Dr. M.G.R
EDUCATIONAL AND RESEARCH INSTITUTE
UNIVERSITY

DEPARTMENT OF MECHANICAL ENGINEERING

M.Tech – CRYOGENIC ENGINEERING

CURRICULUM
2013.

SEMESTER I					
Sub.code	Subjects	L	T	P	C
MCE01	Cryogenic Systems	3	0	0	3
MCE 02	Cryo. Engineering	3	0	0	3
MCE03	Cryo. Mass Transfer and Separation Systems	3	1	0	4
MCE04	Computational Fluid Dynamics	3	1	0	4
MCE05	Semiconductor Devices and Modeling	3	0	0	3
MCE06	Cryo fuel Systems	3	0	0	3
	Total	18	2	0	20

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SEMESTER II					
Sub.code	Subjects	L	T	P	C
MCE07	Fnite Element Analysis	3	0	0	3
MCE08	Computer Aided Design of Cryogenic process plant	3	0	0	3
MCE09	Cryo Heat Transfer	3	1	0	4
MCE10	Gas turbines and jet propulsion	3	1	0	4
MCEE11	Design of Cryo. Equipment and Accessories	3	1	0	4
MCE12	Cryo . Engg. Lab	0	0	3	2
	Total	15	3	3	20

SEMESTER III					
Sub.code	Subjects	L	T	P	C
MCEExx	Elective I	3	0	0	4
MCEE xx	Elective II	3	0	0	4
MCEE xx	Elective III	3	0	0	4
MCE 13	Practical training	0	0	3	2
MCE 14	Project Phase -1	0	0	10	5
	Total	9	0	13	19

SEMESTER IV					
Sub.code	Subjects	L	T	P	C
MCE15	Project Phase –II	0	0	30	15
	Total	0	0	30	15

LIST OF ELECTIVES

Sub.code	Subjects	L	T	P	C
MCEE01	Cryobiology	3	0	0	3
MCEE02	Manpower Economics	3	0	0	3
MCEE03	Robotics and sensors	3	0	0	3
MCEE04	Cryo Heat Transfer	3	0	0	3
MCEE05	Cryo tissue Engineering	3	0	0	3
MCEE06	Bioinformatics	3	0	0	3
MCEE07	Cryo physics	3	0	0	3
MCEE08	Quantitative Methods	3	0	0	3
MCEE09	Superconducting Materials, Magnets and Devices	3	0	0	3
MCEE10	Vacuum Techniques	3	0	0	3

SEMESTER I

MCE 01 CRYOGENIC SYSTEMS 3-0-0-3

UNIT I 9

Review of Basic Thermodynamics, First and Second Law approaches to the study of thermodynamic cycles, Isothermal, Adiabatic and Isenthalpic processes.

UNIT II 9

Production of Low Temperatures: Liquefaction systems, ideal, Cascade, Linde Hampson

UNIT III 9

Claude cycles and their derivatives; Refrigerators : Stirling, Gifford-McMahon cycles and their derivatives.

UNIT IV 9

Cryogenic Insulations: Foam, Fibre, powder and Multilayer. Design of cryogenic storage and transport vessels.

UNIT V 9

Application of Cryogenics in Industry, Space Technology, Biology and Medicine.

Total hrs: 45

Reference:

1. Cryogenic Systems, by R. Barron 1966.
2. J.H Bell, Crogenic Engineering, 1963
3. R.B.Scott, Crogenic Engineering, 1959

MCE 02 CRYOENGINEERING 3-0-0-3

UNIT I 9

Review of tree electron and. band theory of solids: Thermal, Electrical and Magnetic properties of materials at low temperature.

UNIT II 9

Basic properties of Superconductors; Phenomenological theories; out lines of Ginzbarg Landau and Bardeen-Cooper-Schrieffer theories of superconductivity:

UNIT III 9

Superconducing tunneling phenomena; Introduction to type II superconductivity including flux flow and critical current density:

UNIT IV 9

High temperature superconductivity and its applications

UNIT V 9

Production of very low temperatures by Adiabatic demagnetization, dilution refrigeration and nuclear demagnetization and their measurements.

