PH.D. PROGRAMME

(PHYSICS)

SYLLABUS

2023- 2024 ONWARDS

List of Papers

Semester	Course	Sub. No	Sub Code	Subject Name
1	I	101	RCW001	RESEARCH METHODOLOGY
1	II	102	RCW002	RESEARCH AND PUBLICATION ETHICS
2	III	103	RCW003	INSTRUMENTATION
2	IV	104	RCW004	NANOSCIENCE AND APPLICATIONS
2	IV	105	RCW004	APPLIED SPECTROSCOPY
2	IV	106	RCW004	MATERIALS SCIENCE
2	IV	107	RCW004	CHEMICAL PHYSICS
2	IV	108	RCW004	ULTRASONICS
2	IV	109	RCW004	BIOPHYSICS

Semester	Course	Sub. No	Sub Code	Subject Name
1	I	101	RCW001	RESEARCH METHODOLOGY

Objectives:

- To give proper perception on research, its function, identification and design of research problems.
- To provide the scientific methods of analyzing the data and its presentation technique.
- To nurture about scientific writing, presentation and thesis writing.

UNIT- I : Meaning and function of research

Meaning of research - function of research - characteristics of research - steps involved in research - research in pure and applied science - inter disciplinary research. Factors which hinder research - significance of research - research and scientific methods - research process - criteria of good research - problems encountered by researchers - Literature review.

UNIT- II : Identification of research problem and research design

Selecting the research problem - necessity of defining the problem - goals and criteria for identifying problems for research. Perception of research problem - techniques involved in defining the problem - source of problems - personal consideration.

Formulation of research design - need for research design - features of a good design - Important concepts related to research design. Different research design - Basic principles of experimental designs - Computer and internet in designs.

UNIT- III : Scientific data analysis

Basic concepts and definitions on data and error - various types of data and their error - Propagation of error - four steps to a meaningful experimental results. Basic statistical concepts - best estimate of true Chi-squared test for goodness of fit - criteria for goodness of fit. Graphical representation – equation - functional relationships - sequential differences method of extended differences - method of least squares. Analysis and interpretation using MS-XLS and origin.

UNIT- IV : Scientific Communication

Preface – contents - writing of thesis - format of a thesis - acknowledgement - abstract – introduction - review of literature - formulation - writing methods – results - preparation of tables - figures - writing discussion - conclusion - summary and synopsis – reference - citing and listing bibliography - research ethics and plagiarism.

UNIT- V : Introduction to patent laws

Definition of intellectual property - patent and publications - National and international patent - science innovation parts - products development - consultancy - scaling up of products - copyrights and cyber laws.

Text Books:

1. Research Methodology Methods & Techniques, C.R. Kothari, New Age International Publishers, 2008.
2. Statistical Methods, G.W. Snedecor and W.G. Cochrans, Lowa state University Press, 1967.
3. Research in Education, John W. Best, McGraw Hill, 1986.
4. A First course in Numerical Analysis, Anthony Rabston, McGraw Mill Co., New York, 1965
5. Introduction methods of Numerical analysis, S.S. Sastry, Prentice Hall of India Pvt. Ltd., 1977.
6. Mathematical Physics, AK Ghatak, IC Goyal & SJ Chua Macmillan, New Delhi, 2002

Reference Books:

1. A Hand Book of Methodology of Research, Rajammal, P. Devadas and K. Kulandaivel, RMM Vidyalaya press, 1976.
2. Thesis and Assignment Writing, J. Anderson, Wiley Eastern Ltd., 1997.
3. Research Methodology, Mukul Gupta, Deepa Gupta – PHI Learning Private Ltd., New Delhi, 2011.
4. Fundamentals of Mathematical statistics, S.C. Gupta and V.K. Kapoor, Sultan Chand & Sons, New Delhi, 1999.
5. How to write and publish a Scientific paper - Robert A. Day and Barbara Gastel- VII- Edition
6. Numerical Analysis and algorithm, E.V. Krishnamurthy, Wiley Eastern, 1982.

Semester	Course	Sub. No	Sub Code	Subject Name
1	II	102	RCW002	RESEARCH AND PUBLICATION ETHICS

Objectives:

- To impart knowledge on research ethics, academic conduct and Integrity.
- To sensitize the scholars about their responsibilities to science, society and eco system.
- To equip the scholars with techniques and skills to avoid ethical misconduct.
- To provide hands on experience in the use various software tools in research and publication process.
- To acquaint participants with tools and techniques popularly utilized for ensuring academic standards, avoiding plagiarism and promoting high impact publication.

