemical shift - Applications : - stoichiometric analysis-electronic structure – XPES techniques used in astronomy, glass industries, paints and in biological research	**12**

COURSE OUTCOMES:

	At the end of the course, the student will be able to:
CO 1	Comprehend set of operations associated with symmetry elements of a molecule; apply mathematical theory while working with symmetry operations. Apply mathematical theory while working with symmetry operations. To use group theory as a tool to characterize molecules.
CO 2	Align with the recent advances in semiconductor laser technology combined sensitive spectroscopic detection techniques.
CO 3	Understand principle behind Mossbauer spectroscopy and apply the concepts of isomer shift and quadrupole splitting to analyse molecules.

CO 4	Assimilate this XPES quantitative technique and the instrumentation associated with this, as applied in understanding surface of materials.
CO 5	Employ IR and Raman spectroscopic data along with other data for structural Investigation of molecules. Analyze thermodynamic functions and other parameters to evolve molecular models.

TEXT BOOKS	
1	William Kemp, 2019, Organic Spectroscopy (2nd Edition) MacMillan, Indian Edition.
2	C.N.Banwell and McCash,1994, Fundamentals of Molecular Spectroscopy, 4th Edition, Tata McGraw–Hill, New Delhi.
3	D.N. Satyanarayana, 2001, *Vibrational Spectroscopy and Applications*, New Age International Publication.
4	B.K. Sharma , 2015, *Spectroscopy*, Goel Publishing House Meerut.
5	G. Aruldhas Molecular structure and spectroscopy (2007) II edition
REFERENCE BOOKS	
1	Demtroder. W, Laser Spectroscopy: Basic concepts and Instrumentation, SpringerLink.
2	B. P. Straughan and S. Walker, 1976, Spectroscopy Vol.I., Chapman and Hall, New York.
3	J L McHale, 2008, Molecular Spectroscopy, Pearson Education India, New Delhi.
4	David.L. Andrews, Introduction to Laser Spectroscopy, Springer, 2020
5	Kalsi.P.S,2016,Spectroscopy of Organic Compounds (7th Edition) New Age International Publishers
WEB SOURCES	
1	Fundamentals of Spectroscopy - Course (nptel.ac.in)
2	http://mpbou.edu.in/slm/mscche1p4.pdf
3	https://onlinecourses.nptel.ac.in/noc20_cy08/preview
4	https://www.coursera.org/lecture/spectroscopy/nmr-spectroscopy-introduction-XCWRu
5	https://serc.carleton.edu/research_education/geochemsheets/techniques/mossbauer.html

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) and LOW (1)**.**

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	3	3	2	2	3	3	3	3	3	2
CO2	2	2	2	3	3	3	2	3	3	2
CO3	2	2	3	3	3	3	3	2	3	3
CO4	3	2	3	3	2	3	3	3	3	2
CO5	3	2	3	3	3	3	3	3	3	3

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**	**PSO10**
CO1	3	3	2	2	3	3	3	3	3	2
CO2	2	2	2	3	3	3	2	3	3	2
CO3	2	2	3	3	3	3	3	2	3	3
CO4	3	2	3	3	2	3	3	3	3	2
CO5	3	2	3	3	3	3	3	3	3	3

Title of the Course		**MICROPROCESSOR 8085 & MICROCONTROLLER 8051**						
Category	SEC - III	**Year**	II	**Credits**	2	**Course Code**		**232104306**
		Semester	III					
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**	**CIA**	**External**	**Total**
		2	-	--	2	25	75	100

Learning Objectives

- To provide an understanding of the architecture and functioning of microprocessor 8085A and to the methods of interfacing I/O devices and memory to microprocessor
- To introduce 8085A programming and applications and the architecture and instruction sets of microcontroller 8051

UNITS	Course details	No. of Periods for the Unit
I	**8085 PROGRAMMING, PERIPHERAL DEVICES AND THEIR INTERFACING** Instruction set - Addressing modes - Programming techniques - Memory mapped I/O scheme- I/O mapped I/O scheme - Memory and I/O interfacing- Data transfer schemes	6
II	**8085 INTERFACING APPLICATIONS** Seven segment display interface - Interfacing of Digital to Analog converter and Analog to Digital converter - Stepper motor interface - Measurement of electrical quantities –Voltage and current) Measurement of physical quantities (Temperature an strain).	6
III	**8051 MICROCONTROLLER HARDWARE** Introduction – Features of 8051 – 8051 Microcontroller Hardware: Pin-out 8051, Central Processing Unit (CPU), internal RAM, Internal ROM, Register set of 8051	6
IV	**8051 INSTRUCTION SET AND ASSEMBLY LANGUAGE PROGRAMMING** Logical instructions: byte and bit level logical operations, Rotate and swap operations – Arithmetic instructions: Flags, Incrementing and decrementing, Addition, Subtraction, Multiplication and division	6
V	**INTERRUPT PROGRAMMING AND INTERFACING TO EXTERNAL WORLD** LED Interface Seven segment display interface- Interfacing of Digital to Analog converter and Analog to Digital converter - Stepper motor interface - Measurement of electrical quantities – Voltage and current) Measurement of physical quantities(Temperature an strain).	6

	TEXT BOOKS
1	A. NagoorKani, Microprocessors & Microcontrollers, RBA Publications (2009).
2	A. P. Godse and D. A. Godse, Microprocessors, Technical Publications, Pune (2009).
3	Ramesh Gaonkar, Microprocessor Architecture, Programming and Applications with 8085, Penram International Publishing (2013).
4	B. Ram, Fundamentals of Microprocessors & Microcontrollers, DhanpatRai publications New Delhi (2016).
5	V. Vijayendran, 2005, Fundamentals of Microprocessor-8085", 3rd Edition S.Visvanathan Pvt, Ltd.
	REFERENCE BOOKS
1	Douglas V. Hall, Microprocessors and Interfacing programming and Hardware, Tata Mc Graw Hill Publications (2008)
2	Muhammad Ali Mazidi, Janice GillispieMazidi, Rolin D. Mckinlay, The 8051 Microcontroller and Embedded Systems, Pearson Education (2008).

