REGULATIONS AND SYLLABUS

of

Master of Technology

in

Biomedical Instrumentation & Signal Processing

(w.e.f. 2020-21 admitted batch)

GITAM
(DEEMED TO BE UNIVERSITY)
VISAKHAPATNAM • HYDERABAD • BENGALURU
VISAKAPATNAM-530 045
www.gitam.edu

A University Committed to Excellence

M.Tech in Biomedical Instrumentation and Signal Processing

REGULATIONS
(w.e.f. 2020-21 admitted batch)

1. ADMISSION

1.1 AdmissionintoM.Tech.in**Biomedical Instrumentation and Signal Processing** program of GITAM University is governed by GITAM University admission regulations.

2. ELIGIBILITYCRITERIA

2.1 A pass in B.E./ B.Tech./AMIE in ECE / EEE / EIE / Instrumentation / Biotech or its equivalent.

2.2 Admissions in to M.Tech. will be based on the following:

(i) Score obtained in GAT(PG), if conducted.
(ii) Performance in Qualifying Examination/Interview.
(iii) Candidates with valid GATE score shall be exempted from appearing for GAT(PG).

2.3 Theactualweightage to be given to the above items will be decided by the authorities at the time of admissions.

3. CHOICEBASEDCREDITSYSTEM

3.1 ChoiceBasedCredit System (CBCS)was introduced with effect from the admitted Batch of 2015-16 based on UGC guidelines in order to promote:

- Student Centered Learning
- Cafeteria approach
- Students to learn courses of their choice
- Learning at their own pace
- Inter-disciplinary learning

3.2 Learning goals/ objectives and outcomes are specified leading to what a student should be able to do at the end of the program.

4. STRUCTUREOFTHEPROGRAM

4.1 The Program Consists of

i) Core Courses (compulsory) which give general exposure to a student in core and subject related area.

ii) Program Electives.

iii) Open Electives.

4.2 Each course is assigned a certain number of credits depending upon the number of contact hours (lectures/tutorials/practical)perweek.

4.3 In general, credits are assigned to the courses based on the following contact hours per week per semester.

- One credit for each Lecture/Tutorial hour per week.
- One credit for two hours of Practicalsperweek.

4.4 The curriculum of the four semesters M.Tech. Program is designed to have a total of 68 credits for the

award of M.Tech. Degree

5. MEDIUMOFINSTRUCTION

The medium of instruction (including examinations and project reports) shall be English.

6. REGISTRATION

Every student has to register himself/herself for each semester individually at the time specified by the Institute/University.

7. ATTENDANCEREQUIREMENTS

7.1 A student whose attendance is less than75% in all the courses put together in any semester will not be permitted to attend the end- semester examination and he/she will not be allowed to register for subsequent semester of study. He/she has to repeat the semester along with his/her juniors.

7.2 However, the Vice Chancellor on the recommendation of the Principal/Director of the Institute/School may condone the shortage of attendance to the students whose attendance is between 65% and 74% on genuine grounds and on payment of prescribed fee.

8. EVALUATION

8.1 The assessment of the student's performance in a Theory course shall be based on two components: Continuous Evaluation (40 marks) and Semester-end examination (60marks).

8.2 A student has to secure an aggregate of 40% in the course in the two components put together to be declared to have passed the course, subject to the condition that the candidate must have secured a minimum of 24marks (i.e.40%) in the theory component at the semester-end examination.

8.3 Practical/Project Work/Industrial Training/Viva voce/Seminar etc. course arecompletelyassessed under Continuous Evaluation for a maximum of 100 marks, and a student has to obtain a minimum of 40% to secure Pass Grade. Details of Assessment Procedure are furnished below in Table1.

Table:Assessment Procedure

S.No.	Component of Assessment	Marks Allotted	Type of Assessment	Scheme of Evaluation
1	Theory	40	Continuous Evaluation	i) Thirty (30) marks for mid Semester examinations. Three mid examinations shall be conducted for15 marks each; performance in besttwo shall be taken into consideration. ii) Ten (10) marks for Quizzes, Assignments and Presentations. Sixty (60) marks for Semester-end examinations
		60	Semester-end Examination	
	Total	100		

2	Practicals	100	Continuous Evaluation	i) Fifty (50) marks for regularity and performance, records and oral presentations in the laboratory. Weightage for each component shall be announced at the beginning of the Semester. ii) Ten (10) marks for case studies. iii)Forty (40) marks for two tests of20 marks each (one at the mid-term and the other towards the end of the Semester) conducted by the concerned lab Teacher.
3	Project work (III Semester)	100	Continuous Evaluation	i) Forty (40) marks for periodic evaluation on originality, innovation, sincerity and progress of the work, assessed by the Project Supervisor. ii) Thirty (30) marks for mid-termevaluation for defending the Project, before a panel of examiners. iii) Thirty (30) marks for final Report presentation and Viva-voce, by a panel of examiners
4	Project work (IV Semester)	50	Continuous Evaluation	i) Twenty (20) marks for Periodic evaluation on originality innovation, sincerity and progress of the work, assessed by the Project Supervisor. ii) Fifteen (15) marks for mid-term evaluation for defending the Project, before a panel of examiners*. iii) Fifteen (15) marks for interim Report presentation and Viva-voce.
		50	Semester-end Examination	Fifty (50) marks for final project report and viva-voce examination assessed by external examiners.
	Total	100		
5	Seminar (II Semester)	100	Continuous Evaluation	Through five periodic seminars of 20 marks each

**PanelofExaminersshallbeappointedbytheconcernedHeadoftheDepartment*

9. PROVISION FOR ANSWER BOOK VERIFICATION AND CHALLENGE EVALUATION

9.1 If a student is not satisfied with his/her grade, the student can apply for, answer book verification on payment of prescribed fee for each course within one week after announcement of results.

9.2 After verification, if a student is not satisfied with marks/grade awarded, he/she can apply for challenge valuation within one week after announcement of answer book verification result/ two weeks after the announcement of results, which will be valued by two examiners i.e., one Internal

and one External examiner in the presence of the student on payment of prescribed fee. The challenge valuation fee will be returned, if the student is successful in the appeal with a change for a better grade.

10. REAPPEARANCE

10.1 Astudentwho has secured 'F' grade in a Theory course shall have to reappear at the subsequent Semester end examination held for thatcourse.

10.2 Astudentwho has secured 'F'gradein a Practical course shall have to attend Special Instruction Classes held during summer.

10.3 A student who has secured 'F' Grade in Project work / Industrial Training etcshallhave to improve his/her report and reappear for viva–voce at the time of Special Examination to be conducted in the summer vacation.

11. SUPPLEMENTARY EXAMINATIONS AND SPECIAL EXAMINATIONS.

11.1 The odd semester supplementary examinations will be conducted on daily basis after conducting regular even semester examinations during April/May.

11.2 The even semester supplementary examinations will be conducted on daily basis after conducting regular odd semester examinations during October/November.

12. MASSIVE OPEN ONLINE COURSES

Greater flexibility to choose variety of courses is provided through Massive Open Online Courses (**MOOCs**) during the period of study. Students without any backlog courses up to first semester are permitted to register for MOOCs in second semester up to a maximum of 6 credits from program elective / open elective courses. However, the Departmental Committee (DC) of the respective campuses has to approve the courses under MOOCs. The grade equivalency will be decided by the respective Board of Studies (BoS).

11. BETTERMENTOFGRADES

A student who has secured only a Pass or Second class and desires to improve his/her Class can appear for Betterment Examinations only in Theory courses of any Semester of his/her choice, conducted in Summer Vacation along with the Special Examinations. Betterment of Grades is permitted 'only once' immediately after completion of the program of study.

12. GRADINGSYSTEM

12.1 Based on the student performance during a given semester, a final letter grade will be awarded at the end of the semester in each course. The letter grades and the corresponding grade points are asgiveninTable2.