Unit – I PHILOSOPHY, ETHICS & SCIENTIFIC CONDUCT

Introduction to philosophy - definition, nature and scope, concept, branches – Ethics - definition, moral philosophy, nature of moral judgments and reactions - Ethics with respect to science and research - Intellectual honesty and research integrity - Scientific misconducts - Falsification, Fabrication and Plagiarism (FFP) - Redundant Publications - duplicate and overlapping publications, salami slicing - Selective reporting - misrepresentation of data.

Unit -II PUBLICATION ETHICS

Publication ethics - definition, introduction and importance - Best practices/standard setting initiatives and guidelines - COPE, WAME, etc. - Conflict of Interest - Publication misconduct - definition, concept, problems that lead to unethical behaviour and vice versa - types violation of publication ethics, complaints and appeals Identification of publication misconduct, complaints and appeals - Predatory publication and journals

Unit - III OPEN ACCESS PUBLISHING

Open access publication and initiatives - SHERPA/RoMEO Online resource to check publisher - copyright & self-archiving policies - Software tool to identify predatory publications developed by SPPU - Journal finder/journal suggestion tool viz. JANE, Elsevier, Journal Finder, Springer Journal Suggestion, etc.

Unit – IV PUBLICATION MISCONDUCT

Group Discussions - Subject specific ethical issues, FFP, authorship - Conflicts of interest - Complaints and appeals - examples and fraud from India and abroad Software tools - Use of plagiarism software like Turnitin, Urkund and other open source software tools.

Unit – V DATABASES AND RESEARCH METRICS

Databases - Indexing databases - Citation databases - Web of Science, Scopus, etc., Research Metrics (Journal) - Impact Factor of journal as per Journal Citation Report, SNIP, SIR, IPP, Cite Score - Research Metrics (Author) – Metrics - h-Index, i10 index, altmetrics

Semester	Course	Sub. No	Sub Code	Subject Name
2	III	103	RCW003	INSTRUMENTATION

Objectives:

- To highlight the concept of instrumentation
- To familiarize the functioning and applications of various analytical instruments

UNIT - I : XRD and microscopic instrumentation

Principle and instrumentation of X-ray Diffractometer (XRD) - Field Emission Scanning Electron Microscopy (FE-SEM) with EDAX - High Resolution Transmission Electron Microscopy (HRTEM) and Atomic force microscopy.

UNIT - II : Thermal instrumentation

Principle and instrumentation of Thermogravimetry – Differential thermal analysis (TG-DTA), Differential scanning calorimetry (DSC), Inductively coupled plasma atomic emission spectroscopy (ICP-AES), Inductively coupled plasma mass spectrometry (ICP-MS).

UNIT- III : Analytical instrumentation

Principle and instrumentation of Fourier transform infrared spectroscopy (FTIR), Fourier transform Raman spectroscopy (FT-Raman), Ultraviolet spectroscopy (UV), Photoluminescence spectroscopy (PL), X-ray photoelectron spectroscopy (XPS).

UNIT- IV : Magnetic instrumentation

Principle and instrumentation of Nuclear magnetic resonance **(**NMR), Electron spin resonance spectroscopy (ESR), Vibrating sample magnetometer (VSM), Squid magnetometer - hall effect, four probe - IV characteristics.

UNIT- V: Sophisticated analytical instrumentation

Brunauer-Emmett-Teller (BET), Gas sensor, cyclic voltammetry (CV), Galvanostatic charge/discharge analysis (GCD), electrochemical impedance spectroscopy (EIS), Solar cell and fuel cell.

Text Books

1. Instrumental methods of analysis, H. Willard, D. Merrit, A. Dean and A. Settle, CBS Publishers, 2004
2. An Introduction to Surface Analysis by XPS and AES, John F. Watts, John Wolstenholme, wiley and sons, Ltd., 2003
3. Principles of Instrumental Analysis Doughs A.Skoog, F. James Holler and stanely R. crouch, Cengage publishing.
4. "Cyclic Voltammetry," Kissinger, P. T., Heineman, W. R., Journal of Chemical Education, 60, 702 (1983)

5. Atomic Force Microscopy: Understanding the Basic Modes and Advanced Applications, Greg Haugstad,2012.
6. Fourier Transform infrared spectrometry by Peter R. Griffiths, James A. De Haseth John Wiley & Sons, 2007

Reference Books:

1. Handbook of Analytical Instruments, R.S. Khandpur, Tata McGraw - Hill Publishers Company Ltd, 2007.
2. Instrumental methods of analysis, Gurdeep Chatwal and Sham Anand, Himalaya Publishers, 2003.

