

BHARATHIAR UNIVERSITY : COIMBATORE- 641 046

M.Phil./Ph.D. in Applied Physics
(w.e.f. 2008-2009 and onwards)

PART-I SYLLABUS

PAPER I : Teaching / Pedagogical Techniques in Life Sciences

PAPER II : Research Methodology

PAPER III : Special Papers

1. Modern Sensors : Physics, Design and Applications
2. Recent Trends in Thin Film Technology

Paper – I : Teaching / Pedagogical Techniques In Life Sciences

UNIT I - Teaching Techniques

Meaning, Concept and Scope – Instructional Designs – Objective based, Skill Based, Competency based, Learning Style base and Model Based. Instructional Media, Concept, Selection and Use; Variety of Learning; e-Learning; e-Book, e-Journals, Web - based learning.

UNIT II - Thesis Writing

Format of Thesis and dissertation; Research article; Reviews; Monographs; Bibliography; Literature search; Citation literature; Significance of research, Research methods versus methodology, Research and Scientific Methods; Defining the research problem; Research Design.

UNIT III - Interpretation and Report Writing

Meaning of interpretation; Techniques of interpretation; Precautions in Interpretation; Significance of Report writing; Different steps in Report writing; Layout of Research Project; Types of Reports; Patent writing and filing and Oral presentation.

UNIT IV - Data Processing

Data acquisition and Management : DNA, RNA and Protein sequence; Protein Structure data; Gene and Protein expression data; Sequence analysis with acquired data sequence comparison; Alignment, Building Phylogenetic Trees; Use of Micro-array to study gene expression and protein expression; Molecular visualization tool study, Protein Structure Bioinformatics and Drug discovery.

UNIT V - Statistical Methods

Definition and Scope; Types of data; Collection and presentation of Data (Tables, Graphs, Diagrams); Measure of Central Tendency; Dispersion; Skewness and Kurtosis; Testing of significance; Goodness of fit (χ^2 Test); Students t-test; Simple Regression; Correlation Coefficient; ANOVA (One way and Two way analysis)

References:

1. Kumar K. L.' (1997), Educational Technology, New Age International (P) Ltd., New Delhi.
2. Kothari, C.R; II ed. (2004), Research Methodology, Methods and techniques; New Age Internartional (p) Ltd., Publishers, New Delhi.
3. Jerrald H. Zar (1999), Biostatistical analysis of Prentice Hall International, Inc. Press, London
4. Attwood, T.K. and Pary Smith, D. J. (2002); Introduction to Bioinformatics, Pearson Education, Singapore.
5. Tony Bates A.W. Technology, (2005), e-Learning and Distance Education, New York, Routledge.

Paper-II : Research Methodology

Unit – I INTRODUCTION TO METHODOLOGY

Format of thesis and dissertation, Research article, Reviews, Monographs, Bibliography, Literature search, Citation literature Principles of Chromatography Ion exchange, size exclusion, and Affinity column, HPLC and Gas chromatography, GLC: GCMS significance of research, research methods versus methodology, research and scientific methods. Defining the research problem, research design.

Unit –II PRINCIPLES OF INSTRUMENTATION

Principles and applications of the following: Microscope- Fluorescence, Confocal, Phase contrast, Electron (Scanning and transmission)- Centrifugation high speed and ultra, Electrophoresis- Polyacrylamide, Agarose, Pulsed field electrophoresis, Denaturing gradient gel electrophoresis, Immunoelectrophoresis. Isoelectric focusing: NMR, CD, IR, DSC, Spectrophotometry- Principle and application of Spectrophotometer- Visible, UV, Atomic absorption spectrophotometer- Spectrofluorimetry, Flow cytometry, Immunotechniques- ELISA, Immunoblotting. Characterization of Chromosomes by various banding techniques. RIA.

Unit –III CELL CULTURE, AND MOLECULAR BIOLOGICAL TECHNIQUES

PREPARATION OF Culture media, Modes of sterilization, Culture of microbes. Plant and animal cell and Tissue Bioprocess Engineering : Operation types, Continuous, Batch, Fed batch. Designs: Fluidized bed, Packed bed, Immobilization of enzyme and cells. Nucleic acid isolation- Isolation of genomic DNA, RNA, Plasmid DNA, PCR and blotting techniques and Hybridization technique.

