

BHARATHIAR UNIVERSITY : COIMBATORE- 641 046

M.Phil. / Ph.D. - Life Science (DRDO)
(W.e.f. 2008-2009 and onwards)

PART-I SYLLABUS

PAPER I : Teaching Techniques / Pedagogical Techniques in Life Sciences

PAPER II : Research Methodology in Life Sciences

PAPER III : Special Papers

1. Environmental Management Division

1. Application of Remote Sensing and GIS for Environmental Management
2. Remediation Technique for Environmental Management
3. Microbes in Biotechnology

2. Molecular Biology and Biotechnology Division

1. Plant Biotechnology
2. Molecular Biology

3. Physics Division

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

PAPER I - TEACHING TECHNIQUES / 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. Atttwood, 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 IN LIFE SCIENCES

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, Eelectrophoresis- Polyacrylamide, Agarose, Pulsed field electrophoresis, Denaturing gradient gel electrophoresis, Immunoelectrophoresis. Isoelectric focussing: NMR, CD, IR, DSC, Spectrophotometry- Principle and application of Spectrophotometer- Visible, UV, Atomic absorption spectrophotometer- Spectrofluorimetry, Floweytometry, 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 Internation (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.

PAPER III - ENVIRONMENTAL MANAGEMENT DIVISION

Paper –1 : Application Remote sensing and GIS Environmental Management

UNIT I. SATELLITE REMOTE SENSING

Fundamentals: Definition- Scope- types- Energy sources – Electro Magnetic Radiation – energy interaction in the atmosphere – energy interaction with earth surface features – spectral reflectance patterns for different regions of EMR. Factors affecting remote sensing signatures – Satellites and Sensors – data capture types and systems and data recording method.

UNIT II. TYPES OF REMOTE SENSING

History of Aerial Photography, Principles of photography, Elements of photography, photo interpretation elements, Aerial Cameras, Stereoscopic Viewing, Anatomy of the human eye, stereo model. Optical Scanning, Thermal Remote Sensing – Concepts of RADAR and Microwave Remote Sensing, Resolution: Spatial, spectral, radiometric and temporal resolution of the satellites.

UNIT III. PRINCIPLES OF DIGITAL IMAGE PROCESSING

Principles: Data encoding and decoding - digital image formats- band sequential and band interleaved - characteristic features - geometric correction, radiometric correction –noise removal – Methods of image enhancement : Contrast manipulation- graylevel threshold, level slicing and stretching, Filtering, Vegetation Indices, IHS colour space transformation, Classification: Types of Classifiers and post classification methods.

UNIT IV. PRINCIPLES OF GEOGRAPHICAL INFORMATION SYSTEM AND GPS

Introducing GIS and spatial data analysis: Definition – computer assisted mapping and Map analysis – components of GIS – spatial data structures – Digitization –Thematic Mapping – queries - buffering and neighborhood functions - Overlay Analysis – surface Analysis – network analysis DEM, Introduction to GPS – Integration techniques, Tracking and navigation. Advantages and Applications, Future GPS

UNIT V. APPLICATIONS FOR RESOURCES MANAGEMENT

GIS for Natural Resources Management : Natural Resources Management - Forests, Land Evaluation, Wastelands and eroded lands, Water Resources: Surface water Analysis, groundwater potential mapping, integrated watershed development, case studies

GIS for Disaster Management : Earthquake, Volcano and landslide, Cyclones and Flooding, Drought and Desertification : Anthropogenic Disasters, Atmospheric Disasters, Marine Disasters, GIS in Biodiversity Disasters - GIS in environmental modeling – case studies.

Internet GIS: Internet GIS : Internet GIS Applications - transportation, crimes, Emergency and crisis, tourism and urban land management Geographic markup language - commercial Web mapping programs – mobile GIS. Distributed GIS in data warehousing and data sharing.