Table 2: Grades &Grade Points

Sl.No.	Grade	GradePoints	AbsoluteMarks
1	O(outstanding)	10	90andabove
2	A+(Excellent)	9	80to89
3	A(VeryGood)	8	70to79

4	B+(Good)	7	60to69
5	B(AboveAverage)	6	50to59
6	C(Average)	5	45to49
7	P(Pass)	4	40to44
8	F(Fail)	0	Lessthan40
9	Ab.(Absent)	0	-

12.2 Astudentwho earns a minimum of 4 grade points (P grade) in a course is declared to have successfully completed the course, and is deemed to have earned the credits assigned to that course, subject to securing a GPA of 5 for a Pass in the semester.

13. GRADEPOINTAVERAGE

13.1 AGradePoint Average (GPA)for the semester will be calculated according to the formula:

$$\text{GPA} = \frac{\sum_i C_i G_i}{\sum_i C_i}$$

where,

C_i = number of credits for the i^{th}course.

G_i =grade points obtained by the student in the i^{th} course.

13.2 To arrive at Cumulative Grade Point Average(CGPA), a similar formula is used considering the student's performance in all the courses taken, in all the semesters up to that semester.

13.3 CGPA required for classification of class after the successful completion of the program is shown in Table3.

Table3:CGPArequiredforawardofClass

Class	CGPA Required
First Class with Distinction	≥8.0*
First Class	≥6.5
Second Class	≥5.5
Pass Class	≥5.0

*In addition to the required CGPA of 8.0 or more, the student must have necessarily passed all the courses of every semester in first attempt.

14. ELIGIBILITY FOR AWARD OF THE M.Tech. DEGREE

14.1Duration of the program: A student is ordinarily expected to complete the M.Tech.programin four semesters of two years. However, a student may complete the program in not more than four years including study period.

14.2However the above regulation may be relaxed by the Vice Chancellor in individual cases for cogent and sufficient reasons.

14.3 A student shall be eligible for award of the M.Tech. Degree if he/she fulfills all the following conditions.

a) Registered and successfully completed all the courses and projects.

b) Successfully acquired the minimum required credits as specified in the curriculum corresponding to the branch of his/her study within the stipulated time.

c) Has no dues to the Institute, Hostels, Libraries, NCC / NSS etc., and

d) No disciplinary action is pending against him/her.

15. DISCRETIONARYPOWER

Not with standing anything contained in the above sections, the Vice Chancellor may review all exceptional cases, and give his decision, which will be final and binding.

M.Tech in Biomedical Instrumentation and Signal Processing

Department of Electrical, Electronics & Communication Engineering
(Effective from academic year 2020-21 admitted batch)

Semester – I

S.No.	Course Code	Course Title	Category	L	T	P	C
1.	20EEC701	Anatomy & Medical Physiology	PC	3	0	0	3
2.	20EEC703	Biomedical Signal Processing and Analysis	PC	3	0	0	3
3.	20EEC705	Biomedical Instrumentation	PC	3	0	0	3
4.	20EEC7XX	Program Elective I	PE	3	0	0	3
5.	20EEC7XX	Program Elective II	PE	3	0	0	3
6.	20EEC721	Biomedical Signal Processing Lab	PC	0	0	4	2
7.	20EEC723	Biomedical Instrumentation Lab	PC	0	0	4	2
8.	20EMC741	Research Methodology and IPR	MC	2	0	0	2
9.	20EAC7XX	Audit Course 1	AC	2	0	0	0
							21

Semester – II

S.No.	Course Code	Course Title	Category	L	T	P	C
1.	20EEC702	Biomedical Image Processing	PC	3	0	0	3
2.	20EEC7XX	Program Elective III	PE	3	0	0	3
3.	20EEC7XX	Program Elective IV	PE	3	0	0	3
4.	20EEC7XX	Program Elective V	PE	3	0	0	3
5.	20EOE7XX	Open Elective	OE	3	0	0	3
6.	20EEC722	Technical Seminar	PC	0	0	4	2
7.	20EEC724	Soft Computing Lab	PC	0	0	4	2
8.	20EEC726	Biomedical Signal Conditioning Lab	PC	0	0	4	2
9.	20EAC7XX	Audit Course 2	AC	2	0	0	0
							21

Semester – III

S.No.	Course Code	Course Title	Category	L	T	P	C
1.	20EEC891	Project Work – I	PW	0	0	26	13
							13

Semester – IV

S.No.	Course Code	Course Title	Category	L	T	P	C
1.	20EEC892	Project Work II	PW	0	0	26	13
							13

Programme Elective - I

S.No.	Course Code	Course Title	Category	L	T	P	C
1.	20EEC751	Virtual Instrumentation in Biomedical Engineering	PE	3	0	0	3
2.	20EEC753	Biosensors and Body area networks	PE	3	0	0	3
3.	20EEC755	Electronic circuits for medical instrumentation	PE	3	0	0	3
4.	20EEC757	Embedded system design for medical applications	PE	3	0	0	3

Programme Elective – II

S.No.	Course Code	Course Title	Category	L	T	P	C
1.	20EEC759	Biomechanics	PE	3	0	0	3
2.	20EEC761	Diagnostic and Therapeutic Equipment	PE	3	0	0	3
3.	20EEC763	Electrocardiography Signal Analysis	PE	3	0	0	3

Programme Elective - III

S.No.	Course Code	Course Title	Category	L	T	P	C
1.	20EEC752	Biomaterials & Artificial organs	PE	3	0	0	3
2.	20EEC754	Bio-MEMS and Applications	PE	3	0	0	3
3.	20EEC756	Lasers and Optical Instrumentation	PE	3	0	0	3

Programme Elective - IV

S.No.	Course Code	Course Title	Category	L	T	P	C
1.	20EEC760	Healthcare andHospital Management	PE	3	0	0	3
2.	20EEC762	Robotics in Medical Applications	PE	3	0	0	3
3.	20EEC764	Telemedicine	PE	3	0	0	3

Programme Elective - V

S.No.	Course Code	Course Title	Category	L	T	P	C
1.	20EEC768	Adaptive Signal Processing	PE	3	0	0	3
2.	20EEC770	Principles of Radiology	PE	3	0	0	3
3.	20EEC772	Rehabilitation Engineering	PE	3	0	0	3

Audit Courses I & II

S.No	Course Code	Course Title	Category	L	T	P	C
1	20EAC741	English for Research Paper Writing	MC	3	0	0	0
2	20EAC742	Personality Development through Life Enlightenment Skills	MC	3	0	0	0
3	20EAC743	Cost Management of Engineering Projects	MC	3	0	0	0
4	20EAC744	Stress Management by Yoga	MC	3	0	0	0
5	20EAC745	Developing Soft Skills and Personality	MC	3	0	0	0

Open Elective

S.No	Stream	Course Code	Course Title	Category	L	T	P	C
1		20EOE762	Business Analytics	OE	3	0	0	3
2		20EOE764	Operations Research	OE	3	0	0	3
3		20EOE766	Waste to Energy	OE	3	0	0	3

M.Tech in Biomedical Instrumentation and Signal Processing

Number of Credits

Semester	I	II	III	IV	Total
Credits	21	21	13	13	68

20EEC701: ANATOMY & MEDICAL PHYSIOLOGY

L	T	P	C
3	0	0	3

Unit – I **8 Hours**

Introduction to Cellular System:
Structure and organelles, Functions of each component in the cell. Cell membrane, transport across membrane, origin of cell membrane potential (Nernst and Goldman and Katz equations), Action potential.

Unit – II **8 Hours**

Haematological System:
Blood composition, functions of blood, functions of RBC. WBC types and their functions. Blood groups, importance of blood groups, identification of blood groups. Blood flow factors regulating blood flow such as viscosity, radius, density, etc (Fahraeuslindqvist effect, Poiseuille's Law)

Unit – III **8 Hours**

Renal and Respiratory System:
Structure of Kidney and nephron. Mechanism of Urine formation and acid base regulation, Dialysis. Components of respiratory system. Oxygen and carbon dioxide transport and acid base regulation.

Unit – IV **8 Hours**

Cardiac System:
Structure of heart, Properties of Cardiac muscle, Cardiac muscle and pacemaker potential, cardiac cycle, ECG, Heart sound, volume and pressure changes and regulation of heart rate.

Unit – V **8 Hours**

Sensory System:
Structure of a Neuron, Synaptic conduction, Conduction of action potential in neuron, Parts of brain cortical localization of functions EEG. Simple reflexes, withdrawal reflexes. Autonomic nervous system and its functions, Structure of eye, ear and auditory and visual pathways.

