BIOMEDICAL

Programme Structure

Course Code	Course Title	Lecture (L) Hours Per Week	Tutorial (T) Hours Per Week	Practical (P) Hours Per Week	Total Credits
BME2351	Human Anatomy and Physiology-I	3	-	-	3
BME2451	Bioinstrumentation	3	-	-	3
BME2551	Tissue Engineering	3	-	-	3
BME2651	Biomechanic	3	-	-	3
BME2751	Medical Image Processing	3	-	-	3
BME2851	Seminar –Biomedical Engineering	3	-	-	3
	TOTAL				**18**

BIOMEDICAL

Syllabus

HUMAN ANATOMY AND PHYSIOLOGY-I

Course Code: BME2351 **Credit Units: 03**

Course Objective:
To provide students a basic understanding of the human body structure and functioning. Students will be able to relate basic human body systems and life processes, name the major body systems and their functions , understand the anatomy of various body systems .

Course Contents:
Module I:
Basic cell structure , various cell organelles and their functions , Tissue- their types , structure and function , structure and function of skin , Different types of muscles and their function , General description of bones , their structure and function , types of joints and their structure and function .

Module II:
Cell , cell membrane , polarisation and repolarisation , resting membrane potential , Nernst equation , Donnans equilibrium , Goldman equation action potential and its proapagation , synaptic transmission ,

Module III
Blood , Lymph and circulation : blood composition , properties and function . Structure and functions of RBCs, WBCs and platelets , Blood types , Homeostasis , Immune mechanisms , Lymph., Heart position , structure and functions , Heartbeat , electrical excitation , Einthovens triangle , Cardiac and peripheral regulation , blood pressure and its regulation , blood flow and its regulation.

Module IV
Respiratory System : position and functions . Mechanics of respiration , Lung volumes and capacities , Gas exchange between lungs and tissues , regulation of respiration .Digestive system : Different parts of digestive system , functions of each organ , digestion of proteins , carbohydrates , fats , vitamins and minerals.

Module V
Osteology , Bone , brief introduction to different bones in skull , vertebral column , upper extremity , hands , lower extremity , foot .

Examination Scheme:

Components	**A**	**CT**	**S/V/Q**	**HA**	**EE**
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Text and References

- Guyton A.C and J.E. Hall , " Text book of Medical Physiology " Harcourt India Pvt. Ltd.
- Principles of Human Anatomy and Physiology , Tortora , Wiley
- Ganong W.F. " Review of Medical Physiology" , Prentice Hall
- Gray's Anatomy for Students - Gray's Anatomy by A. Wayne Vogl, Richard Drake, Adam W. M. Mitchell

BIOINSTRUMENTATION

Course Code : BME2451 **Credit Units: 03**

Course Objective:
To enable the student to understand the working and construction of various equipments used in the medical field.

Course Contents:

Module I:
Transducers and Reference electrodes: classification of transducers, temperature transducers , displacement transducer , pressure tranducer , catheter transducer , photoelectric transducer , piezoelectric transducer . po2 electrodes , membrane electrodes , blood gas analysis , Ion specific electrodes .

Module II :
ECG : electrodes and conversion of ionic potentials to electric potential , ECG instrumentation amplifiers, driven right leg circuitry.Introduction and characteristics of bio signals (EEG , ECG , EMG) . , removal of artefacts , event detection and correlation analysis of ECG signals .

Module III :
Respiration measurement using electrical impedance plethysmography : electrical impedance changes during breathing , 2 and 4 electrode measurement , 4 electrode technique .

Module IV :
Oxygen saturation using pulse oximetry : optical characteristics of oxygenated and deoxygenated blood , principles of pulse oximetry , circuits of pulse oximetry , constant current source , current – voltage converter , amplifiers .

Module V :
Non invasive blood pressure measurement : theory and circuitry of method using Korotkoff sounds and method based on oscillometry .

Examination Scheme:

Components	**A**	**CT**	**S/V/Q**	**HA**	**EE**
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Text & References:

- Leslie Cromwell , Fred J. Weibell , Erich A Pfeiffer , Biomedical Instrumentation and Measurements , PHI , 2nd Edition , 2004.
- R.S. Khandpur , Handbook of Biomedical Instrumentation , Tata McGraw Hill 2004 .
- John G.Webster , Medical Instrumentation : Application and Design, 3rd Edition , John Wiley & Sons , New York , 1998 .

TISSUE ENGINEERING

Course Code: BME2551 **Credit Units: 03**

Course Objective:
To enable students to understand the principles of tissue engineering and learn the basics of cell culture , tissue culture ,scaffolding , types of bioreactors and mass transfer reactions .