REFERENCES :

- American Society of Photogrammetry, (1983).Manual of Remote Sensing' (2nd edition)' ASP, Falls Church, Virginia
- Lillisand.T.M, and Kiefer, P.W., (1998). Remote Sensing and Image Interpretation John Wiley & Sons, New York'
- Moffit, H.F.and Edward, M.M., (1980). Photogrammetry, Harper and Row Publishers, New York.
- Wolf.P.R., (1974).Elements of photogrammetry Mc Graw Hill books Co.,London.
- Curran P J (1985) Principles of Remote Sensing Longman, Essex
- Sabins F.F Jr.(1987) Remote Sensing :Principles and Interpretation, W.H.Freeman & Co.,New York.
- Alexey Bunkin and Konstantin Voliak, Laser Remote Sensing of the ocean, John wiley and Sons. 2001, Canada.
- Gibso.P and clare H.Power, [2000] Introductory Remote Sensing Principles and Concepts, Routledge, 1st edition, London
- Hayesm L ., [1991] introduction to Remote Sensing Taylor and Fransis Publication' London.
- Henderson, F.M., and Anthony J.Lewis. 998, Manual of Remote Sensing, Volume - 2 Principles and Application of Imaging Radar,3rd Edition,John wiley and Sonc Inc,Canada, USA.
- Haywood.L, comelius.S and S.carver (1988) An Introduction to Geographical Infirmination Systems Addison Wiley Longmont New York
- Burgh P.A (1986) P rincipleso f geographicalI nformation System for Land Resources Assessment, Clarendon Press, Oxford'
- Burrough P A 2000 P A McDonnell [2000] Principles of Geographical Information Systems London: Oxford University Press'
- Lo.C.P.,Yeung. K.W. Albert (2002) concepts and Techniques of Geographic Information Systems, Prentice-Hall of India Pvt ltd, New Delhi
- John,J R [1986] Digital Image Processing 'New Jersey : Prentice-Hall'
- John, R A and Jia Xinping [1999] Remotes ensing Digital Analvsis – An Introduction.Newyork : Verlag Berlin Heidelberg
- Korte,G.B.(2001) the GIS book : 5th edition, onward Press, Australia.

Anji Reddy, M., (2001) Remote Sensing and Geographical Information Systems, 2nd edition, Bs. Publications, Hyderabad.

Demers, Michael N., (2000) Fundamentals of Geographic Information Systems' John Willey and sons. Inc. New York.

John A. Matthews (2002) Natural hazards and environmental change, Bill McGuire, Ian Mason.

Andrew Skell (2002) Environmental Modeling with GIS and Remote sensing, John Willey and sons, Inc New York.

John G. Lyon (2003) GIS for water Resource and water Shed Management, Taylor and Francis.

Fischer M., H.J. Scholten, and D. Unwin, 1996. Spatial Analytical Perspectives on GIS, Taylor & Francis, London, UK.

Fotheringham, S., and P. Rogerson, Ed. 1995. Spatial Analysis and GIS Taylor & Francis, London, U K.

Heit, Michael, H. Dennison Parker, and Art Shortreid (eds), 1996. GIS Applications in Natural Resources 2, GIS World, Inc., Fort Collins, Colorado, 540p

Michael F. Goodchild, Louis T. Steyaert, Bradley O. Parks, 1996. GIS and Environmental Modeling : Progress and Research Issues, Fort Collins, CO 80525: GIS World Inc. Available at the Evans Library reserve desk.

Ripple, William J. (ed.). 1994. The GIS Applications Book: Examples in Natural Resources : A Comieniuuro, American Society for Photogrametry and Remote Sensing, Bethesda, Maryland.

Young, Haines, David Green, and Steven Cousins (eds.), 1994. Landscape Ecology and GIS, Taylor & Francis, Bristol, P.A.

Skidmore Andrew, 2002. Environmental Modeling With GIS and Remote Sensing, Taylor & Francis, London.