Text Books

1. Elaine N. Marie, "Essential of Human Anatomy and Physiology", 8th edition. Pearson Education, New Delhi, 2007.

Reference:

1. W. F. Ganong, "Review of Medical Physiology", Second Edition. McGraw Hill, New Delhi, 2000.
2. Prof. A. K. Jain, "Text Book of Physiology", Third edition, Volume I and II, Avichal Publishing Company, New Delhi, 2005

20EEC703: BIOMEDICAL SIGNAL PROCESSING AND ANALYSIS

L	T	P	C
3	0	0	3

Unit – I **8 Hours**

Introduction to Biomedical signals:
Bio-signal Characteristics of Electro Cardiogram (ECG), Electroencephalogram (EEG), Electromyogram (EMG), Phonocardiogram (PCG), Objectives of Biomedical signal analysis, Difficulties in Biomedical signal analysis, Computer-aided diagnosis.

Unit – II **8 Hours**

ECG Signal Processing:
ECG data acquisition, ECG lead system, ECG parameters and their estimation, ECG QRS detection techniques: Template matching, differentiation based QRS detection techniques. Estimation of R-R Interval: Finite first difference method. The use of multi-scale analysis for parameter estimation of ECG waveforms, Arrhythmia analysis monitoring, long term continuous ECG recording.

Unit – III **8 Hours**

ECG Data Reduction Techniques*:*
direct data compression techniques, direct ECG data compression techniques: Turing point algorithm, AZTEC algorithm and FAN algorithm, other data compression techniques: data compression by DPCM, data compression method comparison.

Unit – IV **8 Hours**

Neurological applications:
EEG rhythms & waveforms, EEG applications- Epilepsy, sleep disorders, brain computer interface. Modeling EEG- linear, stochastic models - Nonlinear modeling of EEG - artifacts in EEG & their characteristics and processing – Nonparametric spectral analysis, Model based spectral analysis -EEG segmentation - Joint Time-Frequency analysis - correlation analysis of EEG channels -coherence analysis of EEG channels. Evoked potentials- noise characteristics, Noise reduction by linear filtering.

Unit – V **8 Hours**

Advanced Signal processing techniques & Modeling of Biomedical Systems:
Optimal Signal Processing: Wiener Filters,Adaptive Signal Processing, Adaptive Noise Cancellation. Parametric system modeling, Autoregressive or All-Pole modeling, Pole-Zero Modeling.

Text Books

1. Rangaraj M Rangayyan ,"Biomedical Signal Analysis" –, IEEE Press, 2001
2. Biomedical Digital Signal Processing – Willis J Tomkins, PHI, 1993.

Reference:

1. Biomedical Digital Signal Processing Principles and Techniques-D C Reddy, TMH, 2005

20EEC705: BIOMEDICAL INSTRUMENTATION

L	T	P	C
3	0	0	3

Unit – I **9 Hours**

Physiological systems and Bio-signals:
Physiological systems of the human body, Functional structure of the cell, electrical activity of cells: resting and action potentials, functioning of the heart, physiological signal amplifiers.

Unit – II **8 Hours**

Electrodes, Sensors, and Transducers:
Introduction to Electrodes, Half-cell potential, Electrode paste, electrode material, Various types of Electrodes: surface electrodes, micro electrodes, needle electrodes depth electrodes, inductive, capacitive, Resistive and temperature transducers.

Unit – III **9 Hours**

Measurement of Physiological parameters:
Measurement of blood pressure, blood flow and cardiac output – Plethysmography, respiration rate, temperature, ECG, EEG, EMG, Safety measures Medical Instrumentation.

Unit – IV **8 Hours**

Patient Monitoring Systems and Medical assist devices:
Intensive cardiac care units and Central monitoring systems, Patient monitoring through biotelemetry. Pacemakers, Defibrillators.

Unit – V **9 Hours**

Medical Imaging Systems:
X-ray machines, Principles of computer tomography (CT), CT number scale Scanning Systems, Detector arrays. Principles of Nuclear Magnetic Resonance (NMR) and MR Imaging, T1 and T2 based imaging, Basic MRI system.

Text Books

1. Biomedical Instrumentation and Measurements, Leslie Cromwell, Fred J Weibell, and Erich A Pfeiffer, PHI/Pearson Education, 2003.
2. Hand Book of Biomedical Instrumentation, RS Khandpur, TMH, 2003.

Reference:

1. Principles of Medical Imaging, K.KirkShung, Benjamin Tsui and Michael. B. Smith, Academic Press Inc., New York.
2. Introduction to Biomedical Equipment Technology, Joseph J Carr, John M.Brown, 4th Edition, Pearson Education, Singapore, 2001.
3. Bio-Medical Instrumentation, M.ArumugamAnuradha Agencies, 2003.

19EMC741: RESEARCH METHODOLOGY AND IPR

L	T	P	C
2	0	0	2

This course introduces the student, to the fundamentals of research, research process, technical writing and intellectual property rights. Students will be able to use this knowledge to gain interest in their subject area and pursue their career in research.

Unit-I

5L

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

Unit-II

5L

Effective literature studies approaches, analysis Plagiarism, Research ethics

Unit-III

5L

Effectivetechnicalwriting,howtowritereport,PaperDevelopingaResearchProposal,Formatofresearch proposal, a presentation and assessment by a reviewcommittee

Unit-IV

5L

Nature of Intellectual Property: Patents, Designs, Trademarks and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Unit-V

8L

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology.Patent information and databases.Geographical Indications.New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc.Traditional knowledge Case Studies, IPR and IITs.

Text Book(s):

1. Stuart Melville and Wayne Goddard, “Research methodology: an introduction for Science and engineering students”, Tata Mcgraw Hill India,2013.
2. Ranjit Kumar, “Research Methodology: A Step by Step Guide for beginners”, 2/e, Prentice Hall of India, 2013.

References:

1. Halbert, “Resisting Intellectual Property”, Taylor and Francis Limited,2007.
2. Mayall, “Industrial Design”, McGraw Hill,1992.
3. Niebel, “Product Design”, McGraw Hill,1974.
4. Asimov, “Introduction to Design”, Prentice Hall,1962.
5. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “Intellectual Property in New Technological Age”, 2016
6. T.Ramappa,“IntellectualPropertyRightsUnderWTO”,S.ChandPublishers,2008

20EEC702 BIOMEDICAL IMAGEPORCESSING

L	T	P	C
3	0	0	3

Unit – I **8 Hours**

Introduction:
Nature of biomedical images, objectives of biomedical image analysis, difficulties in image acquisition and analysis, characterization of image quality, digitization of images, dynamic range, contrast, histogram, blur and spread functions, resolution, signal-to-noise ratio, characterization of artifacts and its removal, synchronized or multiframe averaging, spatial and frequency domain filters.

Unit – II **8 Hours**

Image Enhancement:
Temporal subtraction, gray-scale transforms, histogram transformation, convolution mask operators, high frequency emphasis, homomorphic filtering for enhancement, adaptive contrast enhancement.

Unit – III **8 Hours**

Image segmentation:
Fundamentals, detection of isolated points and lines, edge detection, segmentation and region growing, optimal thresholding, region splitting and merging, morphological watersheds, detection of objects of known geometry. Application: Detection of the breast boundary in mammograms. Shape analysis: Representation of shapes and contours, shape factors. Application: Shape analysis of Breast Masses and Tumors.

Unit – IV **8 Hours**

Image registration:
Spatial and time series, nature of registration – extrinsic (invasive and non-invasive) and intrinsic (landmark, segmentation and voxel property). Image transformation: Nature of transformations – rigid, affine, projective and curved, domain of transformation – local and global, interaction – interactive, semi-automatic and automatic. Image fusion – Types: multi-view fusion, multi-modal fusion, multi-temporal fusion, multi-focus fusion, Classifications: pixel level, feature level and decision level fusion.

