Chhattisgarh Swami Vivekanand Technical University, Bhilai

Scheme of Teaching and Examination

M.Tech. (Biomedical Engineering and Bioinformatics)

2nd Semester

S. N.	Board of Study	Sub Code	Subject Name	Periods Per Week			Scheme of Examination			Total Marks	Credit L+(T+P)/2
							Theory /Practical				
				L	**T**	**P**	**ESE**	**CT**	**TA**		
1	Biomedical Engg.	590211(17)	Experimental & Quantitative Physiology	3	1	-	100	20	20	140	4
2	Biomedical Engg.	590212(17)	Genetic Engineering	3	1	-	100	20	20	140	4
3	Biomedical Engg.	590213(17)	Medical Image Processing and Analysis	3	1	-	100	20	20	140	4
4	Biomedical Engg..	590214(17)	Medical Instrumentation and Sensors	3	1	-	100	20	20	140	4
5	Biomedical Engg.	Elective -III		3	1	-	100	20	20	140	4
6	Biomedical Engg.	590221(17)	Medical Image Processing and Analysis Lab	-	-	3	75	-	75	150	2
7	Biomedical Engg.	590222(17)	Medical Instrumentation and Sensors Lab	-	-	3	75	-	75	150	2
Total				**15**	**5**	**6**	**650**	**100**	**250**	**1000**	**24**

L-Lecture, **T**- Tutorial, **P**- Practical, **ESE**- End Semester Examination, **CT**- Class Test, **TA**- Teacher's Assessment

Table –II Elective (III)

S. N.	Board of Study	Subject Code	Subject Name
1	Biomedical Engg.	590231(17)	Molecular Biology
2	Biomedical Engg.	590232(17)	Bio nanotechnology
3	Biomedical Engg.	590233(17)	Electro diagnosis therapy & electrical safety
4	Biomedical Engg.	590234(17)	Biomaterials
5	Biomedical Engg.	590235(17)	Health Informatics

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Semester: M. Tech- II Branch: Biomedical Engineering and Bioinformatics

Subject: Experimental and quantitative physiology Code: 590211(17)

Total Theory Period: 40 Total Tutorial Period 12

Total Marks in End Semester Exam: 100

Minimum of class test to be conducted: 02

Unit –I

Physical and Chemical Foundations of Physiology: The Core Principles of Physiology, Physical Foundations of Physiology, Chemical Foundations of Physiology, Diffusion, Electrochemical Potential and Free Energy.

Unit-II

Membranes, Transport, and Metabolism: Cell Structure, DNA and Protein Synthesis, Protein Structure, Biological Membranes, Passive Transport and Facilitated Diffusion, Active Transport, Osmosis and Osmotic Pressure, Cell Signaling, ATP Production.

Unit – III

The Origin of the Resting Membrane Potential: The Action Potential, Propagation of the Action Potential, Skeletal Muscle Mechanics, Contractile Mechanisms in Skeletal Muscle, The Neuromuscular Junction and Excitation-Contraction Coupling, Muscle Energetics, Fatigue, and Training, Smooth Muscle.

Unit – IV

The Nervous System: Organization of the Nervous System, Cells, Synapses, and Neurotransmitters, Cutaneous Sensory Systems, Spinal Reflexes, Balance and Control of Movement, The Chemical Senses, Hearing, Vision, Autonomic Nervous System.

Unit –V

Respiratory and Renal Physiology: Mechanics of Breathing, Lung Volumes and Airway Resistance, Gas Exchange in the Lungs, Oxygen and Carbon Dioxide Transport. Body Fluid Compartments, Functional Anatomy of the Kidneys and Overview of Kidney Function, Glomerular Filtration, Tubular Reabsorption and Secretion, Mechanism of Concentration and Dilution of Urine.

Texts & References:

1. Quantitative Human Physiology, 1st Edition, JFeher, Elsevier Publication.
2. Military Quantitative Physiology: Problems and Concepts in Military, by Kari and William, Fort Detrick, Maryland, 2012.

