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

#### DEPARTMENT OF MECHANICAL ENGINEERING

#### M.Tech – BIO MECHANICAL ENGINEERING

# CURRICULUM 2013

#### SEMESTER I

S.No	Sub. Code	Title of Subject	L	Т	Р	С
1	MBM101	Advanced Mathematics for Bio Engineers	3	1	0	4
2	MBM 102	Introduction to Biological Science	3	0	0	3
3	MBM 103	Human Anatomy and Physiology	3	0	0	3
4	MBM 104	Structural kinesiology	3	1	0	4
5	MBM 105	Transport Phenomena	3	1	0	4
6	MBM 106	Micro fluid devices Lab	0	0	3	2
		TOTAL	15	3	3	20

S.No	Sub. Code	Title of Subject	L	Т	Р	С
1	MBM 107	Finite element analysis	3	1	0	4
2	MBM 108	Bio Mechanics	3	1	0	4
3	MBM 109	Applied Bio Materials.	3	0	0	3
4	MBM 110	Introduction to cell & Tissue Engineering	3	0	0	3
5	MBM 111	Bio informatics	3	0	0	3
6	MBM 112	Bio Mechanical Lab	0	0	3	2
		TOTAL	15	2	3	19

#### **SEMESTER-II**

S.No	Subject Code	Title of Subject	L	Т	Р	С
1	MBM 113	Computational fluid dynamics	3	1	0	4
2	MBM 114	Bio medical equipments & devices	3	0	0	3
3	MBME XXX	Elective I	3	0	0	3
4	MBME XXX	Elective II	3	0	0	3
5	MBME XXX	Elective III	3	0	0	3
6	MBM 115	Mini Project	0	0	12	5
		TOTAL	15	1	12	21

#### **SEMESTER-III**

#### SEMESTER-IV

S.No	Subject Code	Title of Subject	L	Т	Р	С
1	MBM116	Project work	0	0	20	15

Sl. No.	Sub.Code	Title of Subject	L	Т	Р	С
1	MBME001	Cryo Biology	3	0	0	3
2	MBME002	Evolution of Biological Machines	3	0	0	3
3	MBME003	Quantitative Methods	3	0	0	3
4	MBME004	Stem cell Technology	3	0	0	3
5	MBME005	Bio Physics	3	0	0	3
6	MBME006	Recent advances applied to Hospital Engineering	3	0	0	3
7	MBME007	Robotics and sensors.	3	0	0	3
8	MBME008	IPR, Bio safety and Bio Ethics	3	0	0	3
9	MBME009	Bio Medical Instrumentation	3	0	0	3
10	MBME010	Digital image processing	3	0	0	3

### LIST OF ELECTIVES

### **SEMESTER-I**

#### MBM 101 ADVANCED MATHEMATICS FOR BIO ENGINEERS 3 1 0 4

#### UNIT I MATRIX THEORY

Eigen values using QR transformations – generalized eigenvectors – canonical forms – singular value decomposition and applications – pseudo inverse – least square approximations.

# UNIT IIDIFFERENTIAL EQUATIONS – NONLINEAR ORDINARY DIFFERENTIAL<br/>& PARTIAL DIFFERENTIAL EQUATIONS12

Introduction – Equations, with separable variables – Equations reducible to linear form – Bernoulli's equation – Riccati's equation – Special forms of Riccati's equation – Laplace transform methods for one dimensional wave equation – Displacement in a long string – Longitudinal vibration of an elastic bar.

#### UNIT III CALCULUS OF VARIATION

Introduction – Euler's equation – several dependent variables Lagrange's equations of Dynamics – Integrals involving derivatives higher than the first – Problems with constraints – Direct methods and eigen value problems.

#### UNIT IV INTERPOLATION AND INTEGRATION 12

Hermite's Interpolation – Cubic Spline Interpolation – Gaussian Qundraline – Cubature.

#### UNIT V LINEAR PROGRAMMING PROBLEM

Simplex algorithm – Two phase and Big M Techniques – Duality theory – Dual simplex method – Integer programming.

#### Total hrs: 60

#### **TEXT BOOKS**

- 1. Stephenson, G, Radmore, P.M., Advanced Mathematical Methods for Engineering and Science students, Cambridge University Press 1999.
- 2. Bronson, R., Matrix Operations, Schaum's outline series, McGraw Hill, New York, 1989.
- 3. Kreyszig, E., Advanced Engineering Mathematics, John Wiley, 8<sup>th</sup> Edition, 2004.

#### REFERENCES

- 1. Froberg, C.E. Numerical Mathematics, The Benjamin/Cummings Publishing Co., Inc., 1985.
- 2. Jain, M.K., Iyengar, S.R.K., and Jain, R.K., Numerical Methods for Scientific & Engineering computation, Wiley Eastern Ltd., 1987.
- 3. Gupta, A.S. Calculus of Variations with Applications, Prentice Hall of India Pvt. Ltd., New Delhi, 1997.
- 4. Sankara Rao, K., Introduction to Partial Differential Equations, Prentice Hall of India Pvt Ltd., New Delhi 1997.
- 5. Boyce & Di Prima, Elementary Differential Equations and Boundary value problems, with ODE Architect CD, 8<sup>th</sup> Edition, 2005.

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#### M.Tech Bio Mechanical Engineering

#### **MBM102** INTRODUCTION TO BIOLOGICAL SCIENCE

#### UNIT – I

UNIT – II

UNIT – III

**MOLECULES OF LIFE** 

#### SINGLE CELL BIOLOGY

Chemical Foundation for cells, carbon compounds in cell, cell structure and function, Energetic at the cellular level, Oxidation of food stuffs.