Unit – V **8 Hours**

Feature extraction:
Boundary pre-processing, boundary and feature descriptors, region feature descriptors, principal components as descriptors, scale-invariant feature transform (SIFT). Pattern recognition: Patterns and pattern classes, recognition based on decision theoretic methods,

structural methods

Text Books

1. Rangaraj M. Rangayyan, Biomedical Image Analysis, CRC Press, 2004
2. AtamPDhwanMedical image analysis, 2nd Edition, John Wiley & Sons, Inc

Reference:

1. R C Gonzalez & R E Woods, Digital Image Processing , Pearson Education,3e, 2008
2. A K Jain, 'Fundamentals of Digital Image processing , PHI / Pearson Education, 1 edition, 2011
3. Chanda and Majumder, Digital Image Processing and Analysis, PHI Learning Pvt. Ltd., 2004
4. Taylor & Francis, Richard A. Robb "Biomedical Imaging, Visualization, and Analysis", John Wiley & Sons, 1999.

20EEC751 Virtual Instrumentation in Biomedical Engineering

L	T	P	C
3	0	0	3

Unit-I

Introduction to Virtual Biomedical Instrumentation: Introduction, history, Evolution, Virtual vs. Traditional Instruments, Advantages of VI, Role of Hardware and Software in Virtual Instrumentation.

Unit-II

Virtual Instrument Architecture: Sensor module, sensor interface, processing module, database interface, medical information system interface, presentation and control, functional integration; **Tools and Platforms:**hardware platforms and operating systems, programming language environments, graphical programming tools, Comparison of text-based and graphical programming.

Unit-III

Introduction to Data Acquisition: Analog Signal Transducers, Analog Signal Conditioning; Analog-to-Digital & Digital-to-Analog Conversion; Sampling, noise and filtering; Standard Hardware Interfaces.

Unit-IV

Introduction to Modular Programming: Build a Vi Front Panel and Block Diagram, Repetition and Loops, Arrays, Clusters, Plotting Data, Structure, Strings and File I/O, 2D & 3D plots.

Unit-V

Designing Virtual Biomedical Applications: Electroneurology**,** Neuromuscular electrophysiology,Cardiac electrophysiology,cardiopulmonary dynamics-Pulmonary function, cardiovascular pressure-Dimension analysis system.

Textbooks:

1. LabVIEW based advanced Instrumentation System by S. Sumathi, P. Surekha Springer
2. Data Acquisition Techniques using PCs by Howard Auserlitz Academic Press 2nd Edition
3. Virtual Instrumentation using LabVIEW by JovithaJerome PHI Learning pvt. ltd.

References:

1. Virtual Bio-Instrumentation by Jon B. Olansen, Eric Rosow Prentice-Hall
2. PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control by Kevin James Newnes
3. Virtual Prototyping & Bio Manufacturing in Medical Applications by BopayaBidanda, Paulo J. B´artolo Springer

20EEC753: BIOSENSORS AND BODY AREA NETWORKS

L	T	P	C
3	0	0	3

Unit – I **8 Hours**

Introduction:
Biosensors and recognition receptors, classification based on enzyme, DNA, RNA, antibody, aptasensors, peptide, Biomarkers in health care

Unit – II **8 Hours**

Biosensor technologies in disease detection and diagnosis:
SPR, piezoelectric, electrochemical, MEMS, lab on chip.

Unit – III **8 Hours**

Advanced biosensors:
Nanomaterial, smart Nanomaterial, magnetic Nanomaterial, grapheme based biosensors, Optical biosensors, Biosensors for detection of anticancer drug DNA interactions.

Unit – IV **8 Hours**

Body Area Networks:
Introduction, Architecture, applications, Middleware for a BAN-based pervasive health-monitoring system, BAN models and requirements, safety, security, sustainability.

Unit – V **8 Hours**

Wireless Body Area Networks:
Introduction, Wireless patient monitoring in a clinical setting, Real time cardiac arrhythmias monitoring for pervasive health care, Human bio kinematic monitoring with body area

networks.

Text Books

1. Biosensors and Nanotechnology applications in healthcare diagnostics, by ZeynepAltintas, Berlin, Germany.
2. Body area networks: Safety security and sustainability, Sandeep K S Gupta, Tridib Mukherjee.

Reference:

1. Wireless body area networks, Technology, Implementation and Applications. Mehmet R Yuce, Jamil Y Khan.

20EEC755:ELECTRONIC CIRCUITS FOR MEDICAL INSTRUMENTATION

L	T	P	C
3	0	0	3

Unit – I **8 Hours**

Bio potential Electrodes and Amplifiers

Electrode- Electrolyte interface, half cells and their potentials, Silver – silver Chloride electrodes, circuit model of electrode, Carrier amplifiers, Chopper amplifiers, Lock-in amplifiers, Isolation amplifiers, Instrumentation amplifiers

Unit – II **8 Hours**

Differential Amplifier

Differential Amplifier(DA) Circuit Architecture, Common-Mode Rejection Ratio (CMRR), CM and DM Gain of Simple DA Stages at High Frequencies, Input Resistance of Simple Transistor DAs, Noise in Differential Amplifiers, DAs for Medical Applications.

Unit – III **8 Hours**

Operational Amplifiers

Ideal Op Amps, Practical Op Amps, Voltage Comparators, Applications of Voltage Comparators, Applications of Op Amps in Biomedicine, Charge Amplifiers, A Two-Op Amp ECG Amplifier.

Unit – IV **8 Hours**

Instrumentation and Medical Isolation Amplifiers

Instrumentation Amps, Medical Isolation Amps, Common Types of Medical Isolation Amplifiers, Safety Standards in Medical Electronic Amplifiers, Certification Criteria for Medical Electronic Systems, Medical-Grade Power Supplies, Noise Factor and Figure of Amplifiers,

Unit – V **8 Hours**

Modulation and Demodulation of Biomedical Signals
Modulation of a Sinusoidal Carrier Viewed in the Frequency Domain, Implementation of AM, Amplitude Modulation Circuits, Generation of Phase and Frequency Modulation, Demodulation of Modulated Sinusoidal Carriers, Modulation and Demodulation of Digital Carriers, Delta Modulation

Text Books
1. .Robert B. Northrop: Analysis and application of analog electronic circuits to biomedical instrumentation,Second edition, Biomedical engineering series, 2012, CRC Press, Taylor & Francis Group, ISBN-10: 1439866694, ISBN-13: 978-1439866696

20EEC757: EMBEDDED SYSTEM DESIGN FOR MEDICAL APPLICATIONS

L	T	P	C
3	0	0	3

Unit – I **8 Hours**

Introduction to Embedded Systems:
Embedded systems vs general computing systems, history of embedded systems, classification of embedded systems, major application of embedded systems, purpose of embedded systems, elements of an embedded systems, core of the embedded systems, memory.

Unit – II **8 Hours**

Communication Buses in Embedded Systems:
On board communication interfaces:I2C ,SPI bus,1 Wire bus, parallel interface, External Communication interfaces:RS-232,RS-485,USB,IEEE 1394 firewire bus, IrDA, Bluetooth, Wi-Fi, Zigbee.

Unit – III **8 Hours**

Software Development Tools:
Software Development environment-IDE, assembler, compiler, linker, simulator, debugger, In-circuit emulator, target hardware debugging, need for hardware-software partitioning and co-design, Overview of UML, scope of UML modeling, conceptual model of UML, architectural, UML basic elements-diagram- Modeling techniques - structural, behavioral, activity diagrams.

Unit – IV **8 Hours**

Real-Time Operating Systems:
A brief history of operating systems, defining an RTOS, the scheduler, introduction to task,

task states and scheduling, round-robin scheduling algorithm, co-operative scheduling algorithm, preemptive scheduling algorithm, introduction to semaphores.

Unit – V **8 Hours**

Biomedical Applications:
Real-Time Embedded Software Development, Sending a Message over a Serial Link, Simulation of a Process Control System, Controlling an Appliance from the RT Linux System, Embedded Database Applications, Embedded medical applications: Medical Imaging Acquisition User Interface, Automated Biochemical analysis systems, Drug delivery systems, Patient monitoring Systems.

Text Books

1. Rajkamal, Embedded Systems Architecture, Programming and Design, TATA McGraw-Hill, First reprint Oct. 2003
2. M A Mazidi&Mazidi, The 8051 micro controllers, Pearson Education
3. RS KhandpurHand Book of Biomedical Instrumentation, , TMH, 2003.