Korte, G.B., (2001) The GIS book : 5th Edition, onward press, Australia.

Cartwright, W., M.P. Peterson, G. Gartner (Eds) Multimedia Cartography, Berlin: Springer.

PAPER III : ENVIRONMENTAL MANAGEMENT DIVISION

PAPER 2: Remediation Techniques for Environmental Management

UNIT I - Environmental pollution

Types of pollution, Methods for monitoring pollution; Methodology of Environmental Management – Problem solving Approach and its limitations. Water pollution and Control : Need for water management, Measurement and sources of water pollution. Kind of Aquatic habitats (Fresh water and Marine).

UNIT II - Waste water treatment

Sampling methods. Physico - Chemical properties of water, Physical, Chemical and Biological Treatment processes – primary, secondary, tertiary treatment, Activated Sludge, Oxidation ditches, Trickling filter, Rotating discs, Rotating Drums, Oxidation ponds, Anaerobic digestion, Anaerobic filters. Upflow anaerobic sludge blanket reactors. Treatment Schemes for wastewaters of Dairy, Distillery, Tannery, Sugar, and Antibiotic Industries. Management of estuarine, coastal water systems and man made reservoirs.

UNIT III - Xenobiotics and environment

Xenobiotics : Ecological considerations, Degradative plasmids; Hydrocarbon and substituted hydrocarbons, Cellulosic and non – cellulosic wastes. Oil pollution, pesticides and explosives. Bioremediation of contaminated soil and waste lands. Solid waste management: Sources and management (Composting, Vermiculture and Methane production). Environmental mutagenesis and toxicity testing.

UNIT IV - Renewable energy

Biodiesel, Bioethanol, Hydrogen production, Biopolymer, Bioplastics and Biosurfactants.

UNIT V - Oxidation process for organic removal

Oxidation process for organic removal – Mechanism of oxidation of organic compounds by Chlorine, Oxygen and Ozone. Kinetics and Mechanism of reactions.

References:

1. Alan Seragg, Environmental Biotechnology, Pearson Education Ltd., England.
2. Jogdand S. N., Environmental Biotechnology, Himalaya Publishing House, Bombay.
3. Metcalf and Eddy, Wastewater Engineering: Treatment, Disposal and Reuse, Tata Mc Graw Hill, New Delhi.
4. Rao M. N. and Datta A. K. Waste water treatment, Oxford and IBH publishing Co Pvt Ltd, New Delhi.
5. De, A. K., Environmental Chemistry, Wiley Eastern Ltd., New Delhi
6. Allsopp, D. and Seal, Introduction to BioDeterioration, ELBS/Edward Arnold.
7. Skoog D. A. and West D. M. (2004), Fundamentals of Analytical Chemistry, Thompson Asia Pvt. Ltd., Singapore.
8. Reckhow D. A. and Brink D. R. (1997), Ozone in water treatment – Applications and Engineering, Lewis Publishers, USA.

PAPER III : ENVIRONMENTAL MANAGEMENT DIVISION

PAPER 3 - MICROBIAL BIOTECHNOLOGY

Unit-I MICROBIAL DIVERSITY:

Classification-Bacteria, Fungi, actinomycetes, Bergey's system: Molecular techniques for classification- Biochemical, microbiological, 16s rRNA sequencing, DNA-DNA hybridization, construction of phylogenetic tree, G+C analysis
Preservation and maintenance of microbes.

Unit - II FERMENTATION ENGINEERING:

Fermenter: Types- stirred tank, deep-jet, air-lift and sparged tank fermenters; monitoring and control parameters
Bioreactors: types- batch, fed batch, continuous, CSTR, fluidized, immobilized cell reactors; mode of operation
Optimisation of conditions: screening of factors- Plackett Burman design. Fractional factorial design, Pareto chart: Optimisation of factors- Response Surface methodology: Model Confirmation- experimental, ANOVA, normal plot.

