Chhattisgarh Swami Vivekanand Technical University, Bhilai

Scheme of Teaching and Examination

M.Tech. (Biomedical Engineering and Bioinformatics)

1st Semester

S. N.	Board of Study	Sub Code	Subject Name	Periods Per Week			Scheme of Examination Theory/Practical			Total Marks	Credit L+(T+P)/2
				L	**T**	**P**	**ESE**	**CT**	**TA**		
1	Biomedical Engg.	590111(17)	Biomathematics	3	1	-	100	20	20	140	4
2	Biomedical Engg.	590112(17)	Biomedical signal processing and analysis	3	1	-	100	20	20	140	4
3	Biomedical Engg.	590113(17)	Bioinformatics	3	1	-	100	20	20	140	4
4	Biomedical Engg.	590114(17)	Drug Delivery and Drug Design	3	1	-	100	20	20	140	4
5	Elective -I			3	1	-	100	20	20	140	4
6	Biomedical Engg.	590121(17)	Biomedical signal processing and analysis Lab	-	-	3	75	-	75	150	2
7	Biomedical Engg.	590122(17)	Bioinformatics 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- 1 (**Elective -I)**

S. N.	**Board of Study**	**Sub Code**	**Subject Name**
1	Biomedical Engg.	590131(17)	Physiology for Engineering
2	Biomedical Engg.	590132(17)	Biosensors
3	Biomedical Engg.	590133(17)	Biomechanics
4	Biomedical Engg.	590134(17)	Data Mining in Bio informatics
5	Biomedical Engg.	590135(17)	Biometrics

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Scheme of Teaching and Examination

M.Tech. (Biomedical Engineering and Bioinformatics)

1st Semester

S. N.	Board of Study	Sub Code	Subject Name	Periods Per Week			Scheme of Examination Theory/Practical			Total Marks	Credit L+(T+P)/2
				L	**T**	**P**	**ESE**	**CT**	**TA**		
1	Biomedical Engg.	590111(17)	Biomathematics	3	1	-	100	20	20	140	4
2	Biomedical Engg.	590112(17)	Biomedical signal processing and analysis	3	1	-	100	20	20	140	4
3	Biomedical Engg.	590113(17)	Bioinformatics	3	1	-	100	20	20	140	4
4	Biomedical Engg.	590114(17)	Drug Delivery and Drug Design	3	1	-	100	20	20	140	4
5	Elective -I			3	1	-	100	20	20	140	4
6	Biomedical Engg.	590121(17)	Biomedical signal processing and analysis Lab	-	-	3	75	-	75	150	2
7	Biomedical Engg.	590122(17)	Bioinformatics 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- 1 (**Elective -I)**

S. N.	**Board of Study**	**Sub Code**	**Subject Name**
1	Biomedical Engg.	590131(17)	Physiology for Engineering
2	Biomedical Engg.	590132(17)	Biosensors
3	Biomedical Engg.	590133(17)	Biomechanics
4	Biomedical Engg.	590134(17)	Data Mining in Bio informatics
5	Biomedical Engg.	590135(17)	Biometrics

Chhattisgarh Swami Vivekanand Technical University, Bhilai

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

Subject: Biomathematics Code: 590111(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

Differential equations: Ordinary differential equations of the 1st order, exactness and integrating factors, variation of parameters, Picard's iteration method. Ordinary linear differential equations of nth order, solution of homogeneous and non-homogeneousequations.Operator method.Methods of undetermined coefficients and variation of parameters. Systems of differential equations, Phase plane. Critical points, stability.

Unit – II

Probability and Statistics: Mean and variance, Distribution functions: Normal Distribution,Uniform distribution, Poisson distributions, Knudson's analysis, Wright-Fisher model, Fitting afunction to experimental data (Linear fit, Least-square fit, and Errors), Examples from biology: End-to-end vector distribution of DNA,Flexible protein chain, End-to-end distance scaling withpolymer length.

Unit – III

Population models: Models for population growth, Exponential, Logistic, and Gompertz.Interacting populations, Predator - prey, Lotka -Volterra, and food webs.

Unit –IV

Mathematical Models of Biological Diffusion-Brownian Motion,Random Walks, and Fick's Law. Diffusionwith Advection and Chemotaxis.Reaction-Diffusion Equations.

Unit- V

Chemical Interactions-Law of Mass Action.Michaelis-Menten Kinetics and Enzymatic Reactions. Chemical Master Equations.

Texts & References:

1. G. Eason, C.W. Coles & G. Gittinby: Mathematics and Statistics for Biosciences, Ellis Horwood, 1980.
2. J. D. Murray: Mathematical Biology, Springer-Verlag, Berlin, 1989.
3. E. Kreyszig: Advanced Engineering Mathematics, 5th Ed., Wiley Eastern, 1991,

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Semester: M. Tech- I Branch: Biomedical Engineering and Bioinformatics
Subject: Biomedical signal processing and analysis Code: 590112(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 biomedical signals: Review of signals and transforms, Introduction to Biomedical signals, Natue of Biomedical signals, examples of biomedical signals, objectives of Biomedical signals analysis, Difficulties in Biomedical signal analysis, signal conversion, Review of Design of FIR and IIR filters.

Unit – II

Filters: Various types and sources of noise in biomedical signals. High frequency noise in the ECG, Motion artifact in the ECG, Power line interference in ECG signals,maternal interference in fetal ECG. Removal of high frequency noise: Butterworth low pass filters, Removal of low frequency noise: Butterworth high pass filters, Removal of periodic artifacts: Notch and comb filters, Optimal filtering, Adaptive filter, Signal averaging, selecting an appropriate filters.