MULTI CELLULAR BIOLOGY

Cell division, Mitosis, Meioses, Principles of cell structure & function, Tissues, **Organs & Homeostasis** 

Properties of water, Acids, Bases & Buffers, Structure & Organization of Macro molecules (carbohydrates, Proteins, lipids, nucleoproteins (DNA & RNA)

SIGNAL TRANSDUCTION

**Receptors and Signal Transducers** 

UNIT -V

UNIT – IV

#### **IMMUNE SYSTEM**

Cells of immune System inmate and acquired immunity. Immune response to infectious disease, Genetics of Transplantation, Transplantation Laws.

**Reference:** 

1.Lehninger, Principles of Bio Chemistry, C.B.S.Publishers and distributors.

2.Baltimore, Cell and molecular Biology, Free man publishers.

3.J.L.Jain, leinger, Bio chemistry, C.B.S.Publishers and distributors

4.Kuby,Immunology,TBH Publishers.

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Total hrs: 45

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M.Tech Bio Mechanical Engineering

#### MBM 103HUMAN ANATOMY AND PHYSIOLOGY3003

#### UNIT – I

Human Body Structure - Body Functions and Life Process - Useful Terms for Describing Body Parts and Activities - Directional Terms - Planes of the Body - Body Cavities -

#### UNIT - II

Skeletal System - Functions of the Skeletal System - Structure of Bone Tissue - Bone Development and Growth - Classification of Bones - Divisions of the Skeleton - Articulations.

#### UNIT - III

Muscular System - Functions of the Muscular System - Structure of Skeletal Muscle - Muscle Types - Skeletal Muscle Groups - Muscles of the Head and Neck - Muscles of the Trunk - Muscles of the Upper Extremity - Muscles of the Lower Extremity

#### $\mathbf{UNIT} - \mathbf{IV}$

Cardiovascular System - Introduction to the Cardiovascular System - Heart - Structure of the Heart -Physiology of the Heart - Blood - Classification & Structure of Blood Vessels - Physiology of Circulation - Circulatory Pathways

#### UNIT V

Respiratory System - Introduction to the Respiratory System - Mechanics of Ventilation -Respiratory Volumes and Capacities - Conducting Passages - Nose and Nasal Cavities - Pharynx -Larynx & Trachea - Bronchi, Bronchial Tree, and Lungs

#### Total hrs: 45

#### **References:**

- 1. Sarada Subramanyam and K. Madhavankutty, "**Text Book of Human Physiology**" S. Chand and Company Ltd, New Delhi
- 2. Murugesh. N, "Basic Anatomy and Physiology" Sathya Publishers, Madurai.

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# MBM 104STRUCTURAL KINESIOLOGY3 1 0 4UNIT : I

The concept of Structural Kinesiology, its aims and objectives. - Academic and Professional objectives of Structural Kinesiology - Professional applications of Structural Kinesiology - The role of Kinesiology in Physical Education and Sports - The Kinesiology importance of bones, Joints and muscles - The fundamental movement of joints and their terminology - The axis and planes involved in joint movements - The structural classification of skeletal muscles and type of contractions - Classification of Muscles produced movements - The techniques of muscular analysis.

#### UNIT: II

Classification of Joints- moveable, partly moveable and immovable. The attachment and actions of muscles of following joints - a) Shoulder Girdle and Shoulder: Trapezius, Levator Scapula, Rhomboids, Seratus Anterior, Pectoralis Minor and Major, Deltoids, Supraspinatus, Teres Minor and Major, Infraspinatus, Subscupularis and Biceps. b) Elbow Joint: Biceps Brachii, Pronator Teres, Brachordialis, Brachialis, Triceps, Pronator, Quadratus and Supinator. c) Hip Joint: Illiopsoas Minor and Major, Pactinues, Rectus Femoris, Sartorius, Tensor Fascielatea, Biceps Femoris, Semimebranious, Semitendinosus, Glteus Maximus, Obturator externus and internus, Adductor Magnus, Longus and Brevis.

#### **UNIT: III**

The attachments and actions of muscles of following joints: Knee Joint - Quadriceps- Rectus Femoris, Vastus Medialis, Vastus Lateralis, Vastus Ingtermedius. - Hamstring Group- Biceps Femoris, Semi Membranosus, Semi Tendinisus, Sartorius, Popliteus, Gastrenemius - Ankle and foot Joints: Gasronemius, Soleus, Tibialis anterior and Posterior, Fkexor and Extensor Digitorum Longus & brevis, Extensor Hallucis Longus. Neck and Trunk Region: Sternomastoid, Trapezius, Splenius Capitis, Infraspinatus, Levator Scapulae, Teres Major and Minor, Serratus anterior, Splenius, La-tissimus dorsi, Erector Spial, Rectus abdominis, Obliqes inturnus & externus. Criteria of good posture and its importance - Causes of Poor Posture - Specific deformities- Kyphosis, Lordosis, Scoliosis, Knock knees, Bow legs and flat foot and their remedies

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#### **UNIT: IV**

Meaning and concept of Kin anthropometry - Scope and importance of Kin anthropometry in physical education and sport - Muscular Power, Strength and endurance - Body constitution and composition The mobility and stability of joints. Composition and structure of bone - function of skeleton with an emphasis on movement - classification of bones - load-deformation curve of bone; how bone accommodates force - synovial joints and motions possible at each joint during various types of exercises -. identification of all bones and their major markings (focus is on appendicular skeleton) - factors which affect bone growth (impact of diet and exercise) - identification of ligaments and structural parts of the shoulder, elbow, hip, knee and ankle joints of the body - application of knowledge of skeletal system to the teaching of various skills - diseases/disorders of the skeleton and synovial joints which impact physical activity.