Reference:

1. Tim Wilmshusrst, Designing Embedded Systems with PIC, Newnes publishing, 2007
2. Steve Heath, Embedded Systems Design, Second Edition-2003, Newnes,
3. David E. Simon, An Embedded Software Primer, Pearson Education Asia, First Indian Reprint 2000.

20EEC759: BIOMECHANICS

L	T	P	C
3	0	0	3

Unit – I **8 Hours**

Kinematic and Kinetic Concepts of Human Motion
Introduction, forms of motion, standard reference terminology, joint movement terminology, Spatial reference systems, qualitative analysis of human movement, tools for measuring kinematic quantities, Basic concepts related to kinetics, mechanical loads on the human body, Effects of loading, tools for measuring kinetic quantities, vector algebra

Unit – II **8 Hours**

Biomechanics of Bone Growth and Skeletal Muscle:
Composition and structure of bone tissue, bone growth and development, bone response to

stress-osteoporosis, Joint Architecture, joint stability, joint flexibility, techniques for increasing joint flexibility, common joint injuries, Structural organization of skeletal muscle, skeletal muscle function, factors affecting muscular force generation, common muscle injuries

Unit – III **8 Hours**

Biomechanics of the Human Upper Extremity:
Structure of the shoulder, movements of the shoulder, loads on the shoulder, common injuries of the shoulder, Joint-Articulating surface motion of shoulder, Structure of the elbow, movements at the elbow, loads on the elbow, common injuries of the elbow, Joint-articulating surface motion of elbow, Structure of the wrist, movements of the wrist, structure of the joints of the hand, movements of the hand, common injuries of the wrist and hand, Joint-Articulating surface motion of Wrist

Unit – IV **8 Hours**

Biomechanics of the Human Lower Extremity and Spine:
Structure of the hip, movements at the hip, loads on the hip, common injuries of the hip, Joint-Articulating surface motion of hip, Structure of the knee and ankle, movements at the knee and ankle loads on the knee and ankle, common injuries of the knee and ankle, Joint-articulating surface motion of knee, Structure of the spine, movements of the spine, muscles of the spine, loads on the spine, common injuries of the back and neck

Unit – V **8 Hours**

Application of Biomechanics:
Biomechanics in physical education, Biomechanics in strength and conditioning, Gait analysis, biomechanics in sports medicine and rehabilitation

Text Books
1. Susan J Hall, “Basic Biomechanics”, McGraw-Hill Higher Education, 7th edition, 2014.

Reference:
1. Donald R. Peterson and Joseph D. Bronzino, “Biomechanics- Principles and Applications”, CRC Press, 2nd edition, 2008.
2. Duane Knudson, “Fundamental of biomechanics”, Springer, 2nd edition, 2007.
3. Fung Y C, Biomechanics: “Mechanical Properties of Living Tissues”, Springer, 2nd edition, 1993.

20EEC761: DIAGNOSTIC AND THERAPEUTIC EQUIPMENT

L	T	P	C
3	0	0	3

Unit – I **8 Hours**

X-ray and Digital Radiography:
Basis of diagnostic radiology, nature of X-rays, production of X-rays, X-ray machine, visualization of X-rays, dental X-ray machines, portable and mobile X-ray units, physical parameters for X-ray detectors, digital radiography, X-ray computed tomography, Computed Tomography.

Unit – II **8 Hours**

Medical imaging systems:
Emission Computed Tomography (ECT), Single-photon Emission Computed Tomography (SPECT), Positron Emission Tomography (PET Scanner), Magnetic Resonance Imaging (MRI) system, ultrasonic imaging systems, thermal imaging systems.

Unit – III **8 Hours**

Cardiac pacemakers:
Need for cardiac pacemakers, external pacemakers, implantable pacemakers, recent developments in implantable pacemakers, pacing system analyzer, cardiac defibrillators, Need for a defibrillator, DC defibrillator, implantable defibrillators, pacers-cardioverter-defibrillator, defibrillator analyzers.

Unit – IV **8 Hours**

Physiotherapy and Electrotherapy Equipment:
High frequency heat therapy, short-wave diathermy, microwave diathermy, ultrasonic therapy unit, electrodiagnostic/therapeutic apparatus, pain relief through electrical stimulation, diaphragm pacing by radio-frequency for the treatment of chronic ventilatory insufficiency, bladder stimulators, cerebellar stimulators, anesthesia machine.

Unit – V **8 Hours**

Radiotherapy Equipment:
Use of high voltage X-ray machines, development of betatron, cobalt-60 machine, medical linear accelerator machine, automated drug delivery systems: infusion pumps, components of drugs infusion systems, implantable infusion systems, closed-loop control in infusion systems, examples of typical infusion pumps

Text Books

1. R.S.Khandpur, Biomedical Instrumentation- Technology and Applications,TataMcGraw Hill Publishing Co Ltd., 3rd edition, 2014.

Reference:

1. Albert M.Cook and Webster.J.G, "Therapeutic Medical Devices", Prentice Hall Inc., New Jersey, 1st edition, 1982.
2. Sydney Lou Bonnick, Lori Ann Lewis, "Bone Densitometry and Technologists", Springer, 3rd edition, 2013.
3. Leslie Cromwell, Fred J.Weibell, Erich A.Pfeiffer, "Bio-Medical Instrumentation Measurements", Pearson Education, PHI Learning Private limited, India, 2nd edition, 2007.

20EEC763 Electrocardiography Signal Analysis

L	T	P	C
3	0	0	3

Unit 1:Introduction to Biomedical Signals

Introduction to Biomedical Signals: The nature of Biomedical Signals, Examples of Biomedical Signals, Objectives and difficulties in biomedical analysis, Basic electrocardiography, ECG lead systems, ECG signal characteristics.

Unit -2 Signal Averaging

Signal Averaging**:** Basics of signal averaging, signal averaging as a digital filter, a typical averager, software for signal averaging, limitations of signal averaging.

Adaptive Noise Cancelling: Principal noise canceller model, 60-Hzadaptive cancelling using a sine wave model, other applications of adaptive filtering

Unit -3 Data Compression Techniques

Data Compression Techniques: Turning point algorithm, AZTEC algorithm, Fan algorithm, Huffman coding, data reduction algorithms The Fourier transform, Correlation, Convolution, Power spectrum estimation, Frequency domain analysis of the ECG

Unit -4Cardiological signal processing

Cardiological signal processing: Basic Electrocardiography, ECG data acquisition, ECG lead system, ECG signal characteristics (parameters and their estimation), Analog filters, ECG amplifier, and QRS detector, Power spectrum of the ECG, Bandpass filtering techniques, Differentiation techniques, Template matching techniques, A QRS detection algorithm, Realtime ECG processing algorithm, ECG interpretation, ST segment analyzer, Portable arrhythmia monitor.

Unit -5 Neurological signal processing

Neurological signal processing: The brain and its potentials, The electrophysiological origin of brain waves, The EEG signal and its characteristics (EEG rhythms, waves, and transients), Correlation.

Text Books:

1. Biomedical signal analysis- A case study approach, RangayyanRangaraj, Wiley (IEEE Press)-2005
2. Biomedical Signal Processing- Principles and Techniques – D.C.Reddy, Tata McGraw-Hill, 2005.
3. Biomedical Digital Signal Processing-Willis J.Tompkins, PHI, 2000.

Reference Books:

1. Biomedical Signal Processing -Akay M, , Academic: Press 1994
2. Biomedical Signal Processing (Vol. I Time & Frequency Analysis) – Cohen.A,, CRC Press, 1986.

20EEC752: BIOMATERIALS AND ARTIFICIAL ORGANS

L	T	P	C
3	0	0	3

Unit – I **8 Hours**

Structure of Bio-Materials and Bio-Compatibility
Definition and classification of bio-materials, mechanical properties, visco-elasticity, wound-healing process, body response to implants, blood compatibility.

Unit – II **8 Hours**

Implant Materials
Metallic implant materials, stainless steels, co-based alloys, Ti-based alloys, ceramic implant materials, aluminum oxides, hydroxyapatite glass ceramics carbons, medical applications.