Total hrs: 45

Reference:

1. Cryo genic Fundamentals, by G.G. Haselden, 1971
2. Cryogenic Recycling and processing by Norman R. Braton, 1980

MCE 03 CRYO MASS TRANSFER AND SEPARATION SYSTEMS 3-1-0-4

UNIT I 12

Principles of Diffusion and Mass Transfer, Fick's Law of Diffusion, Molecular diffusion in fluids, mass transfer coefficients in laminar and turbulent flow; mass,heat and momentum transfer analogies.

UNIT II 12

Introduction to the cryogenic gas separation and purification systems; principles of absorption, adsorption, condensation and rectification;

UNIT III 12

ortho-para conversion of hydrogen. Adsorption equilibria; types of adsorbant; adsorption/desorption cycles; PSA, TSA; steady state and dynamic adsorption; concept of break point and mass transfer zone;

UNIT IV 12

Design of fixed bed adsorption system for gas separation and purification. Phase equilibria and phase rule; equilibrium stage operation; X-Y, T-X and H-X diagrams and their use;

UNIT V 12

Design of rectification columns; different tray assemblies; types of column assemblies for cryogenic rectification; salient features of large scale gas separation.

Total hrs: 60

Reference:

1.Heat transfer at Low temperatures, 1975 by W.Frost

2.Cryogenic Systems, by R. Barron 1966.

MCEE 04 COMPUTATIONAL FLUID DYNAMICS 3 1 0 4

UNIT I **12**

Continuum hypothesis, Lagrangian and Eulerian formulation, Governing equations-continuity equation, momentum equation, energy equation, boundary conditions-classification, initial and boundary value problems-Finite difference schemes-forward, central and backward difference, basics of Finite volume schemes, Implicit and explicit approaches.

UNIT II **12**

FDM for Steady one-dimensional conduction, Two and Three dimensional steady state problems, Transient one-dimensional problem, Two-dimensional Transient Problems, Finite Volume formulation for 1D heat transfer. Uniform and non-uniform Grids, Numerical Errors, Grid Independence Test.

UNIT III **12**

Governing Equations, Stream Function – Verticity method, Determination of pressure for viscous flow, SIMPLE Procedure of Patankar and spalding, Computation of Boundary layer flow, Finite difference approach, Unstructured Grids for Viscous Flows.

UNIT IV **12**

Steady One-Dimensional and Two-Dimensional Convection – Diffusion, Unsteady one-dimensional convection – Diffusion, Unsteady two-dimensional convection – Diffusion – Introduction to finite element method – Solution of steady one dimensional heat conduction by FEM – Incompressible flow – Simulation by FEM.

UNIT V **12**

Turbulence, Effect of Turbulence and time averaged Navier Stokes Equation, Algebraic Models – One equation model, K - □ Models, K-W model, Algebric stress model, Reynolds stress equation model, Standard and High and Low Reynolds number models, Prediction of fluid flow and heat transfer using standard codes.

Total hrs: 60

REFERENCES

1.Muralidhar, K., and Sundararajan, T., "Computational Fluid Flow and Heat Transfer", Narosa Publishing House, New Delhi, 1995.

2.Ghoshdasdidar, P.S., "Computer Simulation of flow and heat transfer" Tata McGraw-Hill Publishing Company Ltd., 1998.

3.Subas, V.Patankar "Numerical heat transfer fluid flow", Hemisphere Publishing corporation 1980.

4.Taylor, C and Hughes, J.B. "Finite Element Programming of the Navier Stock Equation", Pineridge Press Limited, U.K

5.Anderson, D.A., Tannehill, J.I., and Pletcher, R.H., "Computational fluid Mechanics and Heat Transfer " Hemisphere Publishing Corporation, Newyork, USA,.

MCE 05 SEMICONDUCTOR DEVICES AND MODELING 3-0-0-3

UNIT I **9**

Integrated circuits diodes and transistors; Current-voltage characteristics;

UNIT II 9

Ebers-Moll model and Gummel-Poon model of bipolar transistors; current gain;

UNIT III 9

Early effect and high level injection; 2-D effects; transient parameters; MOSFETs;

UNIT IV 9

Analysis of MOSFET parameters; short channel and narrow width effects; hot electron effects;

UNIT V 9

MOSFET models; JFET and MESFETs; Modulation doped FETs; HEMTs; Heterojunctions and HBTs; microwave and optonic devices;

Total hrs: 45

Reference:

1. Semi conductor Device fundamendals by Robert F.Pierret
2. Principles of Semiconducor Devices by Bart Van Zeghbroech

MCE 06 CRYOFUEL SYSTEMS 3-0-0-3

UNIT I 9

Properties of Hydrocarbon Mixtures-equations of state, law of corresponding states, transport properties.