3	Barry B. Brey, 1995, The Intel Microprocessors 8086/8088, 80186, 80286, 80386 and 80486, 3rd Edition, Prentice- Hall of India, New Delhi.

4	J. Uffrenbeck, "The 8086/8088 Family-Design, Programming and Interfacing, Software, Hardware and Applications", Prentice-Hall of India, New Delhi.
5	A. Tribel, Avtar Singh, "The 8086/8088 Microprocessors: Programming, Interfacing, Software, Hardware and Applications", Prentice-Hall of India, New Delhi.
WEB SOURCES	
1	https://www.tutorialspoint.com/microprocessor/microprocessor_8085_architecture.html
2	http://www.electronicsengineering.nbcafe.in/peripheral-mapped-io-interfacing/
3	https://www.geeksforgeeks.org/programmable-peripheral-interface-8255/
4	http://www.circuitstoday.com/8051-microcontroller
5	https://www.elprocus.com/8051-assembly-language-programming/

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1	Gain knowledge of architecture and working of 8085 microprocessor.
CO2	Get knowledge of architecture and working of 8051 Microcontroller.
CO3	Be able to write simple assembly language programs for 8085A microprocessor.
CO4	Able to write simple assembly language programs for 8051 Microcontroller.
CO5	Understand the different applications of microprocessor and microcontroller.

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) and LOW (1)**.**

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	2	3	3	3	3	1	1	1	1	1
CO2	2	1	1	1	1	1	1	1	1	1
CO3	3	3	3	3	3	1	1	1	1	1
CO4	3	3	3	3	3	1	1	1	1	1
CO5	3	3	3	3	3	1	1	1	1	1

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**	**PSO10**
CO1	2	3	3	3	3	1	1	1	1	1
CO2	2	1	1	1	1	1	1	1	1	1
CO3	3	3	3	3	3	1	1	1	1	1
CO4	3	3	3	3	3	1	1	1	1	1
CO5	3	3	3	3	3	1	1	1	1	1

Title of the Course		**CRYSTAL GROWTH TECHNIQUES**						
Category	AECC 3	**Year**	II	**Credits**	2	**Course Code**		**232104307**
		Semester	III					
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**	**CIA**	**External**	**Total**
		2	-	--	2	25	75	100

Learning Objectives

- ✍ . To acquire the knowledge on Nucleation of crystal growth
- ✍ To understand the Crystallization Principles.
- ✍ To understand the Solution Growth methods.
- ✍ To study various methods of Gel growth techniques.
- ✍ To study various methods of Melt and Vapour growth techniques.

UNITS	**Course Details**	**No. of Periods for the Unit**
UNIT I:	**CRYSTAL GROWTH AND NUCLEATION** Basic Concepts of Crystal growth and Nucleation - Ambient phase equilibrium of finite phase - super saturation - equation of Thomson - Gibbs - Types of Nucleation - Formation of critical Nucleus - Classical theory of Nucleation - Homo and heterogeneous formation of nuclei - rate of Nucleation.	**6**
UNIT II:	**CRYSTALLIZATION PRINCIPLES** Crystallization Principles and Growth techniques - Solubility diagram - Super solubility - expression for super saturation - Metastable zone and introduction period - Miers TC diagram.	**6**
UNIT III:	**SOLUTION GROWTH** Solution growth - Low and high temperatures solution growth - Slow cooling and solvent evaporation methods - Constant temperature bath as a Crystallizer.	**6**
UNIT IV:	**GEL GROWTH** Gel growth techniques - Principle of Gel techniques - Various types of Gel - Structure and importance of Gel - Methods of Gel growth and advantages.	**6**
UNIT V:	**MELT AND VAPOUR GROWTH** Melt techniques - Czochralski growth - Floating zone - Bridgeman method - Horizontal gradient freeze - Flux growth - Hydrothermal growth - Vapour phase growth - Physical vapour deposition - Chemical vapour deposition.	**6**

TEXT BOOKS	
1	V. Markov Crystal growth for beginners: Fundamentals of Nucleation, Crystal Growth and Epitaxy (2004) 2nd edition
2	M. Ohora and R. C. Reid, “Modeling of Crystal Growth Rates from Solution”
3	D. Elwell and H. J. Scheel, “Crystal Growth from High Temperature Solution”
4	Heinz K. Henish, 1973, “Crystal Growth in Gels”, Cambridge University Press. USA.
REFERENCE BOOKS	
1	J.C. Brice, Crystal Growth Process (John Wiley, New York, 1986)
2	P. Ramasamy and F. D. Gnanam, 1983, “UGC Summer School Notes”.
3	H.E. Buckley, 1951, Crystal Growth, John Wiley and Sons, New York
4	B.R. Pamplin, 1980, Crystal Growth, Pergman Press, London.