Course Contents:
Module I:
Cell culture: Different cell types, progenitor cells and cell differentiations, different kind of matrix, cell-cell interaction. Aspect of cell culture: cell expansion, cell transfer, cell storage and cell characterization, Bioreactors.

Module II :
Molecular biology aspects: Cell signaling molecules, growth factors, hormone and growth factor signaling, growth factor delivery in tissue engineering, cell attachment: differential cell adhesion, receptor-ligand binding, and Cell surface markers.**Module III** :

Module III :
Scaffold and transplant: Engineering biomaterials for tissue engineering, Degradable materials (collagen, silk and polylactic acid), porosity, mechanical strength, 3-D architecture and cell incorporation. Engineering tissues for replacing bone, cartilage, tendons, ligaments, skin and liver. Basic transplant immunology, stems cells: introduction, hepatopoiesis.

Module IV :
Cryopreservation of cells and tissues, Transport in biological system, Mass transport through cell membranes, Mathematical modelling of mass transfer in engineered tissues

Examination Scheme:

Components	**A**	**CT**	**S/V/Q**	**HA**	**EE**
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Text & References:

- Clemens van Blitterswijk, Tissue Engineering, Academic Press, 2008
- Principles of tissue engineering, Robert. P.Lanza, Robert Langer & William L. Chick,Academic press.
- The Biomedical Engineering –Handbook, Joseph D. Bronzino, CRC press.
- Tissue Engineering, B. Palsson, J.A. Hubbell, R.Plonsey & J.D. Bronzino, CRC- Taylor &Francis

BIOMECHANICS

Course Code: BME2651 **Credit Units: 03**

Course Objective:
To enable students to understand the basics of bone movement , gait analysis and mechanics of bone and muscles

Course Contents:
Module I:
Joint motion: relative position of two bones meeting at a joint , description of a rigid body , degrees of freedom , euler angles , rotation matrices, rotation angle anatomical directions , anatomical planes ,

Module II :
Inverse Dyanamics to calculate resultant force and momentum within the body link segment models , intersegmental force and moment ,

Module III :
Human Gait analysis , gait cycle , angular kinematics of hip , knee and ankle , force plates and ground reaction force , gait abnormalities .

Module IV :
Structure and composition of bone , microstructure of bone , skeletal muscle , mechanism of muscle contraction , force length and force celocity relationships , basic muscle models , tendons and ligaments , their basic mechanical models , injuries and factors affecting biomechanical properties , Cartilage , viscoeleasticity and viscoelastic models .

Examination Scheme:

Components	**A**	**CT**	**S/V/Q**	**HA**	**EE**
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Text & References:

- Basic biomechanics of the musculoskeletal system (M Nordin and VH Frankel; Lea& Febiger, London 1989)
- Biomechanics of the musculo-skeletal system (BM Nigg, W Herzog (eds); John Wiley & Sons, Chichester 1994)
- Biomechanics and motor control of human movement (DA Winter; John Wiley &Sons, Chichester 1990)
- Bones and Joints: A Guide for Students. Christine Gunn. Churchill Livingstone,Edinburgh 1996 (3rd ed.)

MEDICAL IMAGE PROCESSING

Course Code: BME2751 **Credit Units: 03**

Course Objective:
To enable students to understand techniques used in imaging in the medical profession , the artefacts and other problems experience in doing so .

Course Contents:
Module I:
Digital image fundamental : Elements of digital image processing systems, Elements of Visual perception, Image sampling and quantization,– Some Basic relationships between pixels, Matrix and Singular Value representation of discrete images

Module II :
Image transforms1DDFT, 2D DFT, Cosine, Sine Hadamard, Haar, Slant, KL transform and their properties

Module III :
Image enhancement : Histogram – Modification and specification techniques, Enhancement by point processing Image smoothening,Image sharpening, generation of spatial masks from frequency domain specification, Homomorphic filtering,and color image processing.

Module IV :
Image segmentation : spatial feature extraction , transforms features , segmentation techniques , analysis techniques,application of matlab for digital image processing .

Module V
Run length, Huffman coding, arithmetic coding, Pixel coding, transform coding, JPEG Standard, predictivetechniques, Application of image processing techniques in thermography, SPECT, PET images.

Examination Scheme:

Components	**A**	**CT**	**S/V/Q**	**HA**	**EE**
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Text & References:

- Rafael C., Gonzalez and Richard E. Woods, *Digital Image Processin*g, Pearson Education Asia, 2001
- Anil K. Jain, *Fundamentals of Digital Image Processing*, Prentice Hall of India, 1997
- William K. Pratt, *Digital Image Processing*, John Wiley, NJ, 1987.
- Albert Macouski, *Medical Imaging systems*, Prentice Hall, New Jersey.1983.
- Sid Ahmed M.A., *Image Processing Theory, Algorithm and Architectures*, McGraw Hill, 1995.