UNIT II 9

Liquefied Petroleum Gas - properties, production and storage. Natural Gas-composition, source and pretreatment.

UNIT III 9

Liquefaction of natural gas - simple cascade, mixed refrigerant and turbine expansion cycles,

UNIT IV 9

Ocean transport of LNG membrane and self-supporting tanks. Storage of LNG. Applications of NG and LNG and safety aspects; Hydrogen - properties, production and pretreatment

UNIT V 9

Liquefaction of hydrogen - Linde, Claude and helium - hydrogen condensing cycles, Ortho-para conversion. Storage and handling of liquefied hydrogen - applications of hydrogen, and its safety.

Total hrs: 45

Reference:

1. Cryogenic Systems, by R. Barron 1966.
2. R.B.Scott, Crogenic Engineering, 1959

SEMESTER II

MCE07 FINITE ELEMENT ANALYSIS 3 1 0 4

UNIT I INTRODUCTION 12

Basic concepts of finite element method. Steps involved in FEM. Solution of Boundary value problem - Integral formulation for numerical solution - Variational method - Collocation method – Sub domain method - Galeriken method - Least square method - Minimum total potential energy formulation.

UNIT II 1D ELEMENTS 12

Use of bar and beam elements in structural analysis. Bar Element – Stiffness matrix formulation by direct and polynomial methods. Boundary condition and assemblage concepts. Beam element characteristics matrix. Global, local, natural coordinates - Numerical Integration.

UNIT III 2D ELEMENTS 12

Rectangular elements - Quadratic quadrilateral elements - Linear Triangular elements - 2D elements applications for plane stress, plane strain and axi-symmetric problems. Numerical integration schemes. Iso Parametric elements

UNIT IV APPLICATION OF FEM 12

1D & 2D problems in Solid mechanics, fluid mechanics and heat transfer by conduction and convection. Torsion of non circular shaft - axisymmetric problem - acoustic vibration. Dynamics problems representation in FE.

UNIT V FIELD PROBLEM 12

Case Studies like Structural analysis of Chassis Frame, Heat transfer analysis of piston, fins, Whirling speed of propeller shaft, contact analysis of gears, modal analysis of suspension system etc. FE software package review.

Total hrs: 60

TEXT BOOK:

1. Segerlind,L.J., Applied Finite Element Analysis, Second Edition, John Wiley and Sons Inc., New York, 1984
2. Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, "Concepts and applications of finite element analysis", 4th edition, John Wiley & Sons, 2007.

REFERENCES

1. Krishnamurthy, C.S., Finite Element Analysis, Tata McGraw Hill, 1987.
2. Ramamurthi,V., Computer Aided Design in Mechanical Engineering, Tata McGraw Hill, 1987.
3. Bathe,K.J. and Wilson,E.L., Numerical methods in finite element analysis, Prentice Hall of India Ltd., 1983.

MCE08 COMPUTER AIDED DESIGN OF CRYOGENIC PROCESS PLANTS 3-0-0-3

UNIT I 9

Introduction to computer aided design; simulation, design and optimization. Sequential modular simultaneous solution method.

UNIT II 9

Simulation of thermal systems. Thermodynamics and transport properties of Cryogenic fluids, equations of state, vapour - liquid equilibrium.

UNIT III 9

MIPROPS, DDMIX AND ALLPROPS physical properties programs. Cryogenic process plants, development of mass, momentum and energy balance equations.

UNIT V 9

Introduction to general and special purpose process plant simulators. Simulation of liquefiers and refrigerators based on Line, Claude and mixed refrigerant cycles using available process simulators.

UNIT V 9

Computer aided design of heat exchangers, expansion turbines and distillation columns.