Unit –III DOWN STREAM PROCESSING:

Separation of cells- flocculation, filtration, plate filters, rotary vacuum filters; Disintegration- mechanical and non-mechanical; Filtration- membrane filtration, ultra filtration reverse osmosis: Extraction- two phase, organic solvents, salts; Chromatography- absorption, adhesive; drying- spray driers, drum driers, freeze driers.

Unit –IV MICROBES IN PHARMACEUTICAL AND FOOD INDUSTRIES:

Production, harvest, recover./, uses and mode of action- enzymes, antibiotics, vitamins (B12, B2) organic acids (acetic acid, lactic acid, citric acid), alcohol (ethanol), organic solvents (acetone-buranol), amino acids, beverages (beer, wine, brandy), microbial supplements (Lactic acid, bacteris) as medicine, biopolymer, biofertilizers, biocides. Steroid biotransformation. Improvement in production – improved strains by protoplast fusion, recombination. Alteration in metabolic pathway; immobilization of cells.

Unit -V BIOREMEDIATION:

Xenobiotics-microbial mechanism; Microbial mining, ore leaching, oil recovery; solid waste treatment- coraposting, vermicomposting, biofuel, animal feed, mushroom cultivation, oil spill remediation, biomedical waste treatment; Wastewater treatment- primary, secondary and tertiary (Biological), heavy metal removal, artillery industrial waste treatment

REFERENCES

1. Microbial Biotechnology- Fundamentals of applied Microbiology by A.N. Glazer and H. Nikaido. W.H. Freeman and company.
2. Principles of Fermentation Technology, P.F. Stanbury & A. Whitaker, Pergamon Press.
3. Microbial Process Development by H.W. Woelle, World Scientific
4. Biotechnology Text book of Industrial Microbiology by W. Creuger and A. Creuger
5. Industrial Microbiology by Casida
6. Industrial Microbiology by Prescott
7. Biochemical Engineering Fundamentals, Bailey, J.E. and Ollis, D.F., McGraw-Hill Book Co. New York.
8. Bioprocess Technology: Fundamentals and Applications, KTH, Stockholm.
9. Bioprocess Engineering: Basic Concepts, Shuler, M.L. and Kargi, P., Prentice Hall Engelwood Cliffs.
10. Bioreaction Engineering Principles, Neilson, J. and Villadsen, J., Plenum Press.

PAPER III : MOLECULAR BIOLOGY&BIOTECHNOLOGY DIVISION

PAPER 1 - PLANT BIOTECHNOLOGY

Unit – I GENOME ORGANIZATION AND ENGINEERING

Plant genome organization, structure of plant gene, Gene family, Chloroplast genome, Mitochondrial genome. Importance of RELP and RAPD in plant breeding Construction of cDNA library. Protein targeting to chloroplast and mitochondria, heat shock proteins.

Unit –II TISSUE CULTURE TECHNIQUES

Brief historical account: Laboratory organization: Preparation of media: Aseptic manipulation: Sterilization of media, Culture vessels and explants: Single cell culture, Suspension culture. Cellular totipotency, Somatic embryogenesis: Synthetic seeds: Somaclonal and gameticclonal variation. Shoot tip culture, Haploid production: Anther and Pollen culture: Triploid production: In vitro pollination and Fertilization, Embryo culture.

Unit- III APPLICATION OF TISSUE CULTURE

Protoplast isolation and culture: Somatic hybridization, Cybrid technology, Micropropagation: Gemplasm conservation: Production of secondary metabolites: Genetic engineering of metabolic pathways, Production of secondary metabolites in Bioreactors and downstream procession.

Unit – IV MOLECULAR BIOLOGY OF PLANT MICROBIAL INTERATION AND TRANSFORMATION

Biofertilizers: Symbiotic and Non-symbiotic nitrogen fixation, Biochemistry and Molecular biology of biological nitrogen fixation, Genetic engineering of nif genes and nod genes. Mycorrhizae: Ecto and Endo Mycorrhizae, Agrobacterium and Crown gall tumours, Mechanism of T- DNA transfer. Ti and Ri plasmid vectors Agro infection. Direct transfer of plants by physical methods. Selectable marker and reporter genes, Chloroplast transformation.