Semester	Course	Sub. No	Sub Code	Subject Name
2	IV	104	RCW004	NANOSCIENCE AND APPLICATIONS

Objectives:

- To provide a deep knowledge on various synthesis techniques
- To develop skill in characterization of the materials
- To impart knowledge on Energy storage and Conversion, Sensor and Drug Delivery

UNIT- I: Synthesis of nanomaterials

Introduction to nanomaterials - different types of synthesis methods – PVD – sputtering - ball milling - CVD - co-precipitation - sol-gel method - hydrothermal/solvothermal - microwave assisted synthesis – green synthesis – microbial - waste biomass synthesis.

UNIT- II : Structural and morphological analysis

Determination of lattice parameters - JCPDS card, crystallite size (Scherrer, W-H method), microstrain - X-ray density – FESEM and HRTEM morphology - size determination using image J-software histogram - SAED pattern - elemental morphology - TG-DTA - exothermic-endothermic reaction - mass loss calculation - temperature stability - phase changes.

UNIT- III: Properties of nanostructured materials

UV-VIS - absorption - reflection - transmission - bandgap – Tauc plot - Kubelka-Munk method - formation of excitation wavelength - PL emission and its interpretation with example - FTIR - functional groups and their wave number range - FT-Raman analysis with different modes

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UNIT- IV : Electrochemical characterisation

Cyclic Voltammetry – electrode preparation – electrolytes - redox reactions - specific capacitance – chronopotentiometry - electrochemical impedance spectroscopy - parameters derived from EIS - Nyquist plot - cycle stability - device fabrication.

UNIT- V: Energy storage materials

Renewable energy resources - solar cells - principle and types of solar cells - the photovoltaic effect - dye sensitized solar cell - efficiency measurements - applications of solar cells.

Fuel cells - principles of fuel cell - types of fuel cells and its components - difference between batteries and fuel cells - fuel cell thermodynamics - heat - work potentials - prediction of reversible voltage - reduction and oxidation - application of fuel cells.

Text books

1. An introduction to nanoscience and nanotechnology – Alain Novailhat, Wiley & Sons, 2008.
2. Chemistry of nanomaterials, synthesis, properties and applications, C.N.R. Rao.
3. Nanotechnologies principle, applications, implications and hands-on activities Luisa Filippani and Duncan Sutherland
4. Nanoparticles: From the theory to applications, Gunter Schmid, Wiley & Sons,2010.
5. Analytical electrochemistry, Joseph Wang, Wiley & Sons , 2000.

References Books

1. Elements of X-ray diffraction, B. D. Cullity Addison- Wesley Publishers. 1977
2. Fuel cell fundamentals, Ryan O'ttayre and Suk-Won cha, Wiley & Sons, Third edition.
3. Nanoparticle Technology Handbook, Masuo Hosokawa, Kiyoshi Nogi, Makio Naito, Toyokazu Yokoyama Elsevier Publishers. 2007.

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Semester	Course	Sub. No	Sub Code	Subject Name
2	IV	105	RCW004	APPLIED SPECTROSCOPY

Objectives:

- To impart knowledge in the field of spectroscopy.
- To educate the students about the fundamental aspects of Rotational and Vibrational Spectroscopy.
- To impart knowledge regarding the fundamental aspects of Resonance Spectroscopy.
- To expose the Students to the effective applications of various Molecular Spectroscopic techniques to study the Chemical and Structural properties of materials.
- To gain the basic knowledge in theoretical spectroscopy.

Unit-I: Data analysis

Line shapes in Spectroscopy: Lorentzian and Gaussian - Fitting of the spectra (curve fitting) - Deconvolution of spectrum - Derivative Peak shapes - software techniques.

Resolution of spectrometer - Resolving Power and factors influencing it - Sensitivity - Accuracy - static and dynamic errors.