Unit –III

ECG signal analysis: ECG signals characteristics; The P, QRS, and T waves in the ECG,The first and second heart sounds, The Derivative based methods for QRS detection, The Pan–Tompkins algorithm for QRS detection, ST segment analyzer, Arrhythmia analyzer.

Unit – IV

Neurological signal processing: EEG, EEG rhythms & waveform categorization of EEG activity, recording techniques, Correlation Analysis of EEG Rhythms, Detection of EEG rhythms, Template matching for EEG spike and wave detection, Detection of EEG rhythms related to seizure. EEG applications in epilepsy, Sleep disorders, Brain computer interface.

Unit –V

Frequency domain analysis: Estimation of the PSD (Power spectral density), The periodogram, The use of windows: Spectral resolution and leakage, Measures Derived from PSDs, Moments of PSD functions, Spectral power ratios, Fractal Analysis, Spectral Analysis of ECG and EEG Signals.

Text & References:

1. R. Ranngayyan," Biomedical signal analysis" Wiley, 2001.
2. D.C. Reddy, "Biomedical signal processing Principles and techniques', TMH, New Delhi, 2005.
3. Willis J. Tompkins, Biomedical Digital Signal Processing, Prentice Hall, 2009.
4. G. R. Sinha&Bhagwati C. Patel, Medical Image Processing: Concept and Application, PHI-2014

Chhattisgarh Swami Vivekanand Technical University, Bhilai

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

Subject: Bioinformatics Code: 590113(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

Review of basics of bioinformatics: Principles of protein structure, Tertiary structure, Quaternary structure, Similarity of ternary and quaternary structure, Bioinformatics databases. Data storage and retrieval, quality of data, data representation.Proteins: From Sequence to Structure to FunctionDNA and RNA Structure, DNA Cloning and Sequencing, Genes, Taxonomy, and Evolution.

Unit-II

Genome analysis:The Genomic Organization of Genes, Comparative Genomics, Functional Genomics Microarray and Bio-array Technology, Genomes as Gene Networks.

Unit – III

Proteome analysis: Proteomics, Hydrodynamic Methods, Predictive Biology, Systems Biology.

Unit- IV

Protein tertiary structure modeling: Basic concepts, Hydrogen bond, Defining a secondary structureelement, Methods for predicting secondary structure, Protein folding and dynamic simulation, Modelingprotein sidechains, Comparative modeling, Threading, Ab initio modeling, Combined modeling approaches.

Unit- V

Information theory and biology: Information theory and biology:Entropy, Shannon's formula, divergences fromequiprobability and independence, Markov chains, ergodic processes, redundancy,application to DNA and protein sequences.

Texts & References:

1. Bioinformatics Basics: Applications in Biological Science and Medicine, Lukas K. Buehler, Hooman H. Rashidi, CRC Press, 2005.
2. Molecular databases for protein sequence and structure studies by Sillince, J A and Sillince M (1991) springerVerlag.
3. Sequence Analysis primer by M. Gribskov, J. Devereux(1989) Stockton Press
4. Computational Methods in Mol.Biol. /Now Comprehensive Biochemistry Vol. 32 S.L. Seizberg, DB Searks, S. KasifElevier 1998.
5. P. Basldi, S Brunak, Bioinformatics," A Machine Learning Approach", MIT Press, 1998.
6. Information theory and living systems by L.I. Garfield, (1992) Columbia UniversityPress.

Chhattisgarh Swami Vivekanand Technical University, Bhilai

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

Subject: Drug Delivery and drug design Code: 590114(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 Drug Delivery: Drug delivery system, drug delivery routes and drug formulations.

Unit- II

Site-Specific Drug Delivery Using Liposomes and Emulsions as Carriers: Introduction, Liposomes in Drug Delivery, The Liposome-Drug Concept, Liposomes as Carriers of Therapeutic Agents, Parenteral Emulsions.

Unit-III

Site-Specific Drug Delivery Utilizing Monoclonal Antibodies: Introduction, Production of Monoclonal Antibodies, Drug–Monoclonal Antibody Conjugates for Drug Targeting.

Unit-IV

Role of Polymers in Drug Delivery: Introduction, Currently Available Polymers, Soluble Polymers as Drug Carriers, Biodegradable or Bioerodible Polymers, Mucoadhesive Polymers, Polymers Containing Pendant Bioactive Substituents, Matrix Systems, Heparin-Releasing Polymers, Ionic Polymers, Oligomers.

Unit –V

Implants in Drug Delivery: Introduction, Insulin Delivery as a Model Implant Pump System, Implants for Contraception, Delivery of Chemotherapeutic Agents Using Implants.

Texts & References:

1. Drug Delivery Systems, Third Edition, Vasant V. Ranade, John B. Cannon, CRC Press, 2011.
2. Drug Delivery Systems, Ed. K. K. Jain, Humana Press, Springer. 2008.
3. Seltzman WM, Engineering Principles of Drug Therapy, Oxford University Press(2001)
4. Wang B., iahaan T, Soltero R, Drug delivery principles and applications, Wiley-Interscience,(2005)

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Semester: M. Tech- I
Branch: Biomedical Engineering and Bioinformatics
Subject:Physiology for Engineering.
Code: 590131(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

Basic cell physiology: The Cell and its functions, genetic control of protein synthesis, cell function and cell reproduction.