Total hrs: 45

Reference:

1. Computer Aided Chemical Engineering By L.M. Rose
2. Plant Design and economics for Chemical Engineers Max Stone Peters, Klaus D. Timmerhaus, Ronald Emmett West, Ronald E. West

MCE09 CRYO HEAT TRANSFER 3-1-0-4

UNIT I Convective Heat Transfer 12

Generalised solution of steady and unsteady conduction equations: Heat transfer through composites and materials of variable thermal properties: Analytical and numerical methods.

UNIT II Conductive Heat Transfer Problem 12

Insulation, Heat leakage and Cooldown looses; Fins and Heat Exchangers.

UNIT III Convective Heat Transfer 12

Analysis and Theories; Evalution of heat transfer and friction coefficients; Reynolds analogy, Turbulent and Laminer flow; Forced convection, Natural convection and near critical heat transfer regions.

UNIT IV Two Phase Phenomena 12

Physical description, Pool boiling, Critical heat flux, Condensation, Evaporation, Pressure drop of Two Phase fluid, Forced convection with Two Phase flow, Super fluid heat transfer.

UNIT V Radiation 12

Physics, Properties, Shape factor, Radiative Exchange.

Total hrs: 60

Reference:

1. Cryo Heat Transfer by Randall Barron.
2. Cryogenic Technology & Applications A.R.Jha

MCE10 GAS TURBINES AND JET PROPULSION 3-1-0-4

UNIT I 12

Thermodynamic cycle analysis of gas turbines; open and closed cycles. Axial flow turbines; blade diagrams and design of blading, performance characteristics.

UNIT II 12

Centrifugal and axial flow compressors, blowers and fans. Theory and design of impellers and blading.

UNIT III 12

Matching of turbines and compressors. Fuels and combustion, effect of combustion chamber design and exhaust on performance.

UNIT IV 12

Basic principles and methods of heat recovery. Thermodynamic cycle analysis and efficiencies of propulsive devices.Thrust equation, classification and comparison of ram jets, turbojets, pulse jets and rockets.

UNIT V 12

Performance of turbo-prop, turbo-jet and turbo-fan engines. Augmentation of thrust.

Total hrs: 60

Referance:

1. Gas Dynamics & Jet Propulsion by S.L.Soma Sundaram
2. Gas Turbines & Jet Propulsion by G.Geoffrey & Smith

MCE11 DESIGN OF CRYO. EQUIPMENT AND ACCESSORIES 3-1-0-4

UNIT I 12

Mechanical and Thermal Properties of engineering materials at low temperatures; Tube, Plate and shell stresses, thermal stresses; safety requirements and codes of practice.

UNIT II 12

Components of Cryogenic refrigerators and liquefiers; Compressors: types, construction and characteristics.

UNIT III 12

Expansion machines: characteristics of reciprocating and turbine expanders; Heat exchangers and regenerators theory, types, design approaches and selection criteria, Computer aided design.

UNIT IV 12

Design of Cryogenic process plants; process charts of existing industrial systems; Stirling and G.M. cycle based cryorefrigeration.

UNIT V 12

Production of industrial gases: nitrogen, oxygen, argon, helium, hydrogen, acetylene and nitrous oxide. Instrumentation and control in cryogenic systems.

Total hrs: 60

Reference:

1. Hand book of cryogenic Engineering by J.G.Weisend

\MCE12 CRYO. ENGINEERING LAB 0-0-3-2

1. Experiments on Heat transfer.
2. Experiments on Mass transfer.
3. Experiments on Compression and expansion
4. Experiments on machinery and components of Cryogenic Systems

SEMESTER - III

MCE 13 PRACTICAL TRAINING 0 0 3 2

Students are supposed to undergo practical training in cryogenic fields for 15 days and submit a report on the training. Viva voce exam will be conducted at the end of the semester to evaluate the knowledge gained during the training.

MCE 14 PROJECT PHASE-I 0 0 10 5

Students should select the area of the project and do extensive literature survey and identify the problem of the project. Should make a review paper based on literature survey and present a paper in National/International conference. At the end of the semester a report has to be prepared and submitted for viva voce examination.

SEMESTER IV

MCE 15 PROJECT WORK 0 0 30 15

Surdents are supposed to carry out a Project work in the inter- disciplinary areas like medicine, biotechnology, instrumentation Engineering. The Project Work will bé for a period of 6months and at the end of the semester they have to submit the Project report. The projects useful to the society are encouraged.