Unit- V TRANSGENIC PLANTS AND THEIR APPLICATIONS

Transgenic plants: Genetic engineering of plants for herbicide resistance, Pest resistance, Virus resistance, Disease resistance, Stress tolerant. Cytoplasmic male sterility, Delayed fruit ripening. Genetic engineering in flower industries, Genetic engineering of seed storage proteins. Vaccine production in plants, Edible vaccine, Transgenic plants as bioreactors.

References

1. Chrispeels M.J & Sadava D.E. (2002).Plants, genes and agriculture.The American Scientific publishers.
2. Chawla H.S. (2004) Biotechnology in crop improvement. International book Distribution Co.,
3. Donal Grierson & Convey S.V. (1984). Plant Molecular Biology by Blackie & Son Ltd, Newyork.
4. Hammond J. Mc Garvey P. and Usibov V. Y (Eds) (2000). Plant Biotechnology Springer Verlag.
5. Moncia, A. Hughes. (1999). Plant Molecular genetics by Pearson education limited, England.
6. Razdan M.K. (2003) . Introduction to plant tissue culture Oxford- IBH publishing Co. Pvt.Ltd.
7. Slater, A. Scott, N and Fowler, M. (2003). Plant Biotechnology: The genetic manipulation of plants. Oxford press.

PAPER III : 2. MOLECULAR BIOLOGY AND BIOTECHNOLOGY DIVISION

Paper-2 Molecular Biology

Unit 1: Molecular Cloning

Vectors in Molecular Biology- Modifying Enzyme- Polymerase chain reaction- DNA/Protein sequencing – Mutagenesis- Transposable Elements- rRNA/ Genomic/ c DNA Library construction and screening – Map based cloning

Unit-II: Cloning in Microorganisms

Cloning Techniques: cloning in E-coli- Cloning in *Bacillus subtilis*- Cloning in Yeast
Specialized vectors: Artificial chromosomes- Operons- Expression of cloned genes- site directed mutagenesis- fusion proteins- Degradative plasmids.

Unit III: Cloning in higher Organisms:

DNA mediated transformation – Gene transfer by viral transduction – Genetic manipulation of mammals- DNA transfer to other vertebrates- Gene transfer in plants- Direct and indirect gene delivery systems- plant viruses as vectors.

Unit IV: Applications of Genetic Engineering

Nucleic acid sequences as diagnostic tools- New drugs/ Therapies for genetic disease- combating infectious diseases- Protein engineering- Metabolic Engineering- Molecular Breeding of plants- Production of interferon's- DNA vaccines

Unit V Recent advances in Biotechnology

DNA/ Protein micro arrays- DNA/ Protein Markers- DNA finger printing- Gene knock out – RNAi and Gene silencing – Metagenomics- Bioethics and IPR

Reference:

1. Bowtell, D and Sambrook, J. DNA Microarray: A Molecular cloning manual. CSHL press
2. Glick, BR., Pasternak, JJ (1998) Molecular Biotechnology: Principles and Applications of recombinant DNA, ASM Press.
3. Grandi, G (2004) Genomics, Proteomics and Vaccines. Wiley press.
4. Hannon, GJ, RNAi: A guide to gene silencing. CSHL Press
5. Kirby, LT (1990) DNA finger printing: An introduction,. Stockton press.
6. Lewin, B (2004). Genes VIII. Pearson- Prentice Hall Press
7. Primrose, S.B., Twyman, R.M., Old. R.W. (2001) Principles of Gene Manipulation Blackwell Science Limited.

PAPER III. PHYSICS DIVISION

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.

3. Physics Division

Paper II: 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