Unit- II

Membrane physiology, nerve and muscle: Transport of substances through the cell membrane, membrane potential and action potential, Contraction and excitation of skeletal muscle and smooth muscle.

Unit- III

Physiology of Arteries: Mechanics of Arterial Walls, Pulse Wave Velocity and the Moens–Korteweg Equation, Vascular Pathologies, Stents, Coronary Artery Bypass Grafting Physiology of Valves: Aortic and Pulmonic Valves, Mitral and Tricuspid Valves, Pressure Gradients across a Stenotic Heart Valve, Prosthetic Mechanical Valves, Prosthetic Tissue Valves ;Pulsatile Flow in Large Arteries: Pulsatile Flow in Rigid Tubes—Womersley Solution, Pulsatile Flow in Rigid Tubes—Fry Solution, Instability in Pulsatile Flow.

Unit- IV

Physiology of heart and circulatory system: Heart muscle, functioning of heart, Normal ECG, Arrhythmias, Overview of the Circulation; Medical Physics of Pressure, Flow, and Resistance, Cardiac Output, Venous Return, and Their Regulation, Muscle Blood Flow and Cardiac Output During, Exercise; the Coronary Circulation and Ischemic Heart Disease, Cardiac Failure, and Heart Sounds.

Unit-V

Biochemical cycles:Systematic physiology; Neuromuscular system; Blood and lymph; Circulatory system; Gastro-intestinal system; Kidney and excretory system; Sensory system-visual, auditory, vestibular; Endocrine-pituitary, adrenal, pancreatic etc.

Texts & References:

1. A. C. Guyton; Textbook of Medical Physiology, 8th Ed., Prism Books(Pvt) Ltd. & W. B. Saunders Company, 1991.
2. J. B. West(Ed): Best and Taylor's Physiological Basis of Medical Practice, 11th Ed, Williams and Wilkins , Balatimore, 1985.
3. W. F. Ganong: Review of Medical Physiology, 13th ed. Prentice Hall, Connecticut, 1987.
4. D. S. Luciano, A. J. Vander & J. S. Sherman: Human Anatomy and Physiology, 2nd ed. McGraw Hill, New York, 1983.

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Semester: M. Tech- I
Branch: Biomedical Engineering and Bioinformatics
Subject: Biosensor
Code: 590132(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: , Transducers, Biosensors, Bioreceptors, Transducers for Biosensors,Sensor Architecture and Classification; Medically significant measurands, Functional specifications of medical sensor; Sensor characteristics; Linearity, repeatability, hysteresis, drift, Sensor models in time and frequency domain.

Unit-II

Sensor for physical measurands: Sensors for measurement of strain, force, pressure, acceleration, flow, volume, temperature, and biopotentials, light sensors.

Unit-III

Electochemical sensors: Electrolytic and Electrochemical Cells, Ion-Selective Electrodes (ISEs; Potentiometric), pH Electrode (Potentiometric), Amperometric Biosensors, Conductometric Biosensors.

Unit-IV

Glucose and Immunosensors: Optical and electrochemical Glucose Sensor, Continuous Glucose Monitoring (CGM), Enzyme-Linked Immunosorbent Assay (ELISA), Antibodies, Antibody Fragments and Aptamers, Lateral-Flow Assay (LFA), Optical Immunosensors, Surface Plasmon Resonance (SPR) Immunosensor, Electrochemical, Immunosensors, Impedance Immunosensors: Interdigitated Microelectrode (IME) Immunosensor .

Unit-V

Application of Biosensors. General Aspects. Biosensors for Clinical Chemistry.Continuous Patient Monitoring and Implantable Sensors.Food Analysis, Bioprocess Control and Environmental Monitoring.

Texts & References:

1. Yoon, Jeong-Yeol , Introduction to Biosensors From Electric Circuits to Immunosensors, 2nd edition, Springer, 2016.
2. J.G. Webster(Ed): Medical Instrumentation- Application and Design; Houghton Mifflin Co. Boston, 1992.
3. R. Ason: Princioples of Biomedical Instrumentation and Measurement, Merril Publishing Co., Columbus, 1990.
4. R.S.C. Cobbold: Transducers for Biomedical Measurements: Principles and Applications, John Wiley & Sons, 1974.
5. E.O. Doebin: Measurement Systems, Appliction and Design, McGraw-Hill, 1985.
6. A.P.F. Turner and J.G. Karube& G.S. Wilson: Biosensors: Fundamentals & Applications, Oxford University Press, Oxford, 1987.

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Semester: M. Tech- I
Branch: Biomedical Engineering and Bioinformatics
Subject:Biomechanics
Code: 590133(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 of Mechanics: Review of the principles of mechanics, Vector mechanicsResultant forces of Coplaner&Noncoplaner and Concurrent & non-concurrent forces, parallel force in space, Equilibrium of coplanar forces, Newton's laws of motion, Work and energy, Moment of inertia.

Unit-II

Biomechanics of Joints: Skeletal joints, forces and stresses in human joints, Analysis of rigid bodies in equilibrium, free body diagrams, types of joint, biomechanical analysis of elbow, shoulder, spinal column, hip knee and ankle.