Project ViaVoce exam will be conducted at the end of the semester with external and internal examiners..

LIST OF ELECTIVES

MCEE 01 CRYO BIOLOGY 3-0-0-3

Unit I 9

Introduction

Low Temperatures in Nature Cryomedicine: Cryosurgery and Cryopreservation.

Lyophillization Cryofixation. Destruction of Biological Tissues.

Forensic Medicine Food Industry Numerical Simulation of Cryoaction

Unit II 9

Ice Formation in Biological Medium

Amorphous Ice, Water, Biological water. Crystallization in Heterogeneous Media

Unit III 9

Biological Effects of Low Temperatures

Processes in cells Under Hypothermia Antifreeze Proteins (AFPs), Ice Nucleating Agents (INAs) Protein Denaturation Membrane Behavior, Cells in Aqueous Solutions Cell Dehydration Intracellular Ice Cryoprotective Agents, Cell Interaction with Crystallization Front

Unit IV 9

Heat Transfer in Biological Tissues

Heat Transfer in Living Tissues, Continuum Models, Vascular Models, temperature Fluctuations in Living Tissues

Unit V 9

Mechanical Stress in Frozen Biological Objects

Stress in Frozen Tissues, Stress in Vitrified Biological Objects

Total hrs: 45

Reference:

1. Fundamentals of Cryobiology by Zhmakin, Alexander I
2. Cherie Winner ,Lener Publishing group 2005- ISBN-10,ISBN-13

MCEE 02 MAN POWER ECONOMICS 3-0-0-3

UNIT I 9

Manpower problems and the Scope of Manpower Economics; Manpower and Human Capital Formation; Employment and Manpower Utilization.

UNIT II 9

Determination of the General Level of Employment, Supply and Demand for Labour, Wage Determination, Definition and Structure of Labour Markets, Labour Productivity - Concepts and Measurement; Concepts and Patterns of Unemployment and Underemployment.

UNIT III 9

Emergence of Education as a Work Prerequisite; Returns to Investment in Education; Role of Apprenticeship and on-the-job Training.

UNIT IV 9

Meaning and Importance of Manpower Planning at the Macro and the Micro Level; Forecasting and Auditing of Manpower; Quantitative and Qualitative Techniques of Manpower Planning.

UNIT V 9

Manpower Planning and Total Quality Management; Comparative Manpower Planning and Development Policies of a few selected countries under Competitive Environment.

Total hrs: 45

Reference :

1. Man power economics by Edward B.Jakubauskas , Neil A.Palomba.(1973)
2. Man power economics by Lowell E. Gallaway

MCEE 03 ROBOTICS AND SENSORS 3 0 0 3

UNIT I INTRODUCTION 9

Basic concepts-Robot anatomy-robot configurations-Basic Robot motions-Types of drives-Applications-

Material Handling-Processing-Assembly and Inspection -Safety considerations.

UNIT II TRANSFORMATIONS AND KINEMATICS 9

Vector operations-Translational transformations and Rotational transformations-Properties of transformation

Matrices-Homogeneous transformations and Manipulator-Forward solution-Inverse solution

UNIT III CONTROLS AND END EFFECTORS 9

Control system concepts-Analysis-control of joints-Adaptive and optimal control-End effectors-

Classification-Mechanical-Magnetic-Vacuum-Adhesive-Drive systems-Force analysis and Gripper design

UNIT IV ROBOT PROGRAMMING 6

Methods -Languages-Computer control and Robot Software-VAL system and Language

UNIT V SENSORY DEVICES 12

Non-optical and optical position sensors-Velocity and Acceleration-Range-Proximity-touch-Slip-Force-

Torque-Machine vision-Image components-Representation - Hardware-Picture coding-Object recognition and

Categorization-Software consideration- Case Studies

Total hrs: 45

REFERENCE:

1. Fu K.S., Gonzalez R.C.., Lee C.S.G., "Robotics control, sensing, vision, and Intelligence", McGraw Hill Book Co.,,1987

2. Klafter R.D., Cmielewski T.A. and Negin M ., "Robot Engineering An Integrated approach", Prentice Hall of India, New Delhi, 1994