Unit-II: UV/Visible and Fluorescence Spectroscopy

UV-Visible: Principle, theory and experimental techniques - study of molecular structure. Fluorescence: Principle - Instrumentation – Microprocessor based Spectrofluorimeter - sample preparation - applications.

Unit-III: Vibrational and Rotational Spectroscopy

Infrared spectroscopy: principle and theory- mode of vibrations of atom in polyatomic molecules, Instrumentation: FTIR spectrophotometer - Attenuated Total Reflectance (ATR) - Applications. Raman spectroscopy: Raman effect-observation of Raman spectra - classical and Quantum theory of Raman effect - vibration Raman spectra - pure rotational Raman spectra - Vibrational rotational Raman spectra – CARS – SERS - Applications.

Unit-IV: Resonance Spectroscopy

Electron Spin Resonance: Theory - Hyperfine structure - Fine structure - Instrumentation of ESR Spectrometer- applications.

Nuclear Magnetic Resonance: Theory - Chemical shift - Relaxation mechanisms - Instrumentation - FT-NMR and applications

NQR Spectroscopy: principle, Instrumentation and applications.

Mossbauer spectroscopy: Theory - Chemical Isomer shift - Quadrupole splitting - Instrumentation and applications.

Unit-V: Theoretical Spectral Studies

Hartree's Theory -Orbital energy and Total energy – Hartree - Fock Self Consistent Field Theory (HFSCF) - Slater Type Orbital (STO) - Roothan's method - Electron correlation and configuration interaction - Koopman's theorem - Density functional theory (DFT). Software – Gaussian – AutoDock - Applications

Text books

1. Quantitative Analysis, Day R.A and Underwood A. L. Pearson education India, 6th Edition, 2015.
2. Handbook of Analytical Instruments, R. S. Khandpur, McGraw Hill Education (India) private Limited, 2015.
3. Molecular Spectra and Structure (Vol. I-III), G. Herzberg - D.Van Nostard Company, 3rd edition, 1996.
4. Introduction to IR and Raman Spectroscopy, B. Norman Colthup, H. Lawrence Daly and E. Stephen Wiberly, Academic press, 1990.
5. Nuclear Magnetic Resonance, E. R. Andrew, Cambridge University Press, 2009.

Reference Books

1. Characterization of Materials, John B. Watchman, Butterworth publisher, Heinemann Greenwich, Manning, 1993.
2. Fundamentals of Analytical Chemistry, Skoog and West Holler, Cengage Learning EMEA, 2013
3. Instrumental Methods of Chemical Analysis (Analytical Chemistry), Gurdeep R Chatwal and Sham K. Anand, Himalaya Publishing House, New Delhi, 2018.
4. Instrumental Methods of Analysis, Hobart H. Willard, Lynne L. Merritt, John A. Dean and Frank A. Settle, CBS Publishers & Distributors, New Delhi,7th Edition,2004.
5. Spectroscopy (Vol. 1-3), B.P Straughan and S. Walker, Chapman and Hall, 1976.

Semester	Course	Sub. No	Sub Code	Subject Name
2	IV	106	RCW004	MATERIALS SCIENCE

Objectives:

- To explore the knowledge on preparation of crystals and thin films fabrication.
- To gives a brief knowledge about the magnetic and dielectric materials.
- To analyze the technologies available for preparation of nano materials.
- To develop skill in Renewable Energy Resources.
- To achieve extensive knowledge about energy storage materials used for various applications in terms of its technical competence and economic implications**.**

Unit-I: Crystal Growth

Concept of crystal growth - Nucleation and growth – Crystal growth theory – classical theory – Classification of Crystal growth techniques – Growth by Slow evaporation – Melt growth – Bridgman method and Czochralski pulling technique – Vapour deposition techniques – measurement of micro hardness – Knoop & Vicker's hardness test.

Unit-II: Thin Films

Preparation of thin films: Substrate materials selection and their cleaning method - condensation nucleation and growth - Methods: Solution growth – Vacuum evaporation – Sputtering - Spray pyrolysis and Spin coating – Thickness measurement: weight method and interference technique - Optical properties: band gap - refractive index - electrical properties of thin films using Hall effect and Four Probe method.

Unit-III: Magnetic and Dielectric Materials

Classification of magnetic materials – Influence of temperature on magnetic behaviour – Origin of domain and Hysteresis - VSM technique. Ordinary and anisotropic magneto-resistance, Giant magneto-resistance (GMR): basic properties, mechanism, and applications

Dielectric behaviour, Field vectors and polarization – Types of polarization: electronic, ionic and orientational polarization. Measurement of Dielectric constant - Scherring Bridge method – Determination of dielectric permittivity and loss.