Unit – III **8 Hours**

Polymeric Implant Materials
Polymerization, polyamides, Acryrilic polymers, rubbers, high strength thermoplastics, medical applications. Bio polymers: Collagen and Elastin.

8 Hours

Unit – IV

Tissue Replacement Implants
Soft-tissue replacements, sutures, surgical tapes, adhesive, Percutaneous and skin implants, maxillofacial augmentation, blood interfacing implants, hard tissue replacement implants, internal fracture fixation devices, joint replacements.

Unit – V **8 Hours**

Artificial Organs
Artificial Heart, Prosthetic Cardiac Valves, Artificial lung (oxygenateor), Artificial Kidney (Dialyser membrane) , Dental Implants.

Text Books
1. SUJATA V. BHATT, Biomaterials Second Edition ,Narosa Publishing House,2005.
2. JoonB.Park Joseph D. Bronzino , BIOMATERIALS - Principles and Applications, CRC Press, 2003

Reference:
1. Park J.B., "Biomaterials Science and Engineering", Plenum Press, 1984.
2. Myer Kutz ,Standard Handbook of Biomedical Engineering & Design –, McGraw-Hill, 2003
3. John Enderle, Joseph D. Bronzino, Susan, M. Blanchard Introduction to Biomedical Engineering, Elsevier, 2005.

20EEC754: Bio-MEMS and Applications

L	T	P	C
3	0	0	3

Unit – I **8 Hours**

Introduction to Bio-MEMS
Silicon Micro fabrication, "Soft" Fabrication Techniques, Polymer Materials, Micro fluidic Principles

Unit – II **8 Hours**

Biosensors:
Micro sensors, Micro actuators and Drug Delivery, Clinical Laboratory Medicine, Micro-Total-Analysis Systems, Detection and Measurement Methods,.

8 Hours

Unit – III

Emerging Bio-MEMsTechnology:

Minimally Invasive Surgery, Point-of-Care Clinical Diagnosis, Cardiovascular, Diabetes, Endoscopy, Neurosciences, Oncology, Ophthalmology, Dermabrasion, Tissue Engineering, Cell-Based Biosensors, Homeland Security

Unit – IV **8 Hours**

Packaging, Power, Data, and RF Safety:

Packaging, Electronic Assembly and Packaging, Power Systems, Data transmission, Radio Frequency (RF) Safety.

Unit – V **8 Hours**

Biocompatibility:

FDA Guidance, International Organization for Standardization, Cytotoxicity, Sensitization, Irritation, Systemic Toxicity, Genotoxicity, Carcinogenicity and Reproduction, Implantation, Hemocompatibility, Degradation, Biocompatibility of Polymers, Biofouling, Biocompatibility of Other Materials.

Text Books

1. Fundamentals of Bio MEMS and Medical Micro devices by Steven S. Saliterman, SPIE Press Book.

Reference:

1. Albert Folch ,Introduction to Bio MEMS by
2. Albert-Ludwigs , Bio MEMS - Freiburg, Germany

20EEC756: Lasers and Optical Instrumentation

L	T	P	C
3	0	0	3

Unit – I **8 Hours**

Introduction:

Fundamental characteristics of lasers – Three level and four level lasers – Properties of laser – Laser modes – Resonator configuration – Q-switching and mode locking – Cavity damping – Types of lasers – Gas lasers, solid lasers, liquid lasers, semiconductor lasers.

Unit – II **8 Hours**

Medical applications of lasers:

laser and tissue interactive – Laser instruments for surgery, removal of tumors of vocal cards,

brain surgery, plastic surgery, gynaecology and oncology

Unit – III **8 Hours**

Laser instruments:
Laser interferometry, velocimetry, pulse echo technique, beam
modulation telemetry and holography, application of holography, laser welding, laser machining and laser spectroscopy.

Unit – IV **8 Hours**

Fiber optics:
Principles of light propagation through a fibre - Different types of fibres and their properties, fibre characteristics – Absorption losses – Scattering losses – Dispersion – Connectors & splicers – Fibre termination – Optical sources – Optical detectors

Unit – V **8 Hours**

Fiber optic sensors
Fibre optic instrumentation system – Different types of modulators – Interferometric method of measurement of length – Moire fringes – Measurement of pressure, temperature, current, voltage, liquid level and strain

Text Books

1. Wilson and Hawkes, “Opto Electronics-An Introduction”, Third Edition, Pearson Education, 1998.
2. John Ready, “Industrial Applications of Lasers”, Second Edition, Academic Press, 1997
3. Wilson and Hawkes, “Laser principles and applications”, Prentice Hall of India, 7th Edition,1987, ISBN: 978-0135237052.

Reference:

1. Wilson & Hawkes, “Optoelectronics”, Prentice Hall of India, 2th Edition, 1997, ISBN 8120310187.
2. A.J.Rogers, “Essentials of Opto Electronics with Applications”, CRC Press. 1th Edition,
   1997, ISBN: 978-0412408908.
3. I.Ravikumar, Bala N. Saraswathi, “Principles of Optical Communication &Opto Electronics”, Lakshmi Publications, 2010, ISBN 978-8170085614.

20EEC760: HEALTHCARE AND HOSPITAL MANAGEMENT

L	T	P	C
3	0	0	3

Unit – I **8 Hours**

Introduction:
Health Organization of the country, National Health Policies, Health Financing System, Organization of Technical Section.

Unit – II **8 Hours**

Management of Hospital Organization
Nursing section Medical Sector, Central Services, Technical Department, Definition and Practice of Management by Objective, Transactional Analysis Human relation in Hospital, Importance to Team Work, Legal aspect in Hospital Management.

Unit – III **8 Hours**

FDA Regulations
Joint Commission of Accreditation for Hospitals, National Fire Protection Association, Standard, IRPC.

Unit – IV **8 Hours**

Organizing Maintenance Operations:
Paper Work Control, Maintenance Job, Planning Maintenance Work.

Unit – V **8 Hours**

Measurement and Standards:
Preventive Maintenance, Maintenance Budgeting and Forecasting, Maintenance, Training, Contract Mainframe, Function of Clinical Engineer, Role to be performed in Hospital, Man power Market, Professional Registration, Structure in hospital.

Text Books
1. R.C. Goyal, “Handbook of Hospital Personal Management”, Prentice Hall of India, 2008.
2. Joseph. F. Dyro, “ Clinical Engineering Management”, Academic Press Series in Biomedical Engineering, 2004

Reference:
1. Antony Kelly, “Strategic Maintenance planning”, Butterworths London, 2006.

2. Cesar A. Caceres and Albert Zara, “The Practice of Clinical Engineering”, Academic Press,
1977.
3. Webster, J.G. and Albert M. Cook, “Clinical Engineering Principles and Practices”, PrenticeHallInc.Englewood Cliffs, 1979.

20EEC762: Robotics in Medical Applications

L	T	P	C
3	0	0	3

Unit – I **8 Hours**

Introduction:
Healthcare requirements, Soft robots for healthcare applications, Critical issues in developing soft robots for healthcare, Rehabilitation robots for healthcare, Minimally invasive surgery and robotic integration, Definitions and development of surgical robotic systems, history of robotics surgery.

Unit – II **8 Hours**

Robotic systems for cardiovascular interventions:
Heart conditions and the evolving role of cardiac surgeons and cardiologists, surgical robot requirements and availability for cardiovascular interventions, proposed novel robots for cardiovascular interventions.**Robotics for neurosurgery:** Introduction to neurosurgical progression, the evolution of neurosurgical robots, Maintaining operator control, Human–machine interface (HMI), informatic surgery.

Unit – III **8 Hours**

Robotics in orthopedic surgery:
Existing orthopedic robotic systems, Evaluation of impact of orthopedic surgical robots. **Robotic-assisted knee replacement surgery:** Apex robotic technology (ART), Clinical experience. **Robotics in ear, nose and throat (ENT) surgery:**Telemanipulators in ENT, Image-guided interventions, Computer numerical control (CNC).

Unit – IV **8 Hours**

Robot-assisted vitreoretinal surgery:
Requirements for vitreoretinal surgery, Master console, Slave robot. **Robotics for minimally invasive surgery:** Minimally invasive surgery (MIS), Natural orifice transluminal endoscopic surgery, **Mesoscale mobile robots for gastrointestinal minimally invasive surgery:** Commercial gastrointestinal wireless capsule endoscopes, Robotic capsule modules.