3. Deb S.R., "Robotics Technology and Flexible Automation", Tata McGraw Hill Publishing Co., Ltd., 1994

4. Craig J.J., "Introduction to Robotics Mechanics and Control", Addison Wesley, 1999

5. Groover M.P., "Industrial robotics Technology, programming and applications", McGraw Hill Book Co., 1995.

WEB REFERENCE:

1. http://www.robotics.com

MCEE 04 BIO MEDICAL EQUIPMENTS & DEVICES 3 0 0 3

UNIT I CARDIAC CARE UNITS 6

Pace makers – different types, batteries for pace makers, AC defibrillators, asynchronous and synchronous DC defibrillators, patient monitoring system.

UNIT II NEUROLOGICAL EQUIPMENTS 10

Stereo toxic UNIT, depth recording system, dot scanners, transcutaneous nerve stimulator, anesthesia Monitor, EEG controlled Anesthesia, Bio Feedback Equipments, Spinal Reflex Measurements, Front end devices for all Biomedical Equipments

UNIT III DIATHERMY AND STIMULATOR 10

Depth of penetration and physiological effects of H.F. radiation, short wave, Ultrasonics, and Micro Wave Diathermy, Surgical Diathermy, Physiological effects of stimulation, Galvanic, Farradical Surged types, Interfrantial Therapy.

UNIT IV BIO-TELEMETRY 8

Principal, frequency selection for Telemetry, radio pills, multiplexing and tracking techniques, Telestimulation

UNIT V RECENT TRENDS 6

Principles of Thermography, detecting circuits, its application in medicine, principles of Cryogenic Techniques, its application in medicine, Principles of Fiber optic cable, Endoscopy, Laproscopy, Opthaimic Equipments.

UNIT VI ELECTRICAL SAFETY 5

Micro and macro shock, sources of shock, monitoring and interrupting circuit from leakage current, Earthing scheme.

Total hrs: 45

REFERENCES:

1. Albert M. Cook and Webster J.G., Therapeutic Medical Devices, Prentice Hall Inc., New Jersery, 1982.
2. Feinberg B.N. Applied Clinical Engineering, Prentice Hall Inc., Engiewood Cliffs, New Jersery, 1986
3. Khandpur R.S. Handbook of Biomedical Instrumentation. Tata McGraw Hill Publishing company, New Delhi 1999.
4. Jacobson B. and Webster. J.G. Medicine and Clinical engineering, Prentice Hall of India, New Delhi, 1999
5. Leslie Cromwell, etal., Biomedical Instrumentation and measurements, Prentice Hall India, New Delhi, 2000

MCEE 05 CRYO TISSUE ENGINEERING 3 0 0 3

UNIT I INTRODUCTION 9

Introduction to tissue engineering: Basic definition; current scope of development; use in therapeutics and in vitro testing, Structure and organization of tissue; epithelial, connective; vascularity, lymph. Basic developmental biology.

Transport Properties of Tissues I: Introduction to mass transfer, Diffusion of simple metabolites, Diffusion & reaction, Diffusion & reaction of proteins, General aspects of cells in culture; Transport limits on 3D cultures.

UNIT II CELL MATRIX & INTERACTIONS 10

Cell – Matrix & Cell –Cell Interactions, Cells in culture on different kinds of matrix – different cell types, staining, differential cell adhesion & tissue organization, Hormone& Growth Factor Signaling I, Hormone & Growth Factor Signaling II, Growth factor delivery in tissue engineering, Quantitative analysis of receptor- legend binding

UNIT III CELL GROWTH 10

Applications of growth factors: VEGF / angiogenesis, Scaffolds & tissue engineering- Basic properties, Scaffolds, LAB DEMO: Scaffolds, Basic transplantation immunology, Stem Cells I:Introduction, Hematopoietic, Stem Cells II: ES cells, Recitation: Cell surface markers, FACS analysis, repopulation experiments, Stem cells III: Jainism paper, Stem Cells IV: Blood from ES Cells paper, Basic wound healing, Stem cells & bone

UNIT IV CELL MIGRATION 9

Cell Migration I, Cell Migration II,Control of cell migration in tissue engineering, Case study of multiple approaches: Introduction to liver path physiology.