#### $\mathbf{UNIT} - \mathbf{V}$

Skeletal muscle considerations for Human Movement Function - . structure, muscle types applied to human motion - types of muscular actions during various exercise – activities - physiology of muscular action - skeletal muscle as part of a lever system during exercise - identification of major skeletal muscles of the body - identification of primary actions of each muscle in walking, running, cycling, striking, kicking, throwing, and weight lifting activities - postural muscles - increasing muscle flexibility - exercises for strengthening and stretching muscles -

#### Total hrs: 60

#### **PRACTICAL DEMONSTRATION:**

- 1. Identification of various kinds of movements of joints
- 2. Measurement of range of movements of various joints with the help of goniometer or flexometer
- 3. Palpitation of superficial muscle of the body
- 4. Demonstration of Isometric, Isotonic and Isokinetic movements
- 5. Demonstration of concentric and eccentric contractions of muscles
- 6. Demonstration of Stretch reflex of muscles
- 7. Identification of kind of lever involve in the movement performed by the examiner
- 8. Demonstration of corrective exercises for Kyphosis, Lordosis, Scoliosis, Knock-Knees and Flat Foot.

#### References

- 1. Zatsiorsky, V.M. Kinematics of Human Motion, Human Kinetics: Champain IL, 1998
- Deiels, L. and Worthinghan, C., Muscle Testing Techniques of Manual Examination, Lousion W.B. Saunders Com, 1956
- Hawley, G. The Kinesiology of Corrective Exercise, Phildelphia Lea ano Febiger, 1937 Syllabus: M.P.Ed- Semester System, P.U, Chandigarh
- 4. Kelly, d.L. Kinesiology: Fundamental of Motions Description Angle Cliffs, N.I Frentice-Hall, Inc. 1971
- Lattgans, K. and others. Kinesiology Scientific Basis of Human Motion 8<sup>th</sup> Ed. Dubuque, W.C.B. Publishers, 1992
- Rasch. P.I. Bruke, R.K. Kinesiology and Applied Anatomy: The Science of Human Movement (6<sup>th</sup> Ed.) Phildelphia: Lea and Febiger, 1978.
- Jenson, C.R. & Schult, G.W, Applied Kinesiology: The Scientific Study of Human Performance (2<sup>nd</sup> Ed.) New York: MC Grautids Book co., 1977
- Hay, J.G. The Biomechanics of Sports Techniques (2<sup>nd</sup> Ed.) Englewood Cliffs, N.I. Prentice Hall Inc. 1993.
- Smith Lara K and other Brunnstram's Clinical Kinesiology, Fifth Edition, Jaypee Brothers, P.B. No. 7193, New Delhi-1998.

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#### MBM105 TRANSPORT PHEMOMENA

#### UNIT I

#### INTRODUCTION AND BASIC CONCEPTS

General overview of transport phenomena including various applications. Transport of momentum, heat and mass, Transport mechanism, level of transport, Driving forces. Molecular transport (diffusion), convective transport (microscopic)

#### UNIT II

#### PROPERTIES, UNITS AND OTHER PHYSICAL PARAMETRES

Unit systems, temperature, mole, concentration, pressure. Gas laws, laws of conservation, energy and heat units.

#### UNIT III

#### MOMENTUM TRANSPORT

Basic concepts in fluid mechanics, Force, unit and Dimensions, Pressure in fluid, head of fluid-Molecular transport for momentum -heat and mass transfer. Viscosity of fluids, Newton's law-Momentum transfer ,Newtonian and non Newtonian fluids. Fluid flow and Reynols number, Overall mass balance .Control volume and Continuity equation. Overall energy balance, Bernoulli's equation, Overall momentum balance. Drag coefficient, Stokes law, Flow in packed beds, Flow in fluidized bed.

#### UNIT IV

#### ENERGY TRANSPORT

Basic concept in heat transfer, Heat transfer mechanisms. Fourier's law of heat conduction, thermal conductivity, convective heat transfer co- efficient. Conduction heat transfer- through flat slab/ wall through hollow cylinder. Conduction through solids in series, Forced convection heat transfer inside pipes. Heat transfer outside various geometrics in forced convection, General discussion on natural convection heat transfer, heat exchangers General discussion on radiation heat transfer

#### UNIT V

#### MASS TRANSPORT

Basic concepts in mass transport, some application examples, Modes of mass transfer. Molecular diffusion – Fick's Law, Analogy between mass, heat and momentum transfer. Dispersion, Hydraulic or Darcy's flow in porous media, Chemical kinetics and activation energy. Film Theory, Convective mass transfer, Liquid – solid mass transfer , Liquid –liquid mass transport. Gas – liquid mass transfer, Aeration and oxygen transport, Air stripping. Calculation using MAT LAB.

Total hrs: 60

#### Reference:

1.Bird.R.B,Stewart and Lightfoot,'Transport Phenomena' revised second edition, John Wiley and son ISBN978-0-470-11539-8

2.Robert.S.Brodkey, Haray.C, Hershy, 'Transport Phenomena A unified Approach.

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#### MBM106 MICRO FLUID DEVICES LAB 0 0 3 2

- 1. Fabrication of micro fluidic devices for biological applications.
- 2. Experiment using Photolithography and soft lithography,
- 3. Experiment using micromechanical valves and pumps. (Emphasis is on device design, fabrication, and testing.)

### **SEMESTER-II**

#### FINITE ELEMENT ANALYSIS **MBM 107**

#### UNIT I **INTRODUCTION**

#### 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**

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.