5	P. Santhana Raghavan and P. Ramasamy, “Crystal Growth Processes”, KRU Publications.

WEB SOURCES	
1	https://www.youtube.com/playlist?list=PLbMVogVj5nJRjLrXp3kMtrIO8kZl1D1Jp
2	https://www.youtube.com/playlist?list=PLFW6lRTa1g83HGEihgwcy7KeTLUuBu3WF
3	https://www.youtube.com/playlist?list=PLADLRin7kNjG1Dlna9MDA53CMKFHPSi9m
4	https://www.youtube.com/playlist?list=PLXHedI-xbyr8xIl_KQFs_R_oky3Yd1Emw
5	https://www.electrical4u.com/thermal-conductivity-of-metals/

COURSE OUTCOMES:
At the end of the course, the student will be able to:

CO1	Acquire the Basic Concepts and Nucleation of crystal growth
CO2	Understand the Crystallization Principles and Growth techniques
CO3	Study various methods of Crystal growth techniques
CO4	Understand the Gel growth methods.
CO5	Apply the techniques of melt and vapour growth method.

MAPPING WITH PROGRAM OUTCOMES:
Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) **and** LOW (1)**.**

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	3	2	1	2	1	3	2	2	2	2
CO2	3	3	1	3	1	2	3	2	2	1
CO3	3	2	1	3	1	2	3	3	3	1
CO4	3	2	1	2	1	2	3	3	3	1
CO5	2	3	3	3	1	3	3	3	3	2

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**	**PSO10**
CO1	3	2	1	2	1	3	2	2	2	2
CO2	3	3	1	3	1	2	3	2	2	1
CO3	3	2	1	3	1	2	3	3	3	1
CO4	3	2	1	2	1	2	3	3	3	1
CO5	2	3	3	3	1	3	3	3	3	2

Core Subject **INTERNSHIP / INDUSTRIAL ACTIVITY** **Code: 232104308**

SEMESTER III **Credit 2**

Preamble:

✍ ***To give Exposure to real world experience.***

The Students will undergo minimum 7 days of summer internship/industrial activity training in subject related organization after their second semester for PG and Fourth semester for UG examinations (Summer Vacation).

The student will be allotted a faculty for guiding the internship/industrial activity. After the completion of the internship/industrial activity, he/she has to document the work, and submit the report along with the Certificate from the concern organization (2 copies – one to the Controller's Office, one to the Department Library)

The External viva voce examination will be conducted on or before last working day of the Third semester for PG and Fifth semester for UG.

Evaluation of internship/industrial activity

	Internal marks	External marks	Total marks
Internship Report	15	50	65
Viva	10	25	35
Total	25	75	100

Title of the Course		**NUCLEAR AND PARTICLE PHYSICS**						
Part		**A**						
Category	Core 10	**Year**	II	**Credits**	4	**Course Code**		**232104401**
		Semester	IV					
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**	**CIA**	**External**	**Total**
		6	-	--	6	25	75	100

Learning Objectives

- ✍ Introduces students to the different models of the nucleus in a chronological order
- ✍ Imparts an in-depth knowledge on the nuclear force, experiments to study it and the types of nuclear reactions and their principles
- ✍ Provides students with details of nuclear decay with relevant theories
- ✍ Exposes students to the Standard Model of Elementary Particles and Higgs boson

UNITS	Course Details	No. of Periods for the Unit
I:	**NUCLEAR MODELS** Liquid drop model – Weizacker mass formula – Isobaric mass parabola – Bohr Wheeler theory of fission – shell model – spin-orbit coupling – magic numbers – angular momenta and parity of ground states – magnetic moment – electric Quadrupole moment - Bohr and Mottelson collective model – rotational and vibrational bands.	18
II:	**NUCLEAR FORCES** Introduction – properties of nuclear forces – ground state of deuteron – Neutron - proton scattering at low energies - Proton-proton scattering at low energies – spin dependence of nuclear forces - Exchange Forces - Meson theory of nuclear forces - Yukawa potential.	18
III:	**NUCLEAR REACTIONS** Kinds of nuclear reactions – Reaction kinematics – Q-value – Partial wave analysis of scattering and reaction cross section – scattering length – Compound nuclear reactions –Resonances – Breit Wigner one level formula – Direct reactions - Nuclear Chain reaction – four factor formula.	18
IV:	**NUCLEAR DECAY** Beta decay – Fermi theory of Beta decay– mass of neutrino – allowed and forbidden decay — neutrino physics – Helicity - Parity violation - Gamma decay – multipole radiations – Angular Correlation - internal conversion – nuclear isomerism – angular momentum and parity selection rules.	18
V:	**ELEMENTARY PARTICLES** Classification of Elementary Particles – Types of Interaction and conservation laws – Families of elementary particles – Isospin – Quantum Numbers – Strangeness – Hypercharge and Quarks –SU (2) and SU (3) groups-Gell Mann matrices– Gell Mann Okuba Mass formula-Quark Model.	18

TEXT BOOKS

1	D. C. Tayal – Nuclear Physics – Himalaya Publishing House (2011)
2	K. S. Krane – Introductory Nuclear Physics – John Wiley & Sons (2008)
3	R. Roy and P. Nigam – Nuclear Physics – New Age Publishers (1996)
4	S. B. Patel – Nuclear Physics – An introduction – New Age International Pvt Ltd Publishers (2011)
5	S. Glasstone – Source Book of Atomic Energy – Van Nostrand Reinhold Inc.,U.S.- 3rd Revised edition (1968)