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Semester: M. Tech- II
Branch: Biomedical Engineering and Bioinformatics
Subject: Genetic Engineering
Code: 590212(17)
Total Theory Period: 40
Total Tutorial Period 12
Total Marks in End Semester Exam: 100
Minimum of class test to be conducted: 02

Unit – I

Introduction to Genetic Engineering: Restriction Endonucleases, Vectors, Modifying Enzymes Basic Principles of Cloning, DNA Libraries: Genomic DNA Libraries, cDNA Libraries, Library screening, Monitoring Transcription.

Unit –II

Protein Production and Purification:Expression Vectors and Recombinant Protein, Expressions, In Vitro Transcription and Translation, Bacterial Expression of Proteins Expressions in Yeast, Expressions in Insect Cells, Expressions in Plant Cells, Expressions in Mammalian Cells, Purification of Proteins, Post-Translational Modifications of Proteins.

Unit-III

Cell Culture: Introduction, Genetic Manipulation of Cells, Reporter Genes, Types of Transfection, Level of Expression.

Unit- IV

Genetic Manipulation of Stem Cells and Animals: Stem Cell Technology and Knockout Cells, Transgenic Animals, RNA Interference and MicroRNAs, Animal Cloning, Pharm Animals, Gene Therapy Genome Editing.

Unit-V

Genetic Manipulation of Plants: Monocotyledons, Dicotyledons, and Commercial Crops Plant Manipulation Methods. Future Trends in Transgenic Plants.

Texts & References:

1. IsilAksanKurnaz, Techniques in Genetic Engineering, CRC Press, 2015.
2. Desmond S. T. Nicholl, An Introduction to Genetic Engineering, Cambridge University Press, 2002.

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Semester: M. Tech- II
Branch: Biomedical Engineering and Bioinformatics
Subject:Medical Image Processing and Analysis
Code: 590213(17)
Total Theory Period: 40
Total Tutorial Period 12
Total Marks in End Semester Exam: 100
Minimum of class test to be conducted: 02

Unit-I

Fundamentals of Medical Image Processing: Digital image representation and modeling image processing steps, Light, Luminance brightness, contrast, visibility function, monochrome vision models, color representation, color reproduction, color models, image sampling and quantization.

Unit-II

Image Transformations: Two dimensional orthogonal and Unitary transforms, Fourier transform, cosine transform, sine transform, Hadamard transform, Haar transform, KL transform Slant transform, SVD.

Unit-III

Image enhancement, filtering and restoration: Point processing , histograms processing, Spatial filtering, multispectral image enhancement, color image enhancement image formation and noise model, inverse and Wiener filtering, FIR filter,geometric mean filtering nonlinear filters, Lead squares filters, Kalman filtering, Speckles noise representation and reduction using Homomorphic filtering, maximum entropy restoration, Bayesian Methods.

Unit-IV

Image compression and Image Analysis: Lossy and Lossless image compression techniques, Feature extraction, edge detection, boundary extraction, boundary representation, Region representation, texture, shape and structural analysis.

Unit-V

Segmentation and classification techniques. Image Compression: Pixel coding, Predictive techniques, transform coding, Hybrid coding, Inter frame coding, Image coding in presence of channel errors, Coding of two tone images, color and multispectral image coding.

Texts & References:

1. K. Jain, Fundamentals of image processing, prentice hall, Eagle cliffs, New Jersey, 1989.
2. Digital Image Processing by Rafael. C. Gonzalez and Richard. E., Pearso Education.
3. Digital Image Processing by Willian K. Pratt, 3rd Edition John Wiley and Sons Inc.
4. P. Suetens, Fundamenatals of image processing, Cambridege University Press, 202.
5. G. R. Sinha&Bhagwati C Patel, Medical Image Processing: Concept and Application. PHI-2014.