Unit-III

Hard and Soft Tissues Mechanics: Bone structure & composition mechanical properties of bone, cortical and cancellous bones, viscoelastic properties, Maxwell&Voight models – anisotropy. Structure and functions of Soft Tissues: Cartilage, Tendon, Ligament, and Muscle; Material Properties: Cartilage, Tendon, Ligament, and Muscle; Modeling: Cartilage, Tendon, Ligament, and Muscle

Unit-IV

Cardiovascular and Respiratory Mechanics: Cardiovascular system, artificial heart valves, biological and mechanical valves development, testing of valves. Mechanism of air flow, respiratory cycle, lung ventilation model, methods of determining pressure, flow rate and volume; spirometer.

Unit-V

Biomechanics of Implants: Design of orthopedic implant, specifications for a prosthetic joint, biocompatibility, requirement of a biomaterial, characteristics of different types of biomaterials, manufacturing process of implants, fixation of implants.

Texts & References:

1. Y C Fung, Biomechanics: Mechanical Properties of Living Tissues, springer, 2nd edition, 1993.
2. N. Ozkaya and M. Nordin, Fundamentals of Biomechanics-Equilibrium, Motion and Deformation, springer-verlag, 2nd edition 1999
3. J. G Webster, Medical instrumentation –Application & design, John Wiley and sons Inc. 3rd ed. 2003. 4. D. J. Schneck and J. D. Bronzino, Biomechanics- Principles and Applications, CRC Press, 2nd Edition, 2000.

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Semester: M. Tech- I
Branch: Biomedical Engineering and Bioinformatics
Subject: Data Mining in Bioinformatics
Code: 590134(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

Biological Databases Integration and knowledge discovery: Biological Data Storage and Analysis, The Curse of Dimensionality, Data Cleaning, Problems of Data Cleaning, Challenges of Handling Evolving Databases, Data Integration,Data warehousing: Data Management with QueryOptimization, Analysis of Data Using Large DatabasesChallenges in Data Cleaning, Models of Data Cleaning, data integration techniques.

Unit-II

Feature Selection and Extraction Strategies in Data Mining: Overfitting, Data Transformation, Normalization and Standardization, Features and Relevance, Overview of Feature Selection, Filter Approaches for Feature Selection, ach.Feature Subset Selection Using Forward Selection, Other Nested Subset Selection Methods, Feature Construction and Extraction, Singular Vector Decomposition (SVD), Principal Component Analysis (PCA), Partial Least-Squares-Based Dimension Reduction (PLS), Factor Analysis (FA), Independent Component Analysis (ICA).

Unit-III

Feature Interpretation for Biological Learning: Normalization Techniques for Gene Expression Analysis, Identification of Differentially Expressed Genes, Selection Bias of Gene Expression Data, Data Preprocessing of Mass Spectrometry Data, Data Transformation Techniques, Techniques for MS Data Analysis, Feature Selection Techniques, Univariate Methods, Multivariate Methods, Data Preprocessing for Genomic Sequence Data, Feature Selection for Sequence Analysis, Ontologies in Bioinformatics.

Unit-IV

Clustering Techniques in Bioinformatics: Clustering in Bioinformatics, Clustering Techniques, Distance-Based Clustering and Measures, *k*-Means Algorithm, *k*-Modes Algorithm, Genetic Distance Measure (GDM), Gene Expression Clustering Using Mutual Information Distance Measure, Gene Expression Data Clustering Using a Local Shape-Based Clustering, Hierarchical Clustering, Applications of Hierarchical Clustering Techniques in Bioinformatics, Self-Organizing Maps Clustering (SOM), Identifying Distinct Gene Expression Patterns Using SOM, Fuzzy Clustering.

Unit-V

Classification techniques: Classification using neural network (Back propagation algorithm), Support vector machine, Bayesian classifier, Decision trees, Random forest. Performance measures, validation and benchmarking

Texts & References:

1. SumeetDua, PradeepChowriappa, Data Mining for Bioinformatics, CRC press, 2012.
2. Pang-NingTan , Michael Steinbach, Vipin Kumar, Introduction to Data Mining, Addison-Wesley, 2005.
3. Jiawei Han, Jian Pei,MichelineKamber, Data Mining: Concepts and Techniques, Morgan Kaufmann; 3 edition (June 9, 2011).

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Semester: M. Tech- I
Branch: Biomedical Engineering and Bioinformatics
Subject: Biometrics
Code: 590135(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- Person recognition, biometric systems, functionalities, errors, The Design Cycle of Biometric Systems, applications, security and privacy issues.

Unit- II

Finger print recognition: Friction ridge pattern, finger print acquisition, Techniques of feature extraction and matching.

Unit-III

Face recognition: Image acquisition, face detection, feature extraction and matching.

Unit-IV

Iris recognition: Design of iris recognition system, Image acquisition, segmentation, normalization, encoding and matching, quality assessment and performance evaluation.

Unit-V

Other biometric traits: Ear, Gait, Hand geometry, Handwriting. Biometrics scope and future.Biometric standards. Facial Scan, Features'- Component-Operation (Steps), Competing facial Scan technologies- Strength and weakness.

Texts & References:

1. Anil Jain, Arun A. Ross, KarthikNanda Kumar,Introduction to Biometrics 2011th Edition, springer.
2. Biometrics of Network Security-Paul Reid, Pearson Education.
3. Biometrics: Concepts and Applications- G.R. Sinha and S. Patil, Wiley India.