REFERENCE BOOKS

1	L. J. Tassie – The Physics of elementary particles – Prentice Hall Press (1973)
2	H. A. Enge – Introduction to Nuclear Physics – Addison Wesley, Publishing Company. Inc. Reading. New York, (1974).
3	Kaplan – Nuclear Physics – 1989 – 2nd Ed. – Narosa (2002)
4	Bernard L Cohen – Concepts of Nuclear Physics – McGraw Hill Education (India) Private Limited; 1 edition (2001)
5	B.L. Cohen, 1971, Concepts of Nuclear Physics, TMCH, New Delhi.
REFERENCE BOOKS	
1	L. J. Tassie – The Physics of elementary particles – Prentice Hall Press (1973)
2	H. A. Enge – Introduction to Nuclear Physics – Addison Wesley, Publishing Company. Inc. Reading. New York, (1974).
3	Kaplan – Nuclear Physics – 1989 – 2nd Ed. – Narosa (2002)
4	Bernard L Cohen – Concepts of Nuclear Physics – McGraw Hill Education (India) Private Limited; 1 edition (2001)
5	B.L. Cohen, 1971, Concepts of Nuclear Physics, TMCH, New Delhi.
WEB SOURCES	
1	http://bubl.ac.uk/link/n/nuclearphysics.html
2	http://www.phys.unsw.edu.au/PHYS3050/pdf/Nuclear_Models.pdf
3	http://www.scholarpedia.org/article/Nuclear_Forces
4	https://www.nuclear-power.net/nuclear-power/nuclear-reactions/
5	http://labman.phys.utk.edu/phys222core/modules/m12/nuclear_models.html
6	https://www.ndeed.org/EducationResources/HighSchool/Radiography/radioactivedecay.html

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Gain knowledge about the concepts of helicity, parity, angular correlation and internal conversion.
CO2	Demonstrate knowledge of fundamental aspects of the structure of the nucleus, radioactive decay, nuclear reactions and the interaction of radiation and matter.
CO3	Use the different nuclear models to explain different nuclear phenomena and the concept of resonances through Briet-Weigner single level formula
CO4	Analyze data from nuclear scattering experiments to identify different properties of the nuclear force.
CO5	Summarize and identify allowed and forbidden nuclear reactions based on conservation laws of the elementary particles.

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) and LOW (1)**.**

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	3	3	2	2	2	2	2	2	2	2
CO2	3	3	2	2	1	2	1	2	2	2
CO3	3	3	1	2	1	2	1	1	2	2
CO4	3	3	2	3	2	3	2	2	3	3
CO5	3	3	2	3	2	3	2	3	3	3

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**	**PSO10**

CO1	3	3	2	2	2	2	2	2	2	2
CO2	3	3	2	2	1	2	1	2	2	2
CO3	3	3	1	2	1	2	1	1	2	2
CO4	3	3	2	3	2	3	2	2	3	3
CO5	3	3	2	3	2	3	2	3	3	3

Title of the Course		**SPECTROSCOPY**						
Part		**A**						
Category	Core 10	**Year**	II	**Credits**	4	**Course Code**	**232104402**	
		Semester	IV					
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**	**CIA**	**External**	**Total**
		5	-	--	5	25	75	100

Pre-Requisites

- Thorough understanding of electromagnetic spectrum, mathematical abilities, knowledge of molecules, their structure, bond nature, physical and chemical behaviour

Learning Objectives

- To comprehend the theory behind different spectroscopic methods
- To know the working principles along with an overview of construction of different types of spectrometers involved
- To explore various applications of these techniques in R &D.
- Apply spectroscopic techniques for the qualitative and quantitative analysis of various chemical compounds.
- Understand this important analytical tool

UNITS	Course Details	No. of Periods for the Unit
I	**MICROWAVE SPECTROSCOPY** Rotational spectra of diatomic molecules - Rigid Rotor (Diatomic Molecules)-reduced mass – rotational constant - - Effect of isotopic substitution - Non rigid rotator – centrifugal distortion constant- Intensity of Spectral Lines- Polyatomic molecules – linear – symmetric asymmetric top molecules.	**15**
II	**INFRA-RED SPECTROSCOPY** Vibrations of simple harmonic oscillator – zero-point energy- Anharmonic oscillator – fundamentals, overtones and combinations- Diatomic Vibrating Rotator- P,R branch – P,Q,R branch- Fundamental modes of vibration of H_2O and CO_2 -Introduction to application of vibrational spectra- IR Spectrophotometer Instrumentation (Double Beam Spectrometer) – Fourier Transform Infrared Spectroscopy.	**15**
III	**RAMAN SPECTROSCOPY** Theory of Raman Scattering - Classical theory – molecular polarizability – polarizability ellipsoid - Quantum theory of Raman effect - rotational Raman spectra of linear molecule - symmetric top molecule – Stokes and anti-stokes line- S,R branch -Raman activity of H_2O and CO_2 .Mutual exclusion principle- determination of N_2O structure -Instrumentation technique and block diagram.	**15**
IV	**RESONANCE SPECTROSCOPY** Nuclear and Electron spin-Interaction with magnetic field - Population of Energy levels - Larmor precession- Relaxation times - Double resonance- Chemical shift and its measurement - NMR of Hydrogen nuclei - Indirect Spin -Spin Interaction – interpretation of simple organic molecules - Instrumentation techniques of NMR spectroscopy. Electron Spin Resonance: Basic principle –Total Hamiltonian (Direct Dipole-Dipole interaction and Fermi Contact Interaction) – Hyperfine Structure (Hydrogen atom) – ESR Spectra of Free radicals –g-factors – Instrumentation.	**15**

V	**UV SPECTROSCOPY** Origin of UV spectra - Laws of absorption – Lambert Bouguer law – Lambert Beer law - molar absorptivity – transmittance and absorbance - Color in organic compounds- Absorption by organic Molecule -Chromophores -Effect of conjugation on chromophores - Choice of Solvent and Solvent effect - Absorption by inorganic systems - Instrumentation - double beam UV-Spectrophotometer - Simple applications	**15**