UNIT V TRANSPLANTION 7

Cell transplantation for liver tissue engineering, In vitro organogenesis Physiological models, case studies.

Total hrs: 45

Reference

1. J B Park, Biomaterials –Science and Engineering, Plenum Press, 1984
2. Sujata V. Bhat, Biomaterials, Narosa Publishing House, 2002
3. Jonathan Black, Biological Performance of materials, Marcel Decker, 1981
4. C.P.Sharma & M.Szycher, Blood compatible materials and devices, Technomic publishing Co.Ltd.,1991

MCEE 06 BIO INFORMATICS 3-0-0-3

Unit I: 9

Sequence Databases and Information Retrieval: Nucleotide Sequence Databases; GenBank, EMBL, DDBJ, all as part of INSDC; accession numbers & annotations, Medical Databases

9

Unit II.

Pairwise Sequence Comparisons: biology of homology, PAM & BLOSSUM scoring matrices, global & local alignment algorithms, statisical significance of pairwise alignments.

Unit III. **9**

BLAST, FASTA and Advanced BLAST: Database searching, FASTA algorithm, BLAST ALGORITHM, PSI BLAST, STATISTICAL SIGNIFICANCE OF DATABASE SEARCHES

9

Unit IV:

Protein Sequence and Structure Analyses : 4 essential perspectives on proteins: (1) domains and motifs, (2) physical properties, (3) protein localization, (4) protein function. Gene Ontology for these perspectives in action; proteomics - methods, practices, databases introduction to protein structure and structural genomics; principles of protein structure & protein folding - X-ray crystallography and NMR - the PDB, RCSB, SCOP, CATH, DALI, FSSP & others.

Unit V. 9

MSA's or Multiple Sequence Alignments: Hierarchical and non-hierarchical Methods - MSAs by PSI-BLAST , Tools for MSAs, 3D-PSSM Protein Fold Recognition (Threading) Server: Introduction to Molecular Evolution, Tree nomenclature and structure; the 4 stages of Phylogenetic Analysis, tree-building methods, NJ, MP, ML, tree-evaluation methods, the Bootstrap, Phylogenetics: Introduction to the basics, Models, Assumptions, & Interpretations, How to construct a Tree in 4 steps; the differences, between Parsimony, Distance, and Likelihood.

Total hrs: 45

TEXTBOOKS

- Bioinformatics and Functional Genomics by Jonathan Pevsner (2003), Wiley-Liss
- Bioinfbook.org - Website dedicated to the text with updated URLs

REFERENCES

1. An Introduction to Bioinformatics Algorithms by N.C. Jones & P.A. Pevzner (2004), MIT Press
2. Phylogenetic Trees Made Easy: A How-To Manual, Second Edition by Barry G. Hall (2004), Sinauer Associates, Inc.
3. Bioinformatics and Molecular Evolution by Paul G. Higgs and Teresa K. Attwood (2005), Blackwell Publishers
4. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, edited by Baxevanis & Oulette (2005), Wiley-Interscience
5. Fundamental Concepts of Bioinformatics by D.E. Krane & M.L. Raymer (2003), Benjamin Cummings

MCEE07 CRYO PHYSICS 3-0-0-3

UNIT-I 9

Introduction to quantum mechanics, the electronic structure of atoms, Molecular orbits and Covalent bonds, Molecular interaction, Stereochemistry and Chirality, Thermodynamics-Entropy, Enthalpy, Free energy of a system, Chemical Potential, Oxidation-Reduction Potential, Radioactivity-rate of radioactivity decay and application of radio isotopes.

UNIT-II 9

Macromolecular structure-Introduction, Chemical structure of nucleic acids, the double Helical structure of DNA,DNA Super coiling and unusual DNA Structures, the Structure of transfer RNA, Protein Structure-Amino acids, Primary structure of proteins, Peptide Bond and Secondary Structures of Proteins, Tertiary Structures, Quaternary Structure.

UNIT-III **9**

Introduction-Free Energy, Coupled reaction, Photosynthesis-Photsystem I, Photosystem II, Photophosphorylation and Carbon fixation. Energy Conservation pathways, Oxidation, Glycolysis Kerbs cycle, Respiratory chain, Membrane transport-active transport, Chemi-Osmotic theory-Passive Transport.