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Semester: M. Tech- II
Branch: Biomedical Engineering and Bioinformatics
Subject:Medical Instrumentation and Sensor
Code: 590214(17)
Total Theory Period: 40
Total Tutorial Period 12
Total Marks in End Semester Exam: 100
Minimum of class test to be conducted: 02

Unit-I

Bioelectric potential and Electrodes- Basis concepts of medical instrumentation Resting and action potential, ECG, EEG, EMG, ECG, ERG,EOG,BCG, electrode theory, Bio potential electrodes,Electrodes for ECG, EEG and EMG, micro electrodes, skin surface electrodes, Needle electrodes, ion selective electrodes, Clark electrodes.

Unit-II

Physiological Transducers: Transducers for measurement of displacement, motion, pressure and bodytemperature. Photo electric transducers, optical fiber sensors.

Unit-III

Biomedical recorders: Electrocariograph, Vectorcardiograph(VCG), Phonocardiograph(PCG), Digital Stethoscope, Electroencephelograph (EEG), Electromyograph, Other biomedical recorders.

Unit-IV

Patient Monitoring systems: Cardiac monitors, bedside monitors, central monitors, Biomedical measurement and devices for heart rate, pulse rate, temperature, Blood pressure, respiration rate, Pulmonary function measurements, patient safety.

Unit-V

Telemedicine: What is telemidicine, Essential parameters, Delivery modes, Telemedicine system, Clinical data interchange/exchange standards, Transmission of still images, video images, digital audio, cyber medicine, applications of telemedicine.

Texts & References:

1. Jacob Fraden,. Handbook of modern sensor physics design and application, Fourth edition Springer.
2. John G. Webseter: Medical Instrumentation, Application & Design Haughtons Mifflin, Co. Boston. USA. 1978.
3. Weikowisty etal.: Biomedical Instruments- Theory and Designs. Academic Press, 1976.
4. R. S. Khandpur: Hand Book of Biomedical Instrumentation. Tata McGraw Hill. 1975.
5. L. a. Gedders& L.E. Baker: Principles of Applied Medical Instrumentation. JohnWisdley& Sons. NY. USA. 1978.

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Semester: M. Tech- II
Branch: Biomedical Engineering and Bioinformatics
Subject:Molecular Biology
Code: 590231(17)
Total Theory Period: 40
Total Tutorial Period 12
Total Marks in End Semester Exam: 100
Minimum of class test to be conducted: 02

Unit-I

Organization of viral, prokaryotic and eukaryotic genomes: Cot curves, repetitive and unique sequences, kinetics and sequence complexities, satellite DNA, DNA melting and buoyant density.

Unit-II

Organelle genomes, Rearrangement and amplification of DNA in the genome, DNA replication models, DNA polymerases - mode of action, DNA damage, DNA repair and recombination., RNA polymerases and reverse transcriptase: structure and mechanism of action ; Enzymes involved in DNA modifications, methylases, demethylases, DNases, DNA gyrase, Topoisomerase.

Unit –III

Organization structures and function of ribonucleoproteins, Protein synthesis: Genetic code, mechanism and regulation of protein synthesis, and Development.

Unit-IV

Properties of cells, cell membranes, subcellular organelles, Cytoskeleton; Cell Junctions: Types and structure of junctions (Tight Junctions, Adherens Junctions, Desmosomes); Cell communication: communication via diffusible molecules (surface receptors and intracellular receptors), Cellular Continuities (Contact-Mediated and ECM-Mediated), Role of ECM in Morphogenesis, Gap Junctions.

Unit-V

Cell adhesion molecules: Modes of cell adhesion, classification and functions of CAMs; Signal Transduction via Surface Receptors: Classification and action of individual surface receptors (Ion Channel Linked Receptor, Enzyme Receptors, GuanylateCyclases, Receptor Tyrosine Kinases, Cytokine-Receptor Superfamily, G-Protein Coupled Receptor).