TEXT BOOKS	
1	C N Banwell and E M McCash, 1994, Fundamentals of Molecular Spectroscopy, 4th Edition, Tata McGraw–Hill, New Delhi.
2	G Aruldhas, 1994, Molecular Structure and Molecular Spectroscopy, Prentice–Hall of India, New Delhi.
3	D.N. Satyanarayana, 2001, *Vibrational Spectroscopy and Applications*, New Age International Publication.
4	B.K. Sharma, 2015, *Spectroscopy*, Goel Publishing House Meerut.
5	Kalsi.P.S, 2016, Spectroscopy of Organic Compounds (7^{th} Edition), New Age International Publishers.
REFERENCE BOOKS	
1	J L McHale, 2008, Molecular Spectroscopy, Pearson Education India, New Delhi.
2	J M Hollas, 2002, Basic Atomic and Molecular Spectroscopy, Royal Society of Chemistry, RSC, Cambridge.
3	B. P. Straughan and S. Walker, 1976, Spectroscopy Vol. I, Chapman and Hall, New York.
4	K. Chandra, 1989, Introductory Quantum Chemistry, Tata McGraw Hill, New Delhi.
5	Demtroder. W, Laser Spectroscopy: Basic concepts and Instrumentation, Springer Link.
WEB SOURCES	
1	https://www.youtube.com/watch?v=0iQhirTf2PI
2	https://www.coursera.org/lecture/spectroscopy/introduction-3N5D5
3	https://www.coursera.org/lecture/spectroscopy/infrared-spectroscopy-8jEee
4	https://onlinecourses.nptel.ac.in/noc20_cy08/preview
5	https://www.coursera.org/lecture/spectroscopy/nmr-spectroscopy-introduction-XCWRu

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Understand fundamentals of rotational spectroscopy, view molecules as elastic rotors and interpret their behaviour. Able to quantify their nature and correlate them with their characteristic properties.
CO2	Understand the working principles of spectroscopic instruments and theoretical background of IR spectroscopy. Able to correlate mathematical process of Fourier transformations with instrumentation. Able to interpret vibrational spectrum of small molecules.
CO3	Interpret structures and composition of molecules and use their knowledge of Raman Spectroscopy as an important analytical tool
CO4	Use these resonance spectroscopic techniques for quantitative and qualitative estimation of a substances
CO5	Learn the electronic transitions caused by absorption of radiation in the UV/Vis region of the electromagnetic spectrum and be able to analyze a simple UV spectrum.

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) and LOW (1)**.**

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	3	3	3	2	3	3	3	3	3	2
CO2	2	2	2	3	3	3	3	3	3	2
CO3	3	2	3	3	3	3	3	3	3	3
CO4	3	2	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**	**PSO10**
CO1	3	3	3	2	3	3	3	3	3	2
CO2	2	2	2	3	3	3	3	3	3	2
CO3	3	2	3	3	3	3	3	3	3	3
CO4	3	2	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3

Title of the Course		**NUMERICAL METHODS AND COMPUTER PROGRAMMING**						
Part		**A**						
Category	Core 12	**Year**	II	**Credits**	4	**Course Code**	**232104403**	
		Semester	IV					
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**	**CIA**	**External**	**Total**
		5	--	--	5	25	75	100

Pre-Requisites

Prior knowledge on computer and basic mathematics

Learning Objectives

- ✍ To make students to understand different numerical approaches to solve a problem.
- ✍ To understand the basics of programming

Course Details		**No. of Periods for the Unit**
UNIT I:	**SOLUTIONS OF EQUATIONS** Zeros or Roots of an equation - Non-linear algebraic equation and transcendental equations - Zeros of polynomials –Roots of polynomials, nonlinear algebraic equations and transcendental equations using Bisection and Newton-Raphson methods – Convergence of solutions in Bisection and Newton-Raphson methods – Limitations of Bisection and Newton-Raphson methods.	**15**
UNIT II:	**LINEAR SYSTEM OF EQUATIONS** Simultaneous linear equations and their matrix representation– Inverse of a Matrix – Solution of simultaneous equations by Matrix inversion method and its limitations – Gaussian elimination method.	**15**
UNIT III:	**INTERPOLATION AND CURVE FITTING** Interpolation with equally spaced points - Newton forward and backward interpolation - Interpolation with unevenly spaced points - Lagrange interpolation – Curve fitting – Method of least squares – Fitting a polynomial.	**15**
UNIT IV:	**DIFFERENTIATION, INTEGRATION AND SOLUTION OF DIFFERENTIAL EQUATIONS** Numerical differentiation – Numerical integration – Trapezoidal rule – Simpson's rule – Error estimates – Gauss-Legendre, Gauss-Laguerre – solution of ordinary differential equations – Euler and Runga Kutta methods.	**15**
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) Newton's forward and backward interpolation, Lagrange Interpolation, (d) Trapezoidal and Simpson's Rules, (e) Solution of first order differential equations by Euler's method.	**15**

TEXT BOOKS	
1	V. Rajaraman, 1993, Computer oriented Numerical Methods, 3rd Edition. PHI, New Delhi

2	M. K .Jain, S. R. Iyengar and R. K. Jain, 1995, Numerical Methods for Scientific and Engineering Computation, 3rd Edition, New Age Intl., 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 Univ. Press
REFERENCE BOOKS	
1	S. D. Conte and C. de Boor, 1981, Elementary Numerical analysis-an algorithmic approach, 3rd 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.
5	V. Rajaraman, Programming in FORTRAN / Programming in C, PHI, New Delhi
WEB RESOURCES	
1	https://www.scribd.com/doc/202122350/Computer-Oriented-Numerical-Methods-by-V-RajaRaman
2	https://www.scirp.org/(S(lz5mqp453edsnp55rrgjct55))/reference/referencespapers.aspx?referenceid=1682874
3	https://nptel.ac.in/course/122106033/
4	https://nptel.ac.in/course/103106074/
5	https://onlinecourses.nptel.ac.in/noc20_ma33/preview