UNIT-IV **9**

Separationtechniques-Chromatography-ColumnChromatography,Thinlayer Chromatography, Paper Chromatography, Adsorption Chromatography, partition
Chromatography, Gas Liquid Chromatography, Ion-exchange Chromatography,
Molecular Exclusion Chromatography, Affinity Chromatography.

UNIT-V **9**

Spectroscopy-Introduction, Ultraviolet Spectroscopy, Fluorescence spectroscopy

Infrared Spectroscopy, Raman Spectroscopy, Electron spin resonance,

NMR-Introduction, Basic Principles of NMR,NMR Application in Biochemistry, Biophysics and Medicine.

Total hrs: 45

Text Books

1. Vasantha Pattabhi, N.Gautham . Biophyiscs

2. G.R.Chatwal, Edited by Madhu Arora.Himalaya Publishing House. Biophysics

3. Rodney Cotterill, John Wiley & sons, LTD. Biophysics an Introduction

MCEE08 QUANTITATIVE METHODS 3-0-0-3

UNIT1 9

Statistical population, sample from population, random sample, Tabular and graphical presentation, Mean and standard deviation of group and ungrouped data. Measures of central tendency, measures of dispersion, measures of skewness (using calculators) , Correlations (product-moment coefficient, Spearman's rank coefficient) and regression (linear regression, curve fitting)

UNIT2. 9

Data presentation (tables/figures): 1-D and 2-D bar charts, pie diagrams, graphs (using computer software packages), Statistical distributions: fitting discrete uniform, binomial, Poisson and normal probability distributions to given data 3

UNIT3. 9

Testing of hypothesis, Test of significance, test for proportion, means and standard deviations, F and t test, chi-square test for goodness 10of fit, Theory of errors, errors and residuals, precision, measure of precision, probable error of function, rejection of observation

UNIT4. 9

Methods of averages and least squares, Correlation and linear regression, associated test of significance, Analysis of variance for one and two way classification.

UNIT5 9

Design of experiments, Sampling, randomization, replication, local control, completely randomized and randomized block design. Nonparametric tests.

Total hrs: 45

Text Book

1.Statistical Methods in biology by Norman T.J. Bailey (3rd Edition), Cambridge University Press (1995)

2.Biostatistics How it works, Steve Selvin, Pearson Education, (2004)

MCEE 09 SUPERCONDUCTING MATERIALS, MAGNETS AND DEVICES 3-0-0-3

UNIT I 9

Review of critical current densities and critical magnetic fields of type II superconductors;

UNIT II 9

Magneto-thermal instabilities in type II superconductors; Concept of flux pinning mechanisms.

UNIT III 9

Techniques of preparation of superconducting materials of type Nb3Sn, V3Ga and ceramic superconductors in the form of wires and tapes; Stabilization Criterion.

UNIT IV 9

Superconducting coil devices: Superconducting magnets, persistent current switches;

UNIT V 9

Basic concepts of superconducting bearings, motors and energy storage. Superconducting thin film devices: negative resistance devices. Weak link devices including SQUIDS and its applications; infrared dectors

Total hrs: 45

Reference:

1. Macroscopic theory of Superconductivity (Vol 1),1950 by Fritz London
2. Macroscopic theory of Superfuilid Helium (Vol 2),1954 by Fritz London
3. Superfluidity & Superconductivity, 1974 by Dr.Tilley & J.Tilley

MCEE 10 VACUUM TECHNIQUES 3-0-0-3

UNIT I 9

Review of physical principles of vacuum - flow regimes: conductance and throughput Viscous and molecular flow calculations for typical cases

UNIT II 9

Physico chemical phenomena in vacuum techniques; production and measurement of high and ultra high vacuum

UNIT III 9

Leak detecting procedures - Materials and components for vacuum and high vacuum systems.

UNIT IV 9

Applications of vacuum Technology; Ultra high vacuum in space simulation and nuclear physics.

UNIT V 9

High vacuum coating units; Super insulated vacuum containers for storage of cryogenic fluids.

Total hrs: 45

Reference:

1. Vacuum Technology by A.Roth, North Holland.
2. Introduction to Vacuum Technology David M. Hata
3. Basic Vacuum Technology by A.Chambars