Texts & References:

1. B.Alberts, A.Johnson, J.Lewis and M.Raff, Molecular Biology of the Cell, Garland Science; 5th edition. Supplementary Reading : 1. H. Lodish, A.Berk, C.A. Kaiser and M.Krieger, Molecular Cell Biology, W. H. Freeman, 6th edition, 2007

2. Gerald Karp: Cell and Molecular Biology: Concepts and Experiments; Wiley; 5 edition, 2007.

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Semester: M. Tech- II
Branch: Biomedical Engineering and Bioinformatics
Subject: Bio-nanotechnology
Code: 590232(17)
Total Theory Period: 40
Total Tutorial Period 12
Total Marks in End Semester Exam: 100
Minimum of class test to be conducted: 02

Unit-I

Introduction to nanotechnology, definition, history. What makes the Nano scale so different from the other lengthscales by considering the underpinning science (i.e. Nano science) and some key examples of nanotechnology. ; Properties in Nano scale: Extensive and Intensive properties, change in physical properties like color, melting point, electrical, magnetic, and mechanical.

Unit-II

Methods of synthesis of nanomaterials fabrication-"Top-down" vs. "bottom-up" approaches. Equipment and processes needed to fabricate nanodevices and structures. ; Focus on different nanomaterial's.

Unit-III

Nanomaterial based biosensors: bio functionalization of nanomaterial's, advantages over other sensors, Field effect transistor based biosensors. Application in cholesterol, blood sugar, single virus detection.

Unit-IV

Nanotechnology in tissue engineering, Scaffold based Approach, Polymeric nanofibers in Tissue Engineering, Synthetic polymers, Biopolymers, Synthesis of nanofibers by different methods, Application of polymeric nanofibers in tissue engineering.

Unit-V

Advanced Bio-Nanomaterials: Fundamentals of magnetic materials, Carbon Nano Structures: Introduction; Fullerenes, C60, C80 and C240 Nanostructures; Properties & Applications in biology

Texts & References:

1. G. Cao, Nanostructures and Nanomaterials: Synthesis, Properties and Applications, Imperial College Press, 2004. 2. M. Winterer, Nano-crystalline Ceramics: Synthesis and Structure, Springer, 2002

2. T. Zikang and S. Ping, Nano science and technology: novel structures and phenomena, Taylor and Francis, 2003. 2

3. B. Rogers, S. Pennathur, J. Adams, Nanotechnology: Understanding small systems, Taylor and Francis, 2008.

4. M. Rieth, Nano-Engineering in Science and Technology: An Introduction to the World of Nano design,World Scientific, 2003

5. R. Kelsall, I. Hamley and M. Geoghegan, Nanoscale Science and Technology, (Eds.), Wiley, 2005.

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Semester: M. Tech- II Branch:Biomedical Engineering and Bioinformatics
Subject: Electro diagnostic therapy and Electrical Safety Code: 590233(17)
Total Theory Period: 40 Total Tutorial Period 12
Total Marks in End Semester Exam: 100
Minimum of class test to be conducted: 02

Unit I: Electro-Physiology

Overview of physiological systems, ionic chemistry of human cell, irritability, threshold of stimulus, all or nothing law, action potential - depolarization, repolarization, relative and absolute refractory periods, electro-physiology of nerve conduction, electrical activity of human heart, the role of bioelectricity in respiration, peristalsis, locomotion, sensory and neural physiology. Biological sensors-Olfactory, Auditory, Chemo, Baro, and optic receptors, electrode theory, bipolar and unipolar electrodes, surface electrodes and physiological transducers.

Unit– II Therapeutic Instruments

Electrical Stimulators, Transcutaneous Electrical Nerve Stimulator (TENS), Automatic External Defibrillators (AEDs), Internal Pacemakers, Microwave diathermy, Electro-Surgical Unit, Lithotripsy.

Unit – IIISignal Conditioning

Electrodes and lead systems used in diagnostic instruments, signal conditioning in diagnostic instruments, Special features of bioelectric amplifiers, safety requirements, design and realization of bioelectric amplifiers, carrier amplifiers, chopper amplifiers, phase sensitive detector, isolation amplifiers, and precision instrumentation amplifiers, Analog recording systems, digital recording and data logging including the use of microprocessor and flash memory chips.