Unit- IV BIOSTATISTICS

Definition and scope. Types of biological data- Collection and presentation of data (Table, Graphs, Diagrams). Measures of central tendency, Dispersion, Skewness and Kurtosis: Probability analysis- Testing of significance- Goodness of fit (X² test)- Student 's t-test-Simple regression- Correlation coefficient- ANOVA (One way and two way analysis).

Unit- V BIOINFORMATICS

Data acquisition and management DNA, RNA and Proteins sequences, Protein structure data, Gene and protein expression data. Sequence analysis with acquired data: Sequence comparison, alignment, building Phylogenetic trees, Use of Micro arrays to study gene expression and Protein expression, Molecular visualization tools study protein structure, Bioinformatics and Drug discovery.

Reference

1. C.R. Kothari, IInd edition (2004) Research methodology, Methods and techniques, New Age International (P) Ltd, Publishers, New Delhi.
2. Jerrod H. Zar (1999) Biostatistical analysis by, Prentice Hall International, Inc. Press, London.
3. Attwood.T.K & Parry-Smith D.J.(2002) Introduction to Bioinformatics, Pearson education Singapore.
4. M.K. Razdan (2003) Plant tissue culture, Oxford and IBH Publishing Co. Pvt, Ltd, New Delhi.
5. Stanbury, P.F.and Whitaker,A.,Principles of Fermentation technology,PergamonPress,Oxford.

Special Paper - 1 : Modern Sensors: Physics, Designs and Applications

Unit I: Sensor Characteristics and Principles

Sensor Classification - sensor characteristics - Physical principles of sensing - electric charges, fields, and potentials - capacitance – magnetism – induction - resistance - piezoelectric effect - pyroelectric Effect - Hall effect - Seebeck and Peltier Effects - SoundWaves - temperature and thermal properties of materials - heat transfer - Light - Dynamic Models of Sensor Elements.

Unit II: Sensor Components and Circuits

Optical Components of Sensors : radiometry - photometry – windows - mirrors - lenses - Fresnel lenses - fiber optics and waveguides – concentrators - coatings for thermal absorption - electro-optic and acousto-optic modulators - Interferometric Fiber-optic Modulation, Interface Electronic Circuits: input characteristics of interface circuits - amplifiers - excitation circuits - analog-to - digital converters direct digitization and processing - ratiometric circuits - bridge circuits - data transmission- Noise in Sensors and Circuits - batteries for low power sensors

Unit III: Types of Sensor I

Occupancy and Motion Detectors : ultrasonic sensors - microwave motion detectors - capacitive occupancy detectors - triboelectric detectors - optoelectronic motion detectors, Position, Displacement, and Level : potentiometric sensors - gravitational sensors - capacitive sensors - inductive and magnetic sensors - optical sensors - ultrasonic sensors - radar sensors - thickness and level sensors, Velocity and Acceleration: accelerometer characteristics - capacitive accelerometers - piezoresistive Accelerometers - piezoelectric accelerometers - thermal accelerometers - gyroscopes - Piezoelectric Cables, Force, Strain, and Tactile Sensors: strain gauges - tactile sensors - piezoelectric force sensors, Pressure Sensors : concepts of pressure - units of pressure - mercury pressure sensor - bellows, membranes, and thin plates-piezoresistive sensors- capacitive sensors- VRP Sensors- optoelectronic sensors - vacuum sensors.

Unit IV: Types of Sensor II

Flow Sensors : basics of flow dynamics - pressure gradient technique - thermal transport sensors - ultrasonic sensors - electromagnetic sensors - microflow sensors - breeze sensor - coriolis mass flow sensors - drag force flow sensors, Acoustic Sensors : resistive microphones - condenser microphones - fiber-optic microphone - piezoelectric microphones - electret microphones - solid-state acoustic detectors, Humidity and Moisture Sensors : concept of humidity - capacitive sensors - electrical conductivity sensors - thermal conductivity sensor - optical hygrometer - oscillating hygrometer. Light Detectors : introduction - photodiodes - phototransistor - photoresistors - cooled detectors - thermal detectors - gas flame detectors, Radiation Detectors : scintillating detectors - ionization detectors, Temperature Sensors: thermoresistive sensors- thermoelectric contact sensors- semiconductor P-N junction sensors-optical temperature sensors- acoustic temperature sensor- piezoelectric temperature sensors.