#### **2D ELEMENTS** UNIT III

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**

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**

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

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#### **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", 4<sup>th</sup> 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.
- 4. J. N. Reddy, "Finite Element Methods", 2<sup>nd</sup> Edition, 6<sup>th</sup> Reprint, Tata McGraw Hill, 2005.
- 5. Singiresu S. Rao, "The Finite Elements Methods in Engineering", 4th Edition, USA, 2005.

### .MBM108 BIO MECHANICS

#### UNIT I INTRODUCTION

Movements of the body, Spatial terms ,Anatomical Position, Planes and axes- Fundamental movements: Actions and definitions- Skeletal System – Osteology Composition and Structure of bones Growth and development of bones. General arthrology- Classification of joints and relation to motion.

#### UNIT II JOINT MOTIONS AND ANATOMICAL KINESIOLOGY

Synarthrodial Amphiarthrodial Diarthrodial Joint motions .Naming Characteristics that describe muscle features. Muscular system, muscle actions, Regional anatomical kinesiology. Upper Extremity Shoulder region ,Shoulder girdle- Lower Extremity Hip, Knee, and thigh Trunk

#### UNIT III LINEAR AND ANGULAR MOTION

Forms of Motion Translation –Rotation, General Motion, Linear Kinematics, Distance and displacement, Speed and Velocity, Acceleration and uniform motion Vector and Scalar Quantities. Units of linear kinematics Angular Kinematics Angular distance and Angular displacement Angular speed and angular velocity Angular acceleration Radius of movement.

#### UNIT IV KINEMATICS

Kinematics -Force -Properties of force -Magnitude ,Direction ,Point of application ,Line of Action ,Internal and External forces, Muscular forces ,Linear Kinetics ,Inertia Mass Weight ,Power Review of Force, Newton's first law of motion, Newton's second law of motion. Force- acceleration relationship ,Force- time relationship, Impulse and momentum .The relationship between force, Inertia and Linear acceleration, Newton's third law of motion- Conservation of Momentum

#### UNIT V FRICTIONAL FORCES AND FULID MECHANICS

Frictional Forces -Starting and stopping friction ,Sliding friction, Rolling friction ,Work and Energy ,Kinetic Energy, Strain Energy ,Potential Energy, Angular Kinetics ,Eccentric, parallel and concurrent forces -Toque -The lever system -Functions Classifications- Analogues to Newton's three laws of motion .Transfer of momentum- Fluid Mechanics -Static considerations: buoyancy and flotation- Dynamic considerations: resistance and propulsion ,Drag forces, Lift forces, Magnus effect. Mechanical Analysis of Movement Activities.

Total hrs: 60

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#### **References:**

- Kreighbaum, E. and Barthels, K. (1996) Biomechanics: A Qualitative Approach for studying Human Movement. Boston: Allyn and Bacon
- 2. Hall, S. (1999). Basic Biomechanics. St. Louis : McGraw Hill.
- Gowitzke, B.A and Milner, M. (1988). Scientific Bases of Human Movement. (3<sup>rd</sup> ed.) Baltimore: Willams and Wilkins.
- Groves, R. and Camaine, D. (1983). Concept in Kinesiology. (2<sup>nd</sup>.ed.), Philadelphia-Saunders college Publishing.
- Hay, J. (1978) The biomechanics of sport techniques. (2<sup>nd</sup> .ed.) Englewood Cliffs: Prentice-Hall
- Hay, J. & Reid, J. (1982) The Anatomical and Mechanical Bases of Human Motion Englewood Cliffs: Prentice – Hall
- Luttgens, K., Deutch, H. and Hamilton, N. (1992). Kinesiology, Madison : Brown and Benchmark
- Nordin, M. & Frankel, V. (1990). Basic Biomechanics of the Musculoskeletal System, Philadelphia: Lea & febiger.
- 9. Northrip, J. Logan, G. & McKinney, W. (1983). Analysis of Sport Motion. (3<sup>rd</sup>.ed.) Dubuque
  : William C. Brown
- 10. Rasch, P. (1989). Kinesiology and Applied Anatomy. Philadelphia : Lea & Febiger.
- Thompson, C. (1985). Manual of Structural Kinesiology. (10<sup>th</sup> ed.). St. Louis: Times Mirror/ Mosby College Publishing.

#### MBM109 APPLIED BIOMATERIALS 3 0 0 3

#### UNIT I INTRODUCTION

Definition of biomaterials, requirements of biomaterial, classification of biomaterials, Comparison of properties of some common biomaterials. Effect of physiological fluid on the properties of biomaterials . Biological responses (extra and intra- vascular system). Surface properties of materials, physical properties of materials, mechanical properties.

#### UNIT II METALLIC IMPLANT MATERIALS

Metallic implant materials- Stainless steel, Co- based alloys, Ti and Ti- based alloys. Importance of Stress- corrosion cracking. Host tissue reaction with biometal, corrosion behavior and the importance of passive films for tissue adhesion. Hard tissue replacement implant: Orthopedic implants, Dental implants. Soft tissue replacement implants: Percutaneous and skin implants, Vasular implants, Heart valve implants- Tailor made composite in medium.

#### UNIT III POLYMERIC IMPLANT MATERIALS

Polymeric implant materials – Polyolefins, polyamides, acrylic polymers, fluorocarbon polymers, silicon rubbers, acetyls. (Classification according to thermosets, thermoplastics and elastomers). Viscoelastic behavior: creep – recovery, Stress-relaxation, strain rate sensitivity. Importance of molecular structure, hydrophilic and hydrophobic surface properties, migration of additives (processing aids), aging and environmental stress cracking. Physiochemical characteristics of biopolymers. Biodegradable polymers for medical purposes, Biopolymers in controlled release systems. Synthetic polymeric membranes and their biological applications.