Unit – IV Electrical Safety

Electrical safety, physiological effects of electricity, micro and macro shock hazards, electrical safety codes and standards, patient safety considerations in power distribution and equipment design, Ground fault interrupter.

Unit – V Clinical Applications: Neuronopathies, Radiculopathies and Plexopathies**.**

Texts & References:

1. Leslie Cromwell, Fred J. Weibell and Erich A Pferffer – Biomedical Instrumentation and measurements - Prentice Hall of India,1990.

2. R.S Khandpur – Handbook of Biomedical Instrumentation – Tata McGraw Hill

3. John G Webster – Medical Instrumentation – Application and Design – Houghton Mifflin Company, Boston

4. John G Cobbold – Transducers for Biomedical Instrumentation – John Wiley & Sons 3. Jacob KlineHandbook of Biomedical Engineering – Academic Press INC.

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Semester: M. Tech- II
Branch: Biomedical Engineering and Bioinformatics
Subject:Biomaterials
Code: 590234(17)
Total Theory Period: 40
Total Tutorial Period 12
Total Marks in End Semester Exam: 100
Minimum of class test to be conducted: 02

Unit-I

Introduction to basic concepts of Biomaterials Sciences; Salient properties of important material classes; overview of body environment.Manufacturing and Properties of metals, ceramics, polymers and compost, concept of bio-compatibility, host response, structure-property of biological cell.

Unit-II

Structure and properties and cells, protein and cellular adaptation process.Concept of cell migration, cell differentiation, cell death and cell apoptosis.

Unit-III

Structures and properties of Protein; cell–material interaction. Assessment of biocompatibility of biomaterials, Assessment of biocompatibility of biomaterials, structure and Properties of bone as well as in vivo testing and his to compatibility assessment

Unit-IV

Important Biometallic Alloys: Ti alloys, Co-Cr-Mo Alloy, Bioceramics. Processing of Bioceramics, Bioglasses.Centering and Mechanical Properties of bioceramics, polymers and Bioglasses. Development of hydroxyapatite based bioceramic composites for hard tissue replacement. Structure and Properties of polymers, Biodegradable polymers (Important)

Unit-V

Mechanism of Bioerosion, External field and cell–Material Interaction, tissue Engineering and Wound Healing, Understanding Design Concepts of Bio-Implant, Understanding Design Concepts of Dental-implants (Tooth Replacement), Understanding Design Concepts of Orthopedic-Implant.

Texts & References:

1. Biomaterials Science: An introduction to Materials in Medicine, Edited by Ratner, Hoffman, Schoet and Lemons, Second Edition: Elsevier Academic Press, 2004.
2. Comprehensive structural interity, Vol.9: Bioengineering Editors: Mithe, Ritchie and Karihalo, Elsevier Academic Press, 2003.
3. Biomaterials Science and Biocompatability, Fredrick H. Silver and David L. Christiansen, Piscataway, Springer, New Jersey.
4 BiologicalPerformance of Materials: Fundamentals of Biocompatibility, Janathan Black, Marcel Dekker, Inc., New York and Basel, 1981.
5. Basic Cell Culture: A Practical Approach, Edited by J.M. Davis, IRL Press, Oxford University Pres, New York, 1994.

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Semester: M. Tech- II
Branch: Biomedical Engineering and Bioinformatics
Subject: Health Informatics
Code: 590235(17)
Total Theory Period: 40
Total Tutorial Period 12
Total Marks in End Semester Exam: 100
Minimum of class test to be conducted: 02

Unit-I

An introduction to Health care informatics: An interaction between health care and information systems. Acquisition, storage, retrieval, and use of information in health and biomedicine.Tools and techniques.Information systems in Medicine, Dentistry, Nursing, surgery and diagnosis.Future prospects.