Unit V: Nanosensors

Chemical Sensors : chemical sensor characteristics - specific difficulties - classification of chemical-sensing mechanisms - direct sensors - complex sensors - chemical sensors versus instruments, Sensor Materials and Technologies : materials - surface processing - nano-technology - photolithography, Chemical and Molecular Sensors – Displacement and Motion Sensors – Force Nanosensors – Pressure Sensing – Thermal Nanosensors – Electric and Magnetic Sensing – Cellular Bioscanning – Non-invasive Neuroelectric Monitoring– Macrosensing– Acoustic Macrosensing – Electric and Magnetic Macrosensing – Neural Macrosensing

References

1. Jacob Fraden, Handbook of Modern Sensors (2003) Springer, 3rd Edition ISBN 0-387-00750-4.
2. Nano Medicines Edited by Dr.Parag Diwan and Ashish Bharadwaj (2006) Pentagon Press ISBN 81-8274-139-4.

Special Paper - 2 : Recent Trends In Thin Film Technology

Unit I: Vacuum Science and Technology

Kinetic theory of gases – molecular velocities – pressure – gas impingement on surfaces – Gas transport and pumping - gas flow regimes – conductance – pumping speed – vacuum pumps and systems – pumps – rotary mechanical pump – diffusion pump - turbo molecular pump – cryopumps – sputter ion pumps – systems – system pumping consideration – vacuum gauges – thermal conductivity vacuum gauges – ionization vacuum gauges.

Unit II: Preparation of thin films

Film deposition methods - introduction – fundamentals of film deposition – thermal evaporation – Spray Pyrolysis - Flame Pyrolysis - molecular beam epitaxy – pulsed laser deposition – dc/rf magnetron sputter deposition – chemical vapour deposition – layer by layer growth and ultra thin films – chemical solution deposition – Langmuir Blodgett films

Unit III: Electrical and Optical Properties of Thin films

Introduction of electrical properties of thin films - measurement of resistivity - conduction in metal films – electrical transport in insulating films – semiconductor contacts and MOS structures - Hall Effect and Magneto Resistance, – photoconduction –field effect thin film transistors- Insulation films – Dielectric properties – dielectric losses – Ohmic contacts – metal-insulator and metal contacts – DC and AC conduction mechanism.

Unit IV: Magnetic properties of Thin films

Electron transport in magnetic multi-layers – GMR - spintronics - spin polarized electron tunneling – interlayer exchange coupling – spin relaxation in magnetic metallic layers and multi-layers - non-equilibrium spin dynamics in laterally defined magnetic structures.

Unit V: Optical properties of thin films and thin film solar cells

Thin Film optics – theory – optical constants of thin films – experimental technique-multilayer optical systems – Interferences – filters – Antireflection coatings. Thin film solar cells: Role and progress and production of thin film solar cells-photovoltaic parameters. Thin film silicon (Polycrystalline) solar cells. Current status of bulk silicon solar cells – fabrication technology photovoltaic performance – Emerging solar cells : GaAs and CuInSe.

Books for Study:

1. The Materials Science of Thin Films, Milton Ohring (1992) Academic Press.
2. Fundamentals of Vacuum technology, Walter Umrath (1998)
3. Hand book of thin film Technology, L. Meissel and Glang
4. Thin Film Phenomena, K. L. Chopra
5. Ultra thin Magnetic Structures III – Fundamentals of Nanomagnetism, J.A. C. Bland and B. Heinrich, Springer (2004) ISBN 3540219536
6. Thin Film Solar Cells, K. L. Chopra and S. R. Das

Books for reference:

1. Vacuum Deposition of thin films, L. Holland
2. The Use of Thin Films in Physical Investigation, J. C. Anderson
3. Thin Film Technology, Berry, Koil and Horris