Unit-IV: Nanomaterials

Introduction to nanomaterials - Solids in reduced dimension – Quantum confinement - Surface to volume ratio – Quantum well, Quantum rod, Quantum dots – Carbon Nanotubes -

Nanomaterial preparation - Top down and bottom up approaches for synthesis of nanostructured materials – Physical and Chemical vapour deposition – Sol-gel – Ball milling technique – Ultrasonic precipitate method - Nanocomposites : Metal-Metal, Polymer-Metal - Core-Shell structured nanocomposites - Application of Nanomaterials.

Unit -V: Energy Storage Materials

Renewable Energy Resources – Solar Cells: Principle and Types of Solar Cells – The Photovoltaic Effect - Dye Sensitized Solar Cell - Efficiency Measurements - Applications of Solar Cells.

Fuel Cells: Principles of Fuel Cells - Types of Fuel Cells and its Components – Difference Between Batteries and Fuel Cells – Fuel Cell Thermodynamics - Heat, Work Potentials - Prediction of Reversible Voltage, Reduction and Oxidation –Applications of Fuel Cells.

Text Books

1. Materials Science and Engineering, V.Raghavan, Prentice Hall of India Pvt. Ltd, Third edition, 2015.
2. Thin Film Deposition: Principles and Practice, Donald L. Smith, McGrawHill, 2015..
3. Modern Magnetism, L.Bates, Cambridge University Press, 2011.
4. Springer Handbook of Nanotechnology, Bharath Bhusan, 3rd edition, Springer-Verlag , 2009.
5. Solar Energy Fundamentals and Applications, H.P. Garg, J. Prakash (Tata McGraw-Hill), 2014.

Reference Books

1. Crystal Growth, Brain R. Pamplin, Pergamon Press, Oxford, 2nd Edn., 2010.
2. The Materials Science and Thin Films, Milton Ohring, Academic Press, 2012
3. Thin film Fundamentals, A.Goswami, New Age international Publishers, 2015.
4. Dielectric properties and molecular behavior, N.E.Hill, W.E.Vaughan, A.H.Price, Mansel Davies, Van Nostrand Reinhold Company, London, 2000.
5. Chemistry of Nanomaterials : Synthesis, Properties and Applications, CNR Rao and T. Cheetham, Wiley & Sons, 2015.
6. Fuel Cell Fundamentals, R.P. O'Hayre, S. Cha, W. Colella, F.B. Prinz, (Wiley) 2006.

Semester	Course	Sub. No	Sub Code	Subject Name
2	IV	107	RCW004	CHEMICAL PHYSICS

Objectives:

- To provide detailed information about dielectric theories
- To understand bonding studies in liquids

Unit-I: Theories of static permittivity and dielectric dispersion

The molecular origin of permittivity and loss – Debye's theory of static permittivity – Onsager's theory of the internal field and permittivity – Kirkwood's and Frohlich's theory for non polarizable dipoles – The macroscopic theory of dielectric dispersion – dielectric loss factor – loss tangent – Representation of Permittivity in theComplex plane.

Unit-II: Frequency domain and Time domain Techniques

X – Band microwave bench – Principle – Experimental arrangement – Dielectric relaxation – Higasi's and Cole-Cole plot methods – Time domain Reflectometry :Principle – Experimental arrangement – procedure – dynamic permittivity – Havariliak – Negami model – Applications.

Unit-III: Dipole moment Studies

Dipole moment – Experimental determination – Debye's method and Onsager'smethod – Application to molecular structure – Dipole moment of molecular complexes –Few and Smith method – Huyskens method.

Unit-IV: Fundamentals of H-bonding studies and IR Spectra in H-bonding

Nature of H – bonding – models of hydrogen bonding (Electrostatic model,Quantum mechanical models) – Thermodynamics of H – bonding – Application of IR Spectra in the study of H – bonding – Determination of equilibrium constant – Nash method – Whetsal and Kagarise method – Thermodynamic properties – Dipole moment derivatives – Enhancement of intensity in H-bonding system.