#### UNIT IV CERAMIC IMPLANT MATERIALS

Ceramic implant materials- Definition of bioceramics. Common types of bioceramics: Aluminum oxides, Glass ceramics, Carbons. Bioresorbable and bioactive ceramics. Importance of wear resistance and low fracture toughness. Host tissue reactions: importance of interfacial tissue reaction (e.g. ceramic/ bone tissue reaction). Composite implant materials- Mechanics of improvement of properties by incorporating different elements. Composite theory of fiber reinforcement ( short and long fibers, fibers pull out). Polymers filled with osteogenic fillers (e.g. hydroxyapatite). Host tissue reactions.

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#### UNIT V BIOCOMPATIBILITY & TOXICOLOGICAL SCREENING OF BIOMATERIALS 9

Biocompatibility and toxicological screening of Biomaterials-definition of Bio compatablity, blood compatibility and tissue compatibility. Toxicity tests, acute and chronic toxicity studies ( in situ implantation, tissue culture, haemolysis, thrombogenic potential test, systemic toxicity, intracutaneous irrigation test), sensitization, carcinogenicity, mutagenicity and special tests.

Sterilization techniques – ETO, gamma radiation, autoclaving. Effects of Sterilization on material properties. Testing of biomaterials/ Implants – In-vitro testing (Mechanical testing): tensile, compression, wears, fatigue, corrosion studies and fracture toughness. In- vivo testing (animals ): biological performance of implants. Ex-vivo testing: in- vitro testing simulating the in- vivo conditions. Standards of implant materials.

#### Total hrs: 45

#### Reference

- 1. J B Park, Biomaterials Science and Engineering, Plenum Press, 1984.
- 2. Sujata V. Bhat, Biomaterils, Narosa Publishing House, 2002
- 3. Jonathan Black, Biological Performance of materials, Marcel Decker, 1981
- C.P.Sharma & M.Szycher, Blood compatible materials and devices, Technomic Publishing Co. Ltd., 1991.
- Piskin and A S Hoffmann, Polymeric Biomaterials (Eds), Martinus Nijhoff Publishers. (Dordrecht. 1986)
- 6. Euguene d. Goldbera, Biomedical Ploymers, Akio Nakajima.
- 7. A. Rembaum & M.Shen, Biomedical Polymers, Mercer Dekkar Inc 1971.
- 8. Lawrence Start & GyanAgarwal, Biomaterials
- 9. L. Hench & E.C. Ethridge, Biomaterials- An Interfacial approach.

#### Department of Mechanical Engineering Dr. M.G.R. Educational and Research Institute University

#### MBM 110 INTRODUCTION TO CELL & TISSUE ENGINEERING 3 0 0 3

#### UNIT I INTRODUCTION

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

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- ligand binding.

#### UNIT III CELL GROWTH

Applications of growth factors: VEGF / angiogenesis, Scaffolds & tissue engineering- Basic properties, Scaffolds, LAB DEMO: Scaffolds, Basic transplantation immunology, StemCells 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

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

#### UNIT V TRANSPLANTION

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

### Total hrs: 45

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#### 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

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#### MBM 111BIOINFORMATICS3 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

#### UNIT II.

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

#### UNIT III.

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

#### 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.

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

An Introduction to Bioinformatics Algorithms by N.C. Jones & P.A. Pevzner (2004), MIT Press Phylogenetic Trees Made Easy: A How-To Manual, Second Edition by Barry G. Hall (2004), Sinauer Associates, Inc.

Bioinformatics and Molecular Evolution by Paul G. Higgs and Teresa K. Attwood (2005), Blackwell Publishers

Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, edited by Baxevanis & Oulette (2005), Wiley-Interscience

Fundamental Concepts of Bioinformatics by D.E. Krane & M.L. Raymer (2003), Benjamin Cummings

#### MBM 112BIO MECHANICAL LAB0 0 3 2

The goal of our laboratory is to advance experimental biomechanics understanding by providing practical training to engineering and medical students and advancing the boundary of knowledge through applied basic science research. To achieve these goals we combine in vivo testing of human and animal subjects with cadaver and surrogate in vitro models to understand injury mechanisms and predict failure risk. Finally, our lab collaborates with clinicians to develop preventative and regenerative treatments for soft tissue damage and degeneration.

Biomechanics: Human body motion analysis. Control of artificial arms/legs using biological principles. Rehabilitation applications of biomechanics. Biosensors and MEMS: Development of sensors for measuring pressure, temperature, force at the fingertips and soles of the feet. Polymer spinners and micro lithography.

#### **Facilities:**

• Vicon motion analysis system for gait analysis as well as joint motions during biomechanical testing.

- MTS servo-hydraulic materials testing machines.
- Pressure sensitive film for measuring contact pressures and areas during loading.
- Custom built shoe/surface rotational traction measurement device.
- Collaboration with tissue engineering laboratory and environmental SEM.

### **SEMESTER III**

#### MBM113 COMPUTATIONAL FLUID DYNAMICS 3 1 0 4

#### UNIT I

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

#### UNIT II

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**

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

Steady One-Dimensional and Two-Dimensional Convection – Diffusion, Unsteady onedimensional 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

Turbulence, Effect of Turbulence and time averaged Navier Stokes Equation, Algebraic Models – One equation model, K -  $\Box$  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: 45

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#### 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,.