Chhattisgarh Swami Vivekanand Technical University, Bhilai

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

Subject: Biomedical Signal Processing and Analysis Lab Code: 590121(17)

Total Marks in End Semester Exam: 75

1. Study of Trainer kits for acquisition of biosignals such as ECG, EEG, EMG etc.
2. Real time data acquisition of ECG.
3. Real time data acquisition of EEG.
4. Real time data acquisition of EMG.
5. Filter design for removing noise and artifacts from ECG.
6. Filter design for removing noise and artifacts from EEG.
7. Filter design for removing noise and artifacts from EMG.
8. ECG feature extraction in time domain.
9. Implementation of QRS complex detection techniques.
10. HRV analysis.

Chhattisgarh Swami Vivekanand Technical University, Bhilai

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

Subject: Bioinformatics Lab Code: 590122(17)

Total Marks in End Semester Exam: 75

1. Biological Databases with Reference to Expasyand NCBI (National center for Biotechnological information)
2. Queries based on Biological databases
3. Sequence similarity searching using BLAST
4. Pairwise sequence alignment
5. Multiple Sequence and Phylogenetic Analysis
6. Gene Prediction
7. Secondary Structure prediction.
8. Tertiary Structure Predication
9. Drug and vaccine designing using bioinformatics tools.
10. Molecular dynamics simulation of macro-molecules

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Scheme of Teaching and Examination

M.Tech. (Biomedical Engineering and Bioinfomatics)

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

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).

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Scheme of Teaching and Examination

M.Tech. (Biomedical Engineering and Bioinfomatics)

3rd 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.	590311(17)	Machine Learning for Bioinformatics	3	1	-	100	20	20	140	4
2	Refer Table- 3 **Elective-III**			3	1	-	100	20	20	140	4
3	Biomedical Engg.	590321(17)	Project Work	-	-	28	100	-	100	200	14
4	Biomedical Engg.	590322(17)	Seminar on Industrial Training and Dissertation	-	-	3	-		20	20	2
Total				**6**	**2**	**31**	**300**	**40**	**160**	**500**	**24**

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

Refer Table- 3 (**Elective -III)**			
S. N.	**Board of Study**	**Sub Code**	**Subject Name**
1	Biomedical Engg.	590331(17)	Protein Engineering & Design
2	Biomedical Engg.	590332(17)	Virtual Instrumentation in BME
3	Biomedical Engg.	590333(17)	Cell Physiology and Bio Potential
4	Biomedical Engg.	590334(17)	Genomics and Proteomics
5	Biomedical Engg.	590335(17)	Biological sequence Analysis

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Scheme of Teaching and Examination

M.Tech. (Biomedical Engineering and Bioinfomatics)

3rd 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.	590311 (17)	Machine Learning for Bioinformatics	3	1	-	100	20	20	140	4
2	Refer Table- 3 **Elective-III**			3	1	-	100	20	20	140	4
3	Biomedical Engg.	590321 (17)	Project Work	-	-	28	100	-	100	200	14
4	Biomedical Engg.	590322 (17)	Seminar on Industrial Training and Dissertation	-	-	3	-		20	20	2
Total				**6**	**2**	**31**	**300**	**40**	**160**	**500**	**24**

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

Refer Table- 3 (**Elective -III)**			
S. N.	**Board of Study**	**Sub Code**	**Subject Name**
1	Biomedical Engg.	590331(17)	Protein Engineering & Design
2	Biomedical Engg.	590332(17)	Virtual Instrumentation in BME
3	Biomedical Engg.	590333(17)	Cell Physiology and Bio Potential
4	Biomedical Engg.	590334(17)	Genomics and Proteomics
5	Biomedical Engg.	590335(17)	Biological sequence Analysis

Chhattisgarh Swami Vivekanad Technical University, Bhilai

Semester: M. Tech-III Branch: Biomedical Engineering and Bioinfomatics
Subject: Machine Learning For Bioinformatics Code: 590311(17)
Total Theory Period: 40Total Tutorial Period 12
Total Marks in End Semester Exam: 100
Minimum of class test to be conducted: 02

Unit- I

Introduction: Machine-Learning Foundations: The Probabilistic Framework, Bayesian modelling, The Cox Jaynes axioms,Bayesian inference & induction, Model structures: graphical models & other tricks - Probabilistic Modeling & Inference: Examples - The simplest sequence models, Statistical mechanics Machine Learning Algorithms, Dynamic programming Gradient descent, EM/GEM algorithms, Markov chain Monte, Carlo methods Simulated annealing, Evolutionary & genetic algorithms. Learning algorithms: miscellaneous aspects.

Unit- II

SVM: introduction, architecture, kernel, ROC, feature selection, sensitivity, specificity, accuracy implementation, SVM applications in sequence analysis, structure prediction, drug design, SVM light - LIBSVM , Weka, R.

Unit- III

Neural Networks: Introduction, Universal approximation properties, Priors & likelihoods - Learning algorithms: back-propagation Neural Networks: Applications, Sequence encoding & output interpretation, Sequence correlations & neural networks, Prediction of protein secondary structure, Prediction of signal peptides & their cleavage sites, Applications for DNA & RNA nucleotide sequences, Prediction performance evaluation, Different performance measures, Perceptron's and Multilayer Perceptron's, Neural Networks in Drug Design.

Unit- IV

Hidden Markov Models: The Theory - Introduction -Prior information & initialization - Likelihood & basic algorithms Learning algorithms - Applications of HMMs: general aspects, Protein applications - DNA & RNA applications - Advantages & limitations of HMMs – tools.