Unit-II

BuildingblocksofHealthcareinformatics:Standards,typesofstandards.Modelingprinciplesofmodeling forhealthcare.ArchitectureofHealthcaresystemmodels,subsystems,packagesandcomponents.Modelin gframeworkforhealthcare.Generichealthcareinformationmodel.Unifiedmodelinglanguage.Modeling methodologiesinhealthcaresystems.Databases,types,andapplications.DatabaseArchitecture;ANSI/SP ARCthreetierarchitecture.Datawarehousing;architecture.

Unit-III

Toolsandtechniques inHealthInformatics:Introduction,conditionsforttelemedicinedevelopment,applications,accesstechni quesintelecareandInternettechnologiesinmedicalsystems:RequirementofMedicalsystemsintheinterne tenvironment,internetmedicalarchitectures,andinternetbasedtelemedicineservices,nextgenerationpoi ntofcareinformationsystems,internetaccesstechnologiesintelecare.Wirelesscommunicationtechnologi es.ElectronicHealthrecords(HER):Challengesinclinicalcare,characteristicsofgoodEHR,GenericHER representation, HER StandardsandScopeoftheHER.

Unit-IV

DecisionsupportsystemsandTelematicnetworksinMedicine:Decisionsupportsystems,knowledgebase dandExpertbased.ProbabilisticandLogicaldecisionsystems.Transportlayerintelematicsnetworks,healt hdigitaldatastandards,E-healthnetworksservices.

Unit-V

ApplicationsofITinhearingandchronicproblems:Methodologyofhearingscreening,computeraidedadjust mentofhearingaids,diagnosis,tinnitus treatment.ApplicationofITtodiagnosechronicconditionspatient-centredsymptommonitoring.ComputeraidedtechniquesinMedicine:Laproscopicsurgerynavigation,Intro operativeimaging,multimodelimaging,Bio-signalprocessingandalgorithms.Bio-signaldatabases.

Texts & References:

1. NaakeshA.Dewan,JohnLuo,NancyM.Lorenz.InformationTechnologyEssentialsforBehavioural HealthClinicians,2010.
2. KrzysztofZielinski,MariuszDuplaga.TechnologySolutionsforHealthcare,2006.
3. MoyaConrick,HealthInformatics,2006.
4. FrankSullivan,JeremyWyatt.ABCofHealthInformatics,20

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Semester: M. Tech- II Branch: Biomedical Engineering and Bioinformatics

Subject:Medical Image Processing and Analysis Lab Code: 590221(17)

Total Marks in End Semester Exam: 100

1. Study of Image processing toolbox in MATLAB/OpenCV. Basic image processing commands.
2. Implementation of image enhancement techniques in MATLAB/OpenCV (Point processing methods).
3. Implementation of image enhancement techniques in MATLAB/OpenCV.(Mask Processing methods).
4. Implementation of image enhancement techniques in MATLAB/OpenCV (frequency domain methods).
5. Implementation of image restoration techniques in MATLAB/OpenCV.
6. Histogram and histogram equalization.
7. Point and line detection.
8. Implementation of image segmentation techniques in MATLAB/OpenCV. (Region growing/region splitting/merging).
9. Feature extraction.
10. Color image processing (Ploting histogram and histogram equalization for color images etc.).

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Semester: M. Tech- II Branch: Biomedical Engineering and Bioinformatics

Subject: Medical Instrumentation and sensors Lab Code: 590222(17)

Total Marks in End Semester Exam: 100

1. Blood Pressure Measurement.
2. ECG wave analysis using simulator.
3. Respiratory system analysis using Spirometer
4. Analysis of ECG abnormal wave pattern using Arrhythmia Simulator.
5. EEG wave analysis using simulator.
6. Auditory system checkup using Audiometer
7. Heart sound measurement using phonocardiograph (PCG) .
8. Heart rate variability analysis.
9. Designing hardware circuits for ECG amplification and noise reduction.
10. Study of ECG and EEG recorders (Hands on).