### Department of Mechanical Engineering Dr. M.G.R. Educational and Research Institute University

#### M.Tech Bio Mechanical Engineering

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#### MBM114BIO MEDICAL EQUIPMENTS & DEVICES3 0 0 3

#### 1. CARDIAC CARE UNITS

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

#### 2. NEUROLOGICAL EQUIPMENTS

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

3. DIATHERMY AND STIMULATOR 10 Depth of penetration and physiological effects of H.F. radiation, short wave, Ultrasonics, and Micro Wave Disthermy, Survival Disthermy, Physiological effects of stimulation, Calvania, Formedical

Wave Diathermy, Surgical Diathermy, Physiological effects of stimulation, Galvanic, Farradical Surged types, Interfrantial Therapy.

#### 4. BIO-TELEMETRY

5. RECENT TRENDS

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

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.

#### 6. ELECTRICAL SAFETY

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

#### **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

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Total hrs: 45

#### MBM115 MINI PROJECT 0 0 12 5

Students based on field visits to hospitals, sports training centers ,Bio medical industries should carry out a mini project .The work should be socially useful and towards sustainable development.

The mini project will be reviewed by external and internal examiners during viva voce examination.

#### SEMESTER IV

#### **MBM 116**

**PROJECT WORK** 

0 0 20 15

Students are supposed to carry out a project work in the inter- disciplinary areas like medicine, biotechnology, instrumentation engineering and Mechanical 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..

ELECTIVES.

<b>MBME 001</b>	CRYO BIOLOGY	3003
UNIT I		9
Introduction		
Low Temperatures i	n Nature- Cryo medicine: Cryo surgery and Cryo p	preservation.
Lyo phillization, Cryofixat	ion. Destruction of Biological Tissues.	
Forensic Medicine ,Food In	dustry, Numerical Simulation of Cryo action	
UNIT II		9
Ice Formation in Biologica	al Medium	
Amorphous Ice, Wa	ter, Biological water. Crystallization in Heterogeneo	ous Media
UNIT III		9
Biological Effects of Low	Temperatures	
Processes in cells U (INAs) Protein Denaturation ,Intracellular Ice, Cryo,prot	nder Hypothermia Antifreeze Proteins (AFPs), Ice N n Membrane Behavior, Cells in Aqueous Solutions n ective Agents, Cell Interaction with Crystallization F	lucleating Agents nCell Dehydration Front
UNIT IV		9
Heat Transfer in Biologic	al Tissues	
Heat Transfer in Liv Fluctuations in Living Tiss	ving Tissues, Continuum Models, Vascular Models, t ues	emperature
UNIT V		9
Mechanical Stress in Froz	en Biological Objects	
Stress in Frozen Tis	sues, Stress in Vitrified Biological Objects	
		Total hrs: 45
References:		
1.Cherie winner,Cryo Biolo	ogy,Lener Publishing group.	
2.Fundamentals of Cryobio	logy by Zhmakin, Alexander I	

#### **EVOLUTIONS OF BIOLOGICAL MACHINES MBME 002** 3 0 0 3 UNIT I 9 Living body as an examples of finest designs for diverse activities, functions e.g., flying, swimming, reproduction, sensing, eating, etc. UNIT II 9

Evolution and natural selection as the means of optimization of biological machines at diverse scales: molecular, cellular, organism

UNIT III	9
Principles of micro and macro evolution and population.	
UNIT IV	9
Theories of evolution and Darwinian selection.	
UNIT V	9

Principles of generating diverse body plan and design in nature.

#### Total hrs: 45

M.Tech Bio Mechanical Engineering

#### **References:**

1. Jones and Bartlett, Teaching Biological evolution in higher Education, International Publishers.

2.Fredrkh Pfeifeer and Teresa Zieunsk, Biological and Technical aspects, Springer Wien, Newyork.

#### MBME 003 QUANTITATIVE METHODS 3 0 0 3

#### UNIT1

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

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

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

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

#### UNIT5

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

#### Total hrs: 45

#### **Text Book**

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

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

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#### MBME 004STEM CELL TECHNOLOGY303

#### UNIT 1

Stem Cells: Definition, classification and sources, Blastocyst culture, Xeno-free derivation and Cryopreservation, Properties and application of Embryonic stem cells. Characterization of Human embryonic stem cells.

#### UNIT 2

Stem cells and their Developmental Potential, subcloning and controlled differentiation of human embryonic stem cells. *In vitro* and *in vivo* differentiation of human embryonic stem cells. Feeder free culture of human embryonic stem cells

#### UNIT 3

Therapeutic cloning: Derivation and propagation of human embryonic stem cells by somatic cell nuclear transfer, Hurdles to improving the efficiency of Therapeutic cloning, Stem cells and translational medicine ethics, clinical research-ICMR guidelines in brief.

#### UNIT 4

Haematopoietic Stem Cells: Basic science to Clinical applications, Growth factors and the regulation of haematopoietic stem cells, Haematopoietic stem cells for gene therapy, Haematopoietic cells for leukaemia and Thalessemia.

#### UNIT 5

Skeletal muscle stem cells, Cardiac stem cells, Liver stem cells, Tumour stem cells, Stem cell therapies in animal models: Their outcome and possible benefits in humans

Total hrs: 45

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#### **TEXT BOOKS**:

- 1. Stem Cells: From Bench to Bedside-Ariff Bongso, Eng Hin Lee
- 2. Stem Cells-C S Potten

#### **REFERENCES**:

- Nagy A, Gertenstein M, Vintersten K, Behringer R(2003). Manipulating the Mouse Embryo, New York: Cold Spring Harbor Press.
- 2. Gilbert SF (2000) Developmental biology,6th edition Sunderland, MA:Sinauer Associates,Inc.

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<b>MBME 005</b>	BIOPHYSICS	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

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

#### MBME006 RECENT ADVANCES APPLIED TO HOSPITAL ENGINEERING 3003

#### UNIT-I STANDARDISATION OF HOSPITAL EQUIPMENTS

Need for standardization, classification of equipments, international standards, Experimental methods of testing standards, maintenance of standards and recalibration.