Unit- V

Probabilistic Graphical Models in Bioinformatics, Markov Models & DNA symmetries, Markov Models & gene finders, Hybrid models & neural network parameterization of graphical models, The single-model case, -directional recurrent neural networks for protein secondary structure prediction.

Texts & Reference:

1. Pierre Baldi and SørenBrunak, "Bioinformatics: The Machine Learning Approach", MIT Press, 1998.
2. David W Mount, "Bioinformatics: Sequence and Genome Analysis", 2nd Edition, CBS Publishers, 2004.
3. Zupan J., Gasteiger J., "Neural Networks in Chemistry and Drug Design", Wiley-VCH, 2000.

Chhattisgarh Swami Vivekanada Technical University, Bhilai

Semester: M. Tech-III Branch: Biomedical Engineering and Bioinfomatics
Subject: Protein Engineering & Design Code: 590331(17)
Total Theory Period: 40Total Tutorial Period 12
Total Marks in End Semester Exam: 100
Minimum of class test to be conducted: 02

Unit- I

Aminoacids(thestudentsshouldbethoroughwiththreeandsinglelettercodes)andtheirmolecularproperties(size,solubility,charge,pKa),Chemicalreactivity inrelationtopost-translationalmodification(involvingamino,carboxyl,hydroxyl,thiol,imidazolegroups)andpeptidesynthesis.

Unit- II

Primarystructure:peptidemapping,peptidesequencing-automatedEdmanmethodandMassSpectrometry.High-throughputproteinsequencingsetupSecondarystructure:Alpha,betaandloopstructuresandmethodstodetermineSuper-secondarystructure:Alpha-turn-alpha,beta-turn-beta(hairpin),beta-sheets,alpha-beta-alpha,topologydiagrams,upanddown&TIMbarrelstructuresnucleotidebindingfolds,sitesTertiarystructure:Domains,denaturationanddenaturation,proteinfoldingpathways,overviewofmethodstodetermine3Dstructures,Interactionwithelectromagneticradiation(radio,micro,infrared,visible,ultraviolet,X-ray)andelucidationofproteinstructure.Quaternaryassociations:Modularnature,formationofcomplexes.

Unit- III

Overviewofproteinstructure,PDB,structurebasedclassification,databases,visualizationtools,structurealignment,domain architecturedatabases,protein-ligand interactions.Covalent,Ionic,Hydrogen,Coordinate,hydrophobicandVanderwallsinteractionsinproteinstructure.

Unit- IV

BioinformaticsApproaches:Secondarystructurepredictionanddeterminationofmotifs,profiles,patterns,fingerprints,supersecondarystructures,predictionofsubstratebindingsites,tertiarystructure,quaternarystructure,methodstodetermine tertiaryandquaternarystructure,posttranslationalmodification.

Unit-V

Methodsofproteinisolation,purificationandquantification;largescalesynthesisofengineeredproteins,designandsynthesisofpeptides;methodsofdetectionandanalysisofproteins.Proteindatabaseanalysis, methodstoalterprimarystructure of proteins,examples of engineeredproteins,proteindesign,principlesandexamples.Advantagesandpurpose,overviewofmethods,underlyingprincipleswithspecificexamples:thermalstabilityT4-lysozyme,recombinantinsulintoreduceaggregationandinactivation,*denovo*proteindesign.

Unit- VI

DNA-bindingproteins:prokaryotictranscriptionfactors,Helix-turn-HelixmotifinDNAbinding,Trprepressor,Eukaryotictranscriptionfactors, Znfingers,helix-turnhelixmotifsin home domain,Leucinezippers,Membraneproteins:Generalcharacteristics,Trans-membranesegments,prediction,bacteriorhodopsinandPhotosyntheticreactioncenter.Immunoglobulin's:IgGLightchainandheavychainarchitecture,abzymesandEnzymes:Serineproteases,understandingcatalyticdesignbyengineeringtrypsin,chymotrypsinandelastase,substrate-assistedcatalysisothercommercialapplications.

Texts& Reference:

1. MoodyP.C.EandA.JWilkinson.ProteinEngineering,IRLPress,OxfordUniversityPress.
2. ProteinSciencebyArthurMLesk,OxfordUniversityPress.
3. ProteinStructurebyCreighton,OxfordUniversityPress.
4. IntroductionofproteinstructurebyBrandenCandToozeR.,Garland.

Chhattisgarh Swami Vivekanad Technical University, Bhilai

Semester: M. Tech-III Branch: Biomedical Engineering and Bioinfomatics
Subject: Virtual Instrumentation in BME Code: 590332(17)
Total Theory Period: 40Total Tutorial Period 12
Total Marks in End Semester Exam: 100
Minimum of class test to be conducted: 02

Unit- I

Introduction: Overview of medical instruments, advantages of virtual instrument on hardware instrument, Architecture, educational Laboratory Virtual Instrumentation Suite (ELVIS) and its building blocks, Graphical programming languages.

Unit- II

Data Acquisition (DAQ) Fundamentals: PC-Based DAQ System: Basic hardware architecture of PC, PC Sound card, common communication ports and protocols available in PC, review on sensors and signal conditioning, DAQ hardware, Specifications of Data acquisition systems: Analog input: sampling rate, multiplexing, resolution, relative accuracy, noise, Analog output, Triggers, Real-Time system integration, Digital I/O. Timing I/O, Software Multichannel analog DAQ system, Set up for data acquisition, universal DAQ card, Use of timer-counter and analog outputs on the universal DAQ card.