Unit – V **8 Hours**

Robotic surgery and ethical challenges:
Types of robotic surgery, The patient experience of robotic surgery, The marketing of robotic surgery, Comparing robotic surgery with other types of surgery, The need for training. Ethical issues relating to remotely operated surgery, the automated hospital.

Text Books

1. Soft Robots for Healthcare Applications Design, modelling, and control by S. Xie, M. Zhang and W. Meng

Reference:

1. Paula Gomes , Medical Robotics, Minimally Invasive Surgery,.

20EEC764: TELEMEDICINE

L	T	P	C
3	0	0	3

Unit – I **8 Hours**

Introduction:
Basic Concepts of telemedicine need for telemedicine, scope of telemedicine, challenges in implementing telemedicine, telemedicine standards and guidelines

Unit – II **8 Hours**

Telemedicine systems
Elements of telemedicine systems, trends in telemedicine systems, Delivery modes in telemedicine, setting up a telemedicine facility.

Unit – III **8 Hours**

Technology of telemedicine systems
Data transmission, Image transmission, Transmission of video, Transmission of audio, Hospital information systems, computer networks in health care, Telemedicine software, Interfacing medical devices to computers.

Unit – IV **8 Hours**

Wireless technologies for telemedicine
Wireless communication technologies, Types of wireless technologies in telemedicine, Transmission media for wireless networks, Antennas for Telemedicine

Unit – V **8 Hours**

Applications of telemedicine:
Telemedicine and its applications, teleradiology, telecardiology,tele psychiatry, tele dermatology, tele surgery and telepathology.

Text Books

1. R.S Khandpur ,Telemedicine, Technology & Applications, , PHI Publications 2014
2. R. Aanadanatarajan, Biomedical Instrumentation & Measurements, PHI Publications 2011
3. Bashshur R, Sanders J L and Shannon G W, Telernedicine, Theory and. Practice, Thomas, Springfield, IL, 1997

Reference:

1. Darkins A W and Cary M A, Telemedicine and Telehealth: Principles, Policies, Performance, and Pitfalls, Springer, London, 2000
2. Bauer J C and Ringel M A, Telemedicine and the Reinvention of Healthcare, McGraw-Hill, New York, 1999

20EEC768: ADAPTIVE SIGNAL PROCESSING

L	T	P	C
3	0	0	3

Unit – I **8 Hours**

Introduction: Adaptive systems:
Definitions and characteristics - applications –properties-examples - adaptive linear combiner input signal and weight vectors - performance function-gradient and minimum mean square error - introduction to filtering-smoothing and prediction - linear optimum filtering orthogonality - Wiener – Hopf equation-performance surface.

Unit – II **8 Hours**

Searching performance surface-stability and rate of convergence:
Learning curve-gradient search - Newton's method - method of steepestdescent - comparison - Gradient estimation - performance penalty – variance- excess MSE and time constants – mis-adjustments

Unit – III **8 Hours**

LMS algorithm convergence of weight vector:
LMS/Newton algorithm - properties - sequential regression algorithm - adaptive recursive

filters -random-search algorithms - lattice structure - adaptive filters with orthogonal signals

Unit – IV **8 Hours**

Applications-adaptive modeling and system identification:
Multipath communication channel, geophysical exploration, FIR digital filter synthesis.

Unit – V **8 Hours**

Inverse adaptive modeling:
Equalization, and de convolution adaptive equalization of telephone channels-adapting poles and zeros for IIR digital filter synthesis

Text Books

1. Bernard Widrow and Samuel D. Stearns, "Adaptive Signal Processing", Pearson Education, 1985.

Reference:

1. Simon Haykin, "Adaptive Filter Theory", Pearson Education, 2003.
2. John R. Treichler, C. Richard Johnson, Michael G. Larimore, "Theory and Design of Adaptive Filters", Prentice-Hall of India, 2002.

20EEC770 Principles of Radiology

Unit-1
Introduction to principles of Radiology:
Principles of Radiation Therapy, Radiotherapy treatment planning Dose in Radiotherapy, Mega voltage therapy, Intensity modulated Radiation therapy, Brachy-therapy, Radio therapy using radio isotopes.

Unit-2
X-ray and Computer Tomography:
X-Ray spectrum, Production of X-rays, Modern X-ray tubes, Quality of X-rays, Photographic effects on X-ray films, Fluorescent and Intensifying screen, Scattered rays, Use of filters, HVL, Collimators, Cones, Bucky Grids, Fluoroscopy, Image intensifier, Digital Radiography, Computed Tomography(CT).

Unit-3
Radiation Detectors:
Basic characteristics and units of radio activity, Ionization chamber, GM tubes, Gas filled detectors, scintillation detectors, semiconductor detectors, Liquid scintillation counter, Statistical aspects of nuclear medicine.

Unit-4

Radiation Analysers:

Rectilinear scanners, Scintillation Camera, principle of operation, collimator, photomultiplier tube, Pulse height Analyzer, computerized multi crystal Gamma camera, Principles of PET and SPECT.

Unit-4

Biological effects of Radiation:

Radiation sensitivity of biological materials, Evidence on radio biological damage from cell survival curve, Radiation effects on humans, Maximum permissible dose equivalent limits, Hazard from ingested radioactivity, substances, ICRP regulations, Quality factor and sievert, Principles of radiological protection, personnel dosimetry.

Text Books:

1. Dendy,P.P&Heaton.B, PhysicsforRadiologists.ThirdEdition.CharlesC.Thomas PublisherS.A.,2000
2. .Khan,F.M, PhysicsforRadiationTherapy, Williams&Wilkins.2009

References:

1. GopalB.Saha, PhysicsandRadiation biologyofNuclearMedicine.2006
2. PenelopeJ.Allisy, RobertsObefipsm. Farr‟sPhysicsforMedicalImaging,Ferry Williams.2007

20EEC772: REHABILITATION ENGINEERING

L	T	P	C
3	0	0	3

Unit – I **8 Hours**

Introduction:

Introduction to Rehabilitation Engineering - PHAATE model – Universal design - Design based on human ability - Standards for assistive technology - Test for best design.

Unit – II **8 Hours**

Orthotic & Prosthetic Devices:

Anatomy of upper & lower extremities - Classification of amputation types, Prosthesis prescription - Components of upper limb prosthesis - Fabrication of prosthesis - Components of lower limb prosthesis, different types of models for externally powered limb prosthetics – Orthoses: It's need and types - Lower extremity- and upper extremity-orthoses - mobility aid, Slints – materials used.

Unit – III **8 Hours**

Wheel Chair:

Seating Assessment - Interventions in seating system - Biological aspects of tissue health -

Support surface classification - Manual wheelchairs – Electric power wheelchairs - Power assisted wheelchairs - Wheel chair standards & tests - Wheel chair transportation.

Unit – IV **8 Hours**

Hearing and retinal implants

Anatomy of ear – hearing functional assessment, Types of deafness - Surgical and non surgical hearing aids, Cochlear implants - Assistive technology solutions for hearing Tactile - Information Display, Voice synthesizer, speech trainer.

Anatomy of eye, Categories of visual impairment - Cortical & retinal implants - Auditory Information Display - Blind mobility aids – reading writing & graphics access- Braille Reader, Tactile devices for visually challenged, Text voice converter, screen readers

Unit – V **8 Hours**

Rehabilitation Aids for Mentally Impaired:

Sleeping Aids, Walking Aids, Seating Aids, Postural Aids,MedicalStimulator:Muscle and nerve stimulator, Location for Stimulation, Functional Electrical Stimulation, Sensory Assist Devices, Design issues.AdvancedApplications:Robots in rehabilitation - Rehabilitation in sports -Daily living aids - Assistive technology for dyslexia

Text Books

1. Robinson. C. J., Rehabilitation Engineering,
2. Ballabio. E ,Rehabilitation Technology,.
3. Cook &Hussey ,Assistive Technology- Principles & Practice-.