#### **UNIT-II** CLINICAL ENGINEERING

Hospital design, electrical, air – conditioning, sanitation, ventilation, safety regulation to be incorporated in the hospital center, management and legal aspects, latest rug delivery systems for sustained delivery of medicines.

#### **UNIT-III** NETWORKING

Importance of networking, LAN features, network topologies, LAN components, network operating system, basic data communication concept, application, LAN and multi-user system, planning and installing LAN in hospital set up.

#### **UNIT-IV** FIBRE OPTIC SENSORS FOR MEASURING PHYSIOLOGICAL PARAMETERS

Different optical sources, optical detectors, principle of fiber optic cables, single mode multi mode, step index and graded index type, sensors based on polarisation, interferometer principle, magnetic sensors, application of the sensors in measuring pressure, temperature, flow, rotation and chemical activites, principles of smart sensors.

#### **UNIT-V** EMI AND EMC APPLIED TO HOSPITAL EQUIPMENTS

Principles of EMI, computation of EMI, measuring techniques to quantify the level of interference, method of suppressing and isolating this UNIT from interference.

Total hrs: 45

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#### **REFERENCES**:

- Donald R.J. White, A Handbook of electromagnetic Interference and Compatibility, Vol 4,5, Published by Donwhite Constant – Maryland, 1972.
- Webster J.G. and Albert M. Cook, Clinical Engineering Principles and Practices Printice Hall Inc, Englewood Cliffs, New Jersery, 1979.
- Bernhard Keiser, Principles of Eletromagnetic Compatibility, Artech House- 3<sup>rd</sup> Edition, 1986.
- 4. Eric Udd, Fiber Optic Sensors and introduction for engineers and scientists, Wiley Interscience Publication, New Delhi, 1991.
- Bajbai, P.K. Ceramic a novel device for sustained long term delivery of drugsBio Ceramic Vol III, Rose Heliman Institute of Technology, Terrahaute, Indian, 1992.
- 6. S.K. Basandia, Local Area Network, Golgotia Publishing Pvt Ltd., New Delhi, 1995.

MBME007	<b>ROBOTICS AND SENSORS</b>	3	0	0	3
UNIT-I INTRODU	CTION				9
Basic concepts-Robo	ot anatomy-robot configurations-Basic Re	obot motior	is-Type	es of dr	ives-
Applications-					
Material Handling-P	rocessing-Assembly and Inspection -Safe	ety consider	ations		
UNIT-II TRANSFO	ORMATIONS AND KINEMATICS				9
Vector operations-T	ranslational transformations and Rotation	nal transform	nations	s-Prope	rties of
transformation					
Matrices-Homogene	ous transformations and Manipulator-Fo	rward soluti	on-Inv	verse so	lution
UNIT-III CONTRO	OLS AND END EFFECTORS				9
Control system conc	epts-Analysis-control of joints-Adaptive	and optima	l contr	ol-End	effectors-
Classification-Mech	anical-Magnetic-Vacuum-Adhesive-Driv	/e systems-I	Force a	nalysis	and Gripper
design					
UNIT-IV ROBOT	PROGRAMMING				6
Methods -Languages	S-Computer control and Robot Software-	VAL system	n and I	Languag	ge
UNIT-V SENSORY	<b><i>T</i>DEVICES</b>				12
Non-optical and opti	cal position sensors-Velocity and Accele	eration-Rang	ge-Proz	kimity-t	ouch-Slip-
Force-					
Torque-Machine vis	ion-Image components-Representation -	Hardware-H	Picture	coding	-Object

recognition and

Categorization-Software consideration- Case Studies

Total hrs: 45

M.Tech Bio Mechanical Engineering

#### **REFERENCE:**

- 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
- 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. <u>http://www.robotics.com</u>

# MBME008IPR, BIOSAFETY AND BIO ETHICS3003UNIT I INTRODUCTION TO INTELLECTUAL PROPERTY9

Types of IP: Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications, Protection of New GMOs; International framework for the protection of IP, IP as a factor in R&D; IPs of relevance to Biotechnology and few Case Studies; Introduction to History of GATT, WTO, WIPO and TRIPS

#### UNIT II CONCEPT OF 'PRIOR ART'

Invention in context of "prior art"; Patent databases; Searching International Databases; Countrywise patent searches (USPTO, EPO, India etc.); Analysis and report formation Basics of Patents types of patents; Indian Patent Act 1970; Recent Amendments; Filing of a patent application; Precautions before patenting disclosure/non-disclosure; WIPO Treaties; Budapest Treaty; PCT and Implications; Role of a Country Patent Office; Procedure for filing a PCT application

#### UNIT III PATENT FILING AND INFRINGEMENT

Patent application- forms and guidelines, fee structure, time frames; Types of patent applications: provisional and complete specifications; PCT and convention patent applications; International patenting-requirement, procedures and costs; Financial assistance for patenting-introduction to existing schemes; financial incentives Patent infringement- meaning, scope, litigation, case studies and examples; Case studies

#### UNIT IV BIOSAFETY

Introduction; Historical Background; Introduction to Biological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels; Biosafety Levels of Specific Microorganisms; Recommended Biosafety Levels for Infectious Agents and Infected Animals; Biosafety guidelines - Government of India; Definition of GMOs & LMOs; Roles of Institutional Biosafety Committee, GMO applications in food and agriculture; Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and communication; Overview of National Regulations and relevant International Agreements including Cartegana Protocol.