Unit- III

Application Development Software (LabVIEW): LabVIEW application development for virtual instrumentation (VI), Creating a virtual instrument in LabVIEW, Dataflow programming concepts, Sub VIs and modular code creation, Arrays and File I/O , Textual Math Integration with LabVIEW, Interfacing external instruments to a PC.

Unit- IV

Programming Environment in Virtual Instrumentation: Data formulation, Wave form generators, Acquiring data and its graphical representation, File formats, Simulating a DAQ device, Using counter and digital I/O, Measuring analoginput, Generating analog output, Types of scopes.

Unit- V

Analysis Tools and Medical Applications in Virtual Instrumentation: Realization of Fourier transform and Fast Fourier Transform (FFT), Wavelet transform, Correlation (Windowing and filtering) tools in LabVIEW, VI based temperature monitor, VI based cardiac monitor (ECG), Bio-bench-A virtual instrument application for data acquisition and analysis of physiological signals, ECG signal processing, Bio-Informatics and NI LabVIEW technology in drug discovery process.

Texts & Reference:

1. Olansen, Jon B. and Eric Roscow, Virtual Bio Instrumentation: Biomedical, Clinical, and Healthcare Applications in LabVIEW, Published by Prentice Hall, 2002.
2. Hall T. Martin, Meg L. Martin, LabVIEW for Automotive, Telecommunications, Semiconductor, Biomedical and Other Applications (National Instruments Virtual

Instrumentation Series), Prentice Hall PTR.

3. Gary Jonson, “Labview Graphical Programming”, Second Edition, McGraw Hill, New York, Fourth edition 2006.
4. Lisa K wells & Jeffrey Travis, “Labview for everyone”, Prentice Hall Inc, New Jersey, First edition 1997.
5. Gupta S J, Gu.pta P, “PC interfacing for Data Acquisition & Process Control”, Instrument Society of America, Second Edition, 1994.

Chhattisgarh Swami Vivekanad Technical University, Bhilai

Semester: M. Tech-III Branch: Biomedical Engineering and Bioinfomatics
Subject: Cell Physiology and BiopotentialCode: 590333(17)
Total Theory Period: 40Total Tutorial Period 12
Total Marks in End Semester Exam: 100
Minimum of class test to be conducted: 02

Unit- I
Fundamental Physicochemical Concepts: Introduction: Homeostasis and Cellular Physiology, Diffusion and Permeability, Osmotic Pressure and Water Movement, Electrical Consequences of Ionic gradients

Unit- II
Ion Channels and Excitable Membranes: Ion Channels, Passive Electrical Properties of Membranes, Generation and Propagation of the Action Potential, Ion Channel Diversity.

Unit- III
Solute Transport: Electrochemical Potential Energy and Transport Processes, Passive Solute Transport, Active Transport.

Unit- IV
Physiology of Synaptic Transmission, Synaptic Physiology.

Unit-V
Molecular Motors and Muscle Contraction, Molecular Motors and the Mechanism of Muscle Contraction
Excitation-Contraction Coupling in Muscle, Mechanics of Muscle Contraction.

Texts & Reference:

1. Nicholas Sperelaki , Cell Physiology Source Book: A Molecular Approach.

2. Mordecai P. Blaustein, Mordecai P. Blaustein, Kao Joseph P. Y., Donald R. Matteson, Cellular Physiology

Chhattisgarh Swami Vivekanad Technical University, Bhilai

Semester: M. Tech-III Branch: Biomedical Engineering and Bioinfomatics
Subject: Genomics and ProteomicsCode: 590334(17)
Total Theory Period: 40Total Tutorial Period 12
Total Marks in End Semester Exam: 100
Minimum of class test to be conducted: 02

Unit- I

Introduction: Introduction to Genomics & Proteomics. Structure, Organization and features of Prokaryotic &Eukaryotic genomes.C-values of eukaryotic genomes-coding, non-coding and repetitive sequences.Organization of genome with in nucleus, mitochondria and chloroplast. Genome mapping: Genetic and physical mapping. Polymorphisms.Molecular markers–RFLP, AFLP, RAPD, SCAR, SNP, ISSR, and Protein markers– Allozymes and Isozymes, Telomerase.FISH– DNA amplification markers and Cancer bio markers. Genome sequences data bases and *Genomean* notation and Gene Ontology.

Unit- II

Genome Sequencing: Recent developments and next generation sequencing, ultra-high-through put DNA Sequencing using Micro array technology. Genome sequencing projects on *H.Influenzae, E.coli, Orizasativum*and Neem. Human-genome project.Raw genome sequence data, Gene variation and associated diseases, diagnostic genes and drug targets.Genotyping-DNA Chips.Comparative and Functional Genomics: Studies with model systems such as Yeast, Drosophila, C.*elegans*, and Arabidopsis. Approach estoanalyze global gene expression–transcript me, Serial Analysis of Gene Expression (SAGE), Expressed Sequence Tags (ESTs), Massively Parallel Signature Sequencing (MPSS), micro array and its applications, gene tagging.