Unit-V: H – Bonds in solids and Biological materials

Introduction to Proteins and poly peptides – H-bonding in Proteins – Hydrophobicinteractions – Amide systems – Nucleic acids – Proton transfer in DNA – Carbohydrates– Dimensions of H-bonds – Location of the proton in a H-bond – Proton transfer in H-bonded solids.

Text Books

1. Dielectric properties and Molecular behavior, Nora.E.Hill, Van Nostrant Company, London, 1969.
2. I.R.Spectra of complex molecules, L.J.Bellamy, 1980.
3. X – band Microwave Bench, Laboratory Manual, Sisodia, M.L, Raghuvansi, G.S.,Wiley Eastern Ltd., New Delhi, 1987.
4. Moleculer Interactions Vol.2, H. Rataczak and W.J. Orwille Thomas. John Wiley and Sons , Newyork, 1980.
5. Dielectric Materials and Applications, Von Hippel.A.T., John Wiley and Sons Inc., Newyork, 1974.
6. Hydrogen Bonding and Transfer in the Excited State Google e Book, Ke , I Han, Guang, Jiu Zhao, John Wiley & Sons, 2011.

References Books

1. Dielectric behaviour and Molecular structure, C.P.Smyth, McGraw Hill Publications, 1955.
2. Hydrogen Bonding, S.N.Vinogradov and Robert H.Linnell, Van Nostrand Reinhold Company,1970.
3. Electric Dipole Moment, J.W.Smith, Butter worth Publications, 1955.
4. Molecular Interaction Vol.I, H.Rataczak and W.J. Orwille Thomas. John Wiley and Sons, 1978.
5. The theory of Rate processes, S.Glasstone, K.J.Laider and H.Eyring, Mc Graw Hill, New Delhi,1941.

Semester	Course	Sub. No	Sub Code	Subject Name
2	IV	108	RCW004	ULTRASONICS

Objectives:

- To provide knowledge on the fundamentals of production and propagation of ultrasonic waves in liquids and solids.
- To understand the physico-chemical properties
- To develop skill in the applications of ultrasonics in various fields.

Unit-I: Characteristics, Production and Detection of Ultrasonic Waves

Characteristics of ultrasonic waves- Propagation through matter - Wave equation, absorption, reflection, dispersion and transmission of ultrasonic waves.

Classification of ultrasonic waves-Longitudinal, transverse, Rayleigh and lamb waves. Production and Detection: Low and high frequency waves-Longitudinal and transverse modes-Piezoelectric and magnetostriction transducers-Detection of ultrasonic waves -Crystal receivers.

Unit-II: Propagation of Ultrasonic Waves and Molecular Interactions in Liquids

Propagation of low amplitude waves in liquid - Measurement of ultrasonic velocity and absorption : Progressive wave method - Optical method - Acoustic interferometer - Pulse technique-Impedance method. Relaxation: Thermal and structural relaxation in liquid mixtures.

Theory of physical and thermodynamic properties-Adiabatic compressibility - Molar sound volume - Intermolecular free length - Free volume-Internal pressure - Gibb's free energy - Relaxation time and their excess properties-Apparent molar volume-apparent molar compressibility - Solvation number and viscosity B-coefficient. Hydrogen bond: Nature-Complex formation-Physical and thermodynamic properties-Detection using ultrasonic method.

Unit-III: Propagation of Ultrasonic Waves in Solids

Velocity and attenuation measurement in solid-Stationary and continuous wave method – Pulse echo method - Stress, strain and displacement relations-Elastic constants - equations of motion and their solutions-Propagations of ultrasonic waves in ferromagnetic and ferroelectric materials - Absorption due to lattice imperfections - Pressure and temperature dependence on velocity and attenuation.

Unit-IV: Glass and Nanomaterials

Glasses - types of glasses - bioactive glasses - metallic glasses - principle, preparation, properties and applications-measurement of Debye temperature and microhardness - analysis of glasses using XRD, FTIR and SEM. Nanomaterials - Synthesis and characterization of micro and nanofilters - Organic/Inorganic hybrid materials - Macro and micro composites-Shape memory alloys.

Unit-V: Applications

Scientific-Echo sounding-Sound signaling - depth sounding - SONAR- Cleaning of dirt – Cavitations - Biological and medical applications-Ultrasonic flowmete r- Ultrasonic delay lines – UTT (Ultrasonic Trans Tomogram). NDT-Its importance in characterising of materials – Flaw detection and thickness gauging – Metallurgical applications with special reference to soldering and welding.