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#### **UNIT V BIOETHICS**

Concepts and principles relevance to Biotechnology; Ethics and the Law Issues: Genetic Engineering, Stem Cells, Cloning, Medical techniques, Bioweapons; Research concerns - Animal Rights, Ethics of Human Cloning, Reproduction and Stem Cell Research; Emerging issues: Biotechnology's Impact on Society.

#### Total hrs: 45

#### **Texts/References:**

 BAREACT, Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., 2007
 Kankanala C., Genetic Patent Law & Strategy, 1st Edition, Manupatra Information Solution Pvt. Ltd., 2007

#### **Important Links:**

http://www.w3.org/IPR/ http://www.wipo.int/portal/index.html.en http://www.ipr.co.uk/IP\_conventions/patent\_cooperation\_treaty.html www.patentoffice.nic.in www.iprlawindia.org/ - 31k - Cached - Similar page http://www.cbd.int/biosafety/background.shtml http://www.cdc.gov/OD/ohs/symp5/jyrtext.htm http://web.princeton.edu/sites/ehs/biosafety/biosafetypage/section3.html

#### MBME009 BIO MEDICAL INSTRUMENTATION 3 0 0 3

#### **UNIT I.. BIO-AMPLIFIERS AND ELECTRODES**

Necessity for low – noise pre-amplifiers, differences amplifiers, chopper amplifiers. Different types of electrodes, equivalent circuits of micro electrode.

#### UNIT II. BIO-POTENTIAL RECORDING

ECG, EEG, EMG, PCG, EOG –lead system and recording methods, typical waveforms, frequency spectrum, abnormal waveforms, evoked response.

#### UNIT III. IMPEDANCE TECHINQUES

Bipolar and tetra polar circuits, detection of physiological activities using impedance techniques, GSR., cardiac output, neural activities, respiratory activity, impedance plethysmograohy – resistance and capacitance type.

### UNIT IV. NON – ELECTRICAL PARAMETERS AND RESIPRATORY MEASUREMENTS 8

Respiration, heart rate, temperature, blood pressure, O2, CO2 measurements, Spiro meter, BMR apparatus.

#### UNIT V. BLOOD FLOWMETERS AND BLOOD CELL COUNTING

EM and ultrasonic blood flow meters indicator dilution method, Thermo dilution method, Manual and Automatic Counting of RBC, WBC and Platelets – Auto analyzer

#### 6. BIO-CHEMICAL MEASUREMENTS

pH, pCO2, pO2, pHCO3 electrophoresis, colorimeter, spectrophotometer, flame photometer.

Total hrs: 45

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#### **REFERENCES:**

- 1. Geddes L.A. and Baker L.E., Principles of applied biomedical Instrumentation, John Wiley and Sons, New York, 1975.
- 2. Harry E. Thomas, Handbook of Automated Electronic Clinical Analysis, Reston Publishing Company, Virginia, 1979.
- 3. Heinx Kresse, Handbook of Electro medicine, John Wiley and Sons, Chichester, 1985.
- 4. Richard A. Normann, Principle of Bio Instrumentation, John Wiley and Sons New York, 1988.
- 5. Khandpur R.S., Handbook of Biomedical Instrumentation, Tata McGraw Hill Publishing Company, New Delhi, 1999.
- 6. Webster J.G., Medical Instrumentation, John Widly and sons, New York, 3<sup>rd</sup> edition, 1999.
- John Enderle Susan M. Blancharad, Joseph Brozino, Introduction to Biomedical Engineering, Academic press, Sandiego, 1999.

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#### MBME010DIGITAL IMAGE PROCESSING3003

#### UNIT – I CONTINOUS AND DISCRETE IMAGES AND SYSTEMS

Light, Luminance, Brightness and Contrast, Eye, The Monochrome Vision Model, Processing Problems and Applications, Vision Camera, Digital Processing System, 2-D sampling Theory, Aliasing, Image Quantization, Lloyd Max Quantizer, Dither, Color Images, Linear Systems And Shift Invariance, Fourier Transform, Z-Transform, Matrix theory Results, Block Matrices and Kronecker Products.

#### **UNIT – II IMAGE TRANSFORMS**

2-D orthogonal and UNITary transforms, 1-D and 2-d DFT, Cosine, Sine, Walsh, Hadamard, Haar, Slant, Karhunen-loeve, singular value Decomposition transforms.

#### **UNIT – III IMAGE ENHANCEMENT**

Point operations – Contrast stretching, clipping and thresholding density slicing, Histogram equalization, modification and specification, spatial operations – Spatial averaging, low pass, high pass, band pass filtering, direction smoothing, medium filtering, generalized cepstrum and homomorphic filtering, edge enhancement using 2-D IIR and FIR filters, color image enhancement

#### **UNIT -IV IMAGE RESTORATION**

Image observation models, sources of degradation, inverse and Wiener filtering, geometric mean filter, non-linear filters. Smoothing splines and interpolation, constrained least squares restoration.

### UNIT – V IMAGEDATA COMPRESSION AND IMAGE RECONSTRUCTION FROM PROJECTION

Image data rates, pixels coding, predictive techniques transform coding and vector DPCM, Block truncation coding, wavelet transform coding of images, color image coding. Random transform.

#### Total hrs: 45

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#### **Reference Books:**

- 1. Anil K. Jain, "Fundamentals of Digital Image Processing", PHI 1995.
- 2.M.A.Sid Ahmed, "Image Processing", McGraw Hill, Inc, 1995.
- 3.R.Gonzalazand P.Wintz, "Digital Image Processing", Addition Wesley 2nd Ed, 1987.
- 4. William. K. Pratt, "Digital Image Processing", Wiley Interscience, 2nd Ed, 1991.