Unit- III

Genome annotation: Extrinsic, Intrinsic (Signals and Content), Conservative in formation used in gene prediction. Frame works for Information integration–Ex on chaining. Generative models: Hidden Morkov Models, Discriminative learning and Combiners. Evaluation of Gene prediction methods–Basic tools, Systematic evaluation and Community experiments (GASP, EGASP and NGASP). Functional annotation of Proteins: Introduction, Protein sequence data bases, UniProt, UniProt KB–Sequence curation, Sequence annotation, Functional annotation, annotation of protein structure, post-translational modification, protein-protein interactions and pathways, annotation of human sequences and diseases in UniProt and UniProt KB. Protein family classification for functional annotation–Protein signature methods and Databases, Inter Pro, Inter Pro Scan for sequence classification and functional annotation.Annotation from Genes and Protein to Genome and Proteome.

Unit- IV

Proteomics: Scope, Experimental methods for studying proteomics, methods of protein isolation, purification and quantification. Methods for large scale synthesis of proteins.Applications of peptides in biology. Analysis of proteome–High through put screening–Yeast two hybrid system and Protein chips, engineering novel proteins, Mass Spectroscopy based protein expression and post-translational modification analysis. Bioinformatics analysis clustering methods.Analysis of proteome functional information.

Unit- V Applications of Computational Tools towards Proteomics studies (to be discussed with appropriate case studies)–
Applicationsofproteomeanalysistodrugdevelopmentandtoxicity,phage antibodies astools forproteomics,glycoanalysisinproteomics,proteomics astoolsdiseasediagnosticsandplantgenetics.Chromatographicdataanalysis.Chromatogramsequencealignmentandediting.CGHandGenotypeArrayAnalysis.X-

Raydataandspectroscopicdataanalysis.2DPAGEimageanalysis.MSdataanalysis.

Texts& Reference:

1. PharmacogenomicsbyWernerKalow,UrsA.Meyer,RachelF.Tyndale,InformaHealthcare,2005.
2. StatisticalandComputationalPharmacogenomics(InterdisciplinaryStatistics) by Rongling Wu, Min Linen,Chapman&Hall/CRC, 2008.
3. GenesVIIIbyBenjaminLewis,JonesandBartlettPublisher,2006.
4. GenomicsandProteomicsbySándorSuhai,Springer,2000.
5. Moderngenomeannotation:theBioSapiensNetworkbyDmitrijFrishman,AlfonsoValencia,Springer,2008.

Discoveringgenomics,proteomicsandbioinformaticsbyA.MalcolmCampbell,

LaurieJ.Heyer,PublishedbyPearson/BenjaminCummings,2006.

Chhattisgarh Swami Vivekanad Technical University, Bhilai

Semester: M. Tech-III Branch: Biomedical Engineering and Bioinfomatics
Subject: Biological Sequence Analysis Code: 590335(17)
Total Theory Period: 40Total Tutorial Period 12
Total Marks in End Semester Exam: 100
Minimum of class test to be conducted: 02

Unit- I

Pairwise alignment techniques – Global alignment, Local alignment methods, Algorithm and statistics of global alignment, Algorithm and statistics of local alignment, Scoring matrices, Gap penalty, Dot matrix sequence comparison-Heuristic algorithms – FASTA and BLAST, Gapped BLAST & PSI BLAST, PHI-BLAST, E-value - Significance of sequence alignment.

Unit- II

Multiple sequence alignment – Goal of multiple sequence alignment to pairwise alignment, progressive methods-CLUSTAL W, PILEUP Iterative methods Position – Specific scoring matrices – Hidden Markov Models of multiple sequence alignment.

Unit- III

Predictive methods: Different secondary structure prediction methods – Chou fasman method, GOR method, Algorithm behind the methods - Tools used for secondary structure prediction - Tertiary structure prediction – homology modeling tool - Description on software packages - EMBOSS – programs and its usage.

Unit- IV

Markov chains, Hidden Markov Models for sequence Analysis –Building an HMM, Viterbi algorithms, Forward, Backward and EM algorithms, Applications of HMMs (HMMer, PFAM). Predictive methods using DNA sequences, Predictive methods using protein sequences- Prediction of RNA secondary structure- Expressed sequence tags (ESTs).

Unit- V

Mathematical basis for phylogenetic - Genetic algorithms - Multiple alignment - Construction of phylogenetic trees - Phylogenetic Analysis – building the data model, extraction of a phylogenetic data set, Tree building method, Distance methods, Character based method, phylogenetic software - Gene prediction methods, Genome analysis and annotation, Large–scale genome analysis and computational tools.

Texts& Reference:

1. Durbin R., Eddy S., Krogh A.&Mitchison G., "Biological Sequence Analysis: Probabilistic Models of Proteins & Nucleic Acids", Cambridge University Press, 1999.
2. Gusfield D., "Algorithms on Strings, Trees & Sequences: Computer Science & Computational Biology", Cambridge University Press, 1997.
3. Lesk A.M., "Introduction to Bioinformatics", Oxford University Press, 2002.
4. Pevzner P., "Computational Molecular Biology: An Algorithmic Approach", MIT Press, 2000.
5. Setubal J. &Meidanis J., "Introduction to Computational Molecular Biology", PWS Publishing Company, 1997.

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Scheme of Teaching and Examination

M.Tech. (Biomedical Engineering and Bioinfomatics)

4th Semester

S. N.	Board of Study	Sub Code	Subject	Periods Per Week			Scheme of Examination			Total Marks	Credit L+(T+P)/2
							Theory /Practical				
				L	**T**	**P**	**ESE**	**CT**	**TA**		
1	Bio-Medical Engg.	590421(17)	**Major Project + Seminar**	6	-	34	300	-	200	500	23
Total				**6**	**-**	**34**	**300**	**-**	**200**	**500**	**23**

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