Text Books

1. Fundamentals of Ultrasonics, Jack Blitz, Butter Worths, London, 1967.
2. Introduction to Chemical Ultrasonics, M.J.Blandamer, Academic press,London,1973.
3. Ultrasonic methods in Solid State Physics, Rohntrunell, Charlleselabaum and Bruce B.Chick , Academic press, 2013.
4. Molecular interaction, H. Ratajczak and W.J.O. Thomas. John Wiley and Sons, Britan, 1980.
5. Instrumental methods of analysis, Williard et al., CBS Edition, 1988.

Reference Books:

1. Absorption and Dispersion of Ultrasonic waves, A. Litvoitz and K.F. Herzfeld,Academic Press, London, 2013.
2. Molecular interaction, H. Ratajczak and W.J.O. Thomas. John Wiley and Sons,Britan, 1980.
3. SEM : A user's manual for Material Science, Barbra, L. Gabriel American Society for metals, 1985.
4. Nanostructures and Nanomaterials : Synthesis, properties and applications,Guozhong Cao, Ying Wang,World Scientific Publishing Co. Pt. Ltd., 2011.
5. Ulrasonic methods and applications Biltz Jack, Newnes – Butter worth 1971

Semester	Course	Sub. No	Sub Code	Subject Name
2	IV	109	RCW004	BIOPHYSICS

Objectives:

- To explore the fundamentals of cell organization
- To develop skill in applications of various microscopic tools in cell biology
- To characterize biomolecular interactions and its macromolecular structure.

Unit- I: Cell and Cell Organelles

Universal properties of cell- Origin and evolution of cells- Prokaryotic vs Eukaryotic cells-Structural and functional organization of eukaryotic cells – Cytoskeleton - Plasma membrane - Ribosome- Endoplasmic reticulum - Golgi complex- Lysosome- Mitochondria- Peroxisome- Nucleus.

Unit- II: 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-III: Separation techniques

Electrophoresis-Moving boundary electrophoresis - Zone electrophoresis-Gel electrophoresis - Poly acrylamide gel electrophoresis (PAGE) - Sodium dodecyl sulphate poly acrylamide gel electrophoresis (SDS-PAGE) - Iso electric focusing electrophoresis - Continuous flow electrophoresis.

Centrifugation - Basic principles of sedimentation - Relative centrifugal force (RCF)- Sedimentation Rate - Svedberg unit or Sedimentation Coefficient - Types of Centrifugation - Analytical Centrifugation - Ultra centrifugation - Preparative centrifugation Differential centrifugation - Density gradient centrifugation - Rate zonal centrifugation - Isopycnic centrifugation.

Unit-IV: Histopathology and biochemical parameters

Histopathological and Immunohistochemical techniques - Samples preparation for biological tissues - Light microscopy - Elementary geometrical optics - Limits of resolution. Types of microscopy - Bright field microscopy - Phase contrast microscopy - Fluorescence microscopy - Polarising Microscopy- Scanning electron microscopy - Transmission electron microscope- Preparation of the specimen for electron microscope-Flow cytometer.

Biochemical parameters – SOD - Catalase - GPx- GSH- TBARS - Hematological Parameters - Hepatic parameters and renal parameters.

Unit -V: Infrared, Raman and NMR Spectroscopy

Introduction - Basic concept of IR spectroscopy-IR spectrophotometer - IR Spectrophotometer - Principle and instrumentation - Sample handling techniques - FTIR :principle – Instrumentation – Biomedical Applications. Basic concept of Raman Spectroscopy-Raman Spectrometer - Instrumentation and working - Biomedical applications.

Introduction to NMR - Basic principles of NMR - NMR theory and experiment - NMR applications in biochemistry and biophysics - Conformation of biomolecules - Two-dimensional NMR - Determination of macromolecular structure - NMR in medicine.

Text Books

1. Biophysics, Vasantha Pattabhi, N. Gautham, Narosa Publishing, 2009.
2. Biophysics P.S. Mishra, VK Enterprises, 2010.
3. Fundamentals of Biochemistry, A.C. Deb, New central book agency, 2011.

Reference Books

1 The Cell: A Molecular Approach, Geoffrey M.Cooper, ASM Press, 2013.
2 Biophysics, M.A. Subramanian, MJP Publishers, 2005.
3 Bioinstrumentation, L.Veerakumari, MJP Publishers, 2006.