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Recall the transcendental equations and analyze the different root finding methods. Understand the basic concept involved in root finding procedure such as Newton Raphson and Bisection methods, their limitations.
CO2	Relate Simultaneous linear equations and their matrix representation Distinguish between various methods in solving simultaneous linear equations.
CO3	Understand, how interpolation will be used in various realms of physics and Apply to some simple problems Analyze the newton forward and backward interpolation
CO4	Recollect and apply methods in numerical differentiation and integration. Assess the trapezoidal and Simson's method of numerical integration.
CO5	Understand the basics of C-programming and conditional statements.

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) and LOW (1)**.**

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	3	2	3	1	1	2	3	2	2	3
CO2	3	2	3	1	1	2	3	2	2	3
CO3	3	2	3	1	1	2	3	2	2	3
CO4	3	2	3	1	1	2	3	2	2	3
CO5	3	2	3	1	1	2	3	2	2	3

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**	**PSO10**
CO1	3	2	3	1	1	2	3	2	2	3
CO2	3	2	3	1	1	2	3	2	2	3
CO3	3	2	3	1	1	2	3	2	2	3
CO4	3	2	3	1	1	2	3	2	2	3

CO5	3	2	3	1	1	2	3	2	2	3

Title of the Course		**PRACTICAL IV**						
Part		**A**						
Category	EC - 6	**Year**	II	**Credits**	3	**Course Code**	**232104404**	
		Semester	IV					
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**	**CIA**	**External**	**Total**
		--	--	6	6	25	75	100

Pre-Requisites

Fundamentals of digital principles

Learning Objectives

- To understand the theory and working of Microprocessor, Microcontroller and their applications
- To use microprocessor and Microcontroller in different applications

Course Details

Practical IV:
(ANY EIGHT EXPERIMENTS)

1. 8-bit addition and subtraction, multiplication and division
2. Sum of a set of N data (8-bit number), picking up the smallest and largest number in an array. Sorting in ascending and descending order
3. Code conversion (8-bit number): a) Binary to BCD b) BCD to binary
4. Addition of multi byte numbers, Factorial
5. Clock program- 12/24 hours-Real time application – Six Digits Hexa Decimal and Decimal Counters
6. Interfacing of LED – Binary up/down counter, BCD up/down counter and N/2N up/down counter
7. Interfacing of seven segment display
8. Interfacing of 8-bit R / 2R ladder DAC (IC 741) – Wave form generation – Square, Rectangular, Triangular, Saw tooth and Sine waves
9. DAC 0800/ DAC 1048 interface and wave form generation (Unipolar/ Bipolar output)
10. ADC 0809 interface
11. Interfacing of DC stepper motor – Clockwise, Anti-clockwise, Angular movement and Wiper action
12. Interfacing of Temperature Controller and Measurement
13. Water level detector
14. Elevator
15. Traffic Light Controller
16. Key board Interface
17. Addition, Subtraction, Multiplication and Division of 8-bit numbers.
18. Sum of a series of 8-bit numbers
19. Average of N numbers
20. Factorial of number
21. Fibonacci series of N terms
22. Multi byte Addition / Subtraction Sorting
23. g in ascending and descending order – Picking up smallest and largest number
24. LED interface – Binary up/down counter, BCD up/down counter, Ring and twisted ring counter.
25. Interfacing seven segment displays
26. DAC 0800 / 1408 interface and wave form generation
27. ADC interfacing
28. Stepper motor interfacing
29. Temperature controller and Measurements
30. Traffic light controller

TEXT BOOKS	
1	Douglas V. Hall, Microprocessors and Interfacing programming and Hardware, Tata Mc Graw Hill Publications (2008)
2	Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D. Mckinlay, The 8051 Microcontroller and Embedded Systems, Pearson Education (2008).
3	V. Vijayendran, 2005, Fundamentals of Microprocessor-8085", 3rd Edition S. Visvanathan Pvt, Ltd.
4	The 8085 Microprocessor, Architecture, Programming and Interfacing – K. Udaya Kumar, S. Uma Shankar, Pearson
5	Fundamentals of Microprocessors and Microcontrollers - B. Ram, Dhanpat Rai Publications
REFERENCE BOOKS	
1	W. A. Tribel, Avtar Singh, "The 8086/8088 Microprocessors: Programming, Interfacing, Software, Hardware and Applications", Prentice-Hall of India, New Delhi.
2	Microprocessor and Its Application - S. Malarvizhi, Anuradha Agencies Publications
3	Microprocessor Architecture, Program And Its Application With 8085 - R.S. Gaonkar, New Age International (P) Ltd
4	Barry B. Brey, 1995, The Intel Microprocessors 8086/8088, 80186, 80286, 80386 and 80486, 3rd Edition, Prentice- Hall of India, New Delhi.
5	J. Uffrenbeck, "The 8086/8088 Family-Design, Programming and Interfacing, Software, Hardware and Applications", Prentice-Hall of India, New Delhi.

COURSE OUTCOMES:
At the end of the course, the student will be able to:

CO1	Develop the programming skills of Microprocessor
CO2	Appreciate the applications of Microprocessor programming
CO3	Understand the structure and working of 8085 microprocessor and apply it.
CO4	Acquire knowledge about the interfacing peripherals with 8085 microprocessor.
CO5	Acquire knowledge about the interfacing 8051 microcontroller with various peripherals.

MAPPING WITH PROGRAM OUTCOMES:
Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) and LOW (1)**.**

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	2	2	2	3	3	2	2	1	3	2
CO2	2	1	3	3	3	2	2	1	3	2
CO3	3	3	1	3	3	2	2	1	3	2
CO4	3	3	3	3	3	2	2	1	3	2
CO5	3	3	3	3	3	2	2	1	3	2

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**	**PSO10**
CO1	2	2	2	3	3	2	2	1	3	2
CO2	2	1	3	3	3	2	2	1	3	2
CO3	3	3	1	3	3	2	2	1	3	2
CO4	3	3	3	3	3	2	2	1	3	2
CO5	3	3	3	3	3	2	2	1	3	2

Title of the Course		**Project with Viva Voce**						
Part		**A**						
Category	Core 13	**Year**	II	**Credits**	3	**Course Code**	**232104405**	
		Semester	IV					
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**	**CIA**	**External**	**Total**
		4	-	--	4	25	75	100

Students have to carry out project works under the guidance of the members of the Physics Department during III and IV semesters 3 hours per week. Each batch may be chosen in the fields of theoretical physics, spectroscopy, electronics, crystallography, thin films and Nanomaterials. Each batch will complete the project work in the month of March and submit their report.

It will be duly signed by the project guide and Head of the Department of Physics. The Viva on project will be conducted during the practical examination at the end of IV semester.

	Internal	External
Project	15	50
Viva	10	25
Total	25	75

Title of the Course		**PHYSICS OF NANOSCIENCE AND TECHNOLOGY**						
Part		**B**						
Category	SEC- IV	**Year**	II	**Credits**	2	**Course Code**	**232104406**	
		Semester	IV					
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**	**CIA**	**External**	**Total**
		2	-	--	2	25	75	100

Learning Objectives

- Physics of Nanoscience and Technology is concerned with the study, creation, manipulation and applications at nanometer scale.
- To provide the basic knowledge about nanoscience and technology.
- To learn the structures and properties of nanomaterials.
- To acquire the knowledge about synthesis methods and characterization techniques and its applications.

UNITS	**Course Details**	**No. of Periods for the Unit**
UNIT 1:	**FUNDAMENTALS OF NANOSCIENCE AND TECHNOLOGY** Fundamentals of NANO – Historical Perspective on Nanomaterial and Nanotechnology -– Classification of Nanomaterials – Metal and Semiconductor Nanomaterials - 2D, 1D, 0D nanostructured materials - Quantum dots – Quantum wires – Quantum wells - Surface effects of nanomaterials.	**6**
UNIT II:	**PROPERTIES OF NANOMATERIALS** Physical properties of Nanomaterials: Melting points, specific heat capacity, and lattice constant - Mechanical behavior: Elastic properties – strength - ductility - superplastic behavior - Optical properties: - Surface Plasmon Resonance – Quantum size effects - Electrical properties - Conductivity, Ferroelectrics and dielectrics - Magnetic properties – super para magnetism – Diluted magnetic semiconductor (DMS).	**6**
UNIT III:	**SYNTHESIS AND FABRICATION** Physical vapour deposition - Chemical vapour deposition - sol-gel – Wet deposition techniques - electrochemical deposition method – Plasma arching - Electrospinning method - ball milling technique - pulsed laser deposition - Nanolithography: photolithography – Nanomanipulator.	**6**
UNIT IV:	**CHARACTERIZATION TECHNIQUES** Powder X-ray diffraction – X-ray photoelectron spectroscopy (XPS) - UV-visible spectroscopy – Photoluminescence - Scanning electron microscopy (SEM) - Transmission electron microscopy (TEM) - Scanning probe microscopy (SPM) - Scanning tunneling microscopy (STM) – Vibrating sample Magnetometer	**6**
UNIT V:	**APPLICATIONS OF NANOMATERIALS** Sensors: Nanosensors based on optical and physical properties - Electrochemical sensors – Nano-biosensors. Nano Electronics: Nanobots - display screens - GMR read/write heads - Carbon Nanotube Emitters – Photocatalytic application: Air purification, water purification -Medicine: Imaging of cancer cells – biological tags - drug delivery - photodynamic therapy - Energy: fuel cells - rechargeable batteries - supercapacitors - photovoltaics.	**6**

TEXT BOOKS

1	A textbook of Nanoscience and Nanotechnology, Pradeep T., Tata McGraw-Hill Publishing Co. (2012).
2	Principles of Nanoscience and Nanotechnology, M.A. Shah, Tokeer Ahmad, Narosa Publishing House Pvt Ltd., (2010).

3	Introduction to Nanoscience and Nanotechnology, K. K. Chattopadhyay and A.N. Banerjee, PHI Learning Pvt. Ltd., New Delhi, (2012).

4	Nanostructured Materials and Nanotechnology, Hari Singh Nalwa, Academic Press, (2002).
5	Nanotechnology and Nanoelectronics, D.P. Kothari, V. Velmurugan and Rajit Ram Singh, Narosa Publishing House Pvt. Ltd, New Delhi. (2018)
	REFERENCE BOOKS
1	Nanostructures and Nanomaterials – Huozhong Gao – Imperial College Press (2004).
2	Richard Booker and Earl Boysen, (2005) Nanotechnology, Wiley Publishing Inc. USA
3	Nano particles and Nano structured films; Preparation, Characterization and Applications, J. H. Fendler John Wiley and Sons. (2007)
4	Textbook of Nanoscience and Nanotechnology, B. S. Murty, et al., Universities Press. (2012)
5	The Nanoscope (Encyclopedia of Nanoscience and Nanotechnology), Dr. Parag Diwan and Ashish Bharadwaj (2005) Vol. IV - Nanoelectronics Pentagon Press, New Delhi.
	WEB SOURCES
1	www.its.caltec.edu/feyman/plenty.html
2	http://www.library.ualberta.ca/subject/nanoscience/guide/index.cfm
3	http://www.understandingnano.com
4	http://www.nano.gov
5	http://www.nanotechnology.com

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1	Understand the basic of nanoscience and explore the different types of nanomaterials and should comprehend the surface effects of the nanomaterials.
CO2	Explore various physical, mechanical, optical, electrical and magnetic properties nanomaterials.
CO3	Understand the process and mechanism of synthesis and fabrication of nanomaterials.
CO4	Analyze the various characterization of Nano-products through diffraction, spectroscopic, microscopic and other techniques.
CO5	Apply the concepts of nanoscience and technology in the field of sensors, robotics, purification of air and water and in the energy devices.

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) and LOW (1)**.**

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	3	3	3	2	1	1	3	3	3	3
C02	3	3	3	2	1	1	3	3	3	3
CO3	3	3	2	2	1	1	3	3	3	3
CO4	3	3	3	2	1	1	3	3	3	3
CO5	3	3	2	2	1	1	3	3	3	3

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**	**PSO10**
CO1	3	3	3	2	1	1	3	3	3	3
CO2	3	3	3	2	1	1	3	3	3	3
CO3	3	3	2	2	1	1	3	3	3	3
CO4	3	3	3	2	1	1	3	3	3	3
CO5	3	3	2	2	1	1	3	3	3	3

Title of the Course		**APTITUDE, REASONING, COMPREHENSION AND NUMERICAL ABILITY**						
Part		**A**						
Category	AECC - 4	**Year**	II	**Credits**	2	**Course Code**	**232104407**	
		Semester	IV					
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**	**CIA**	**External**	**Total**
		2	-	--	2	25	75	100

Learning Objectives

- ✍ To prepare students for facing competitive examinations like UPSC / TNPSC
- ✍ To help students aspiring for CSIR UGC NET / SET with their preparation for• General Aptitude paper.

UNITS	**Course Details**	**No. of Periods for the Unit**
I	**Mathematical Reasoning and Aptitude** Types of reasoning - Number series, Letter series, Codes and relationships - Mathematical Aptitude (Fraction, Time & Distance, Ratio, Proportion and Percentage, Profit and Loss, Interest and Discounting, Averages etc.)	**6**
II	**Logical Reasoning** Understanding the structure of arguments: argument forms, structure of categorical propositions, Mood and Figure, Formal and Informal fallacies, Uses of language, Connotations and denotations of terms, Classical square of opposition - Evaluating and distinguishing deductive and inductive reasoning – Analogies - Venn diagram: Simple and multiple use for establishing validity of arguments	**6**
III	**Data Interpretation** Sources, acquisition and classification of data - Quantitative and qualitative data - Graphical representation (Bar-chart, Histograms, Pie-chart, Table-chart and Line-chart) and mapping of data - Data Interpretation.- Data and governance.	**6**
IV	**Reading Comprehension**	**6**
V	**Information and Communication Technology (ICT)** ICT**:** General abbreviations and terminology - Basics of Internet, Intranet, E-mail, audio and video conferencing - Digital initiatives in higher education - ICT and Governance.	**6**

TEXT BOOKS

Madaan K V S, NTA UGC NET | SET | JRF 2023 – Teaching and Research Aptitude (Paper – 1), 7th Edition, Pearson Education (2023)

WEB SOURCES

1. https://byjusexamprep.com/ugc-net/ugc-net-paper-1-preparation-strategy#toc-2
2. https://www.udemy.com/course/ugc-net-paper1-course-bundle/

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1	Analyze number series and letter series and predict sequences and solve problems demonstrating numerical ability.
CO2	Demonstrate deductive and inductive reasoning to arguments and identify fallacies in arguments
CO3	Interpret and analyze data represented in graphs / charts / tables.
CO4	Comprehend passages and answer questions linking their existing knowledge with the given reading content.
CO5	Understand the role of ICT and appreciate ICT initiatives in higher education.
K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate;	

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) and LOW (1)**.**

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	1	2	3	2	3	2
CO2	2	2	3	3	2	2
CO3	3	3	3	3	3	3
CO4	1	1	1	1	1	3
CO5	1	1	1	1	1	3

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	1	2	3	2	3
CO2	1	3	3	2	2
CO3	1	3	3	3	1
CO4	1	1	2	3	1
CO5	1	1	1	1	2

EXTENSION ACTIVITY

Course Code: 232104408
Credit: 1

The Students should undergo any of the following activities during the period of the program (Two Years) outside the college or in any other institutions. This Extension Activity will be evaluated through the certificate (minimum one) submitted by the students. As per the norms, students must carry out any one of the activity for obtaining the PG Degree. The concern Head of the Department will evaluate the students and submit the report to the Controller of Examinations at the end of the IV semester.

List of Extension Activity:

a) Conducting rally, awareness program etc.

b) Seed ball, tree plantation, cleaning work etc.

c) Blood donation, medical camp, organ donation etc.

d) Assisting school children, tribal, and illiterate in learning.

e) Giving assistance to orphanages and old age homes and patients.

f) Awareness program on financial literacy, gender equality, women education etc.

Any other activities which are relevant to develop nearby localities.