Reference:

1. Marion A Hersh, Michael A, Johnson, “Assistive Technology for Visually impaired and blind people”, Springer Publications, First edition, 2008.
2. Albert M. Cook , Janice Miller Polgar, Essentials of Assistive Technologies.
3. Roberto Manduchi, Sri Kurniawan , Assistive Technology for Blindness and Low Vision edited

20EAC741: ENGLISH FOR RESEARCH PAPER WRITING

L	T	P	C
2	0	0	0

Unit I **(8L)**

Planning and Preparation, Word Order, Breaking up long sentences, StructuringParagraphs and Sentences, Being Concise and Removing Redundancy, AvoidingAmbiguity and Vagueness

Unit II **(8L)**

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising,

Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction.

Unit III **(8L)**

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check. key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature

Unit IV **(8L)**

Writing Skills: skills are needed when writing the Methods, skills needed when writing the Results,skills are needed when writing the Discussion, skills are needed when writing the Conclusions.

Unit V **(8L)**

Good Paper Writing: Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

Text Books

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook .
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.

20EAC742: PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

L	T	P	C
2	0	0	0

Unit I **(8L)**

Neetisatakam-Holistic development of personality

- Verses- 19,20,21,22 (wisdom)
- Verses- 29,31,32 (pride & heroism)
- Verses- 26,28,63,65 (virtue)
- Verses- 52,53,59 (dont's)
- Verses- 71,73,75,78 (do's).

Unit II **(8L)**

Approach to day to day work and duties.

- Shrimad BhagwadGeeta: Chapter 2-Verses 41, 47,48,
- Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,
- Chapter 18-Verses 45, 46, 48.

Unit III **(8L)**

Statements of basic knowledge.

- Shrimad BhagwadGeeta: Chapter2-Verses 56, 62, 68
- Chapter 12 -Verses 13, 14, 15, 16,17, 18
- Personality of Role model. Shrimad BhagwadGeeta

Chapter2-Verses 17, Chapter 3-Verses 36,37,42,

- Chapter 4-Verses 18, 38,39
- Chapter18 – Verses 37,38,63

Text Books

1. Swami Swarupananda, "Srimad Bhagavad Gita", Advaita Ashram (Publication Department), Kolkata
2. P.Gopinath, Bhartrihari's Three Satakam (Niti-sringar-vairagya), Rashtriya Sanskrit Sansthanam, New Delhi.

20EAC743: COST MANAGEMENT OF ENGINEERING PROJECTS

L	T	P	C
2	0	0	0

Unit I **(8L)**

Introduction and Overview of the Strategic Cost Management Process, Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

Unit II **(8L)**

Project: meaning, Different types, why to manage, cost overruns centres, various stages of projectexecution: conception to commissioning. Project execution as conglomeration of technical and nontechnicalactivities.

Unit III **(8L)**

Detailed Engineering activities. Pre project execution main clearances anddocuments Project team: Role of each member. Importance Project site: Data required withsignificance. Project contracts. Types and contents. Project execution Project cost control. Bar chartsand Network diagram. Project commissioning: mechanical and process.

Unit IV **(8L)**

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis.

Unit V **(8L)**

Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing. Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory

Text Books

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

20EAC744: STRESS MANAGEMENT BY YOGA

L	T	P	C
2	0	0	0

Unit I **(8L)**

Definitions of Eight parts of yoga (Ashtanga).

Unit II **(8L)**

 Yam and Niyam.

Do‘s and Don’t’s in life.

i) Ahinsa, satya, astheya, bramhacharya and aparigraha

ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan.

Unit III **(8L)**

Asan and Pranayam

i) Various yog poses and their benefits for mind & body

ii)Regularization of breathing techniques and its effects-Types of pranayam.

Text Books

1. ‘Yogic Asanas for Group Tarining-Part-I” :Janardan Swami Yogabhyasi Mandal, Nagpur
2. “Rajayoga or conquering the Internal Nature” by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata

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20EAC745: DEVELOPING SOFT SKILLS AND PERSONALITY

L	T	P	C
2	0	0	0

Unit I **(8L)**

Self-Assessment; Identifying Strength &Limitations;Habits, Will-Power and Drives; Developing Self-Esteem and Building Self-Confidence, Significance of Self-Discipline

Unit II **(8L)**

Understanding Perceptions, Attitudes, and Personality Types: Mind-Set: Growth and Fixed; Values and Beliefs

Unit III **(8L)**

Motivation and Achieving Excellence;Self-Actualisation Need; Goal Setting, Life and Career Planning;Constructive Thinking

Unit IV **(8L)**

Communicating Clearly: Understanding and Overcoming barriers; Active Listening;Persuasive Speaking and Presentation Skills.

Unit V **(8L)**

Conducting Meetings, Writing Minutes, Sending Memos and Notices; Netiquette: Effective E-mail Communication; Telephone Etiquette; Body Language in Group Discussion and Interview.

Text Books

1. Dorch, Patricia. What Are Soft Skills? New York: Execu Dress Publisher, 2013.
2. Kamin, Maxine. Soft Skills Revolution: A Guide for Connecting with Compassion for Trainers, Teams, and Leaders. Washington, DC: Pfeiffer & Company, 2013.
3. Klaus, Peggy, Jane Rohman& Molly Hamaker. The Hard Truth about Soft Skills. London: HarperCollins E-books, 2007.
4. Petes S. J., Francis. Soft Skills and Professional Communication. New Delhi: Tata McGraw-Hill Education, 2011.
5. Stein, Steven J. & Howard E. Book. The EQ Edge: Emotional Intelligence and Your Success. Canada: Wiley & Sons, 2006.

20EOE762: BUSINESS ANALYTICS

L	T	P	C
3	0	0	3

Unit -I **(9L)**

Business analytics: Overview of Business analytics, Scope of Business analytics,Business Analytics Process, Relationship of Business Analytics Process andorganisation, competitive advantages of Business Analytics.Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review ofprobability distribution and data modelling, sampling and estimation methods overview

Unit -II **(8L)**

Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

Unit -III **(9L)**

Organization Structures of Business analytics: Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes.Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analyticsanalysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step inthe business analytics Process, Prescriptive Modelling, nonlinear Optimization.

Unit -IV **(8L)**

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models.
Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

Unit -V **(8L)**

Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making..

Textbook:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G.Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, Pearson Education.

20EOE764: OPERATIONS RESEARCH

L	T	P	C
3	0	0	3

Unit -I **(9L)**

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

Unit -II **(8L)**

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

Unit -III **(9L)**

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

Unit -IV **(8L)**

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Unit -V **(8L)**

Competitive Models,Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

Textbook:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

20EOE766: WASTE TO ENERGY

L	T	P	C
3	0	0	3

Unit-I: **8L**

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forestresidue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

Unit-II: : **8L**

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods -Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

Unit-III: : **8L**

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement forthermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

Unit-IV:: **8L**

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs,Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design,construction and operation - Operation of all the above biomass combustors.

Unit-V: : **10L**

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technologyand status - Bio energy system - Design and constructional features - Biomass resources and theirclassification - Biomass conversion processes - Thermo chemical conversion - Direct combustion -biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion -Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production -Urban waste to energy conversion - Biomass energy programme in India.

Text Books:

1. Desai, Ashok V ,Non-Conventional Energy,., Wiley Eastern Ltd., 1990.
2. Khandelwal, K. C. and Mahdi, S. S ,Biogas Technology - A Practical Hand Book -, Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Khandelwal, K. C. and Mahdi, S. S ,Food, Feed and Fuel from Biomass, IBH Publishing Co. Pvt. Ltd., 1991.
4. C. Y. WereKo-Brobby and E. B. Hagan, Biomass Conversion and Technology, , John Wiley & Sons, 1996.

20EEC721: Biomedical Signal Processing Lab

1. Study and recording of ECG with bipolar limb leads
2. Study and recording of heart sounds using phonocardiograph.
3. Study and recording of EMG and PULSE RATE
4. Study and analysis of EEG & Abnormalities of ECG
5. Instrumentation amplifier
6. Notch filter
7. Representation Discrete time sequences using Matlab
8. Sinewave Generation and Sampling Theorem Verification using TMS320C6713 Processor
9. FIR filter design using Matlab& TMS320C6713 Processor
10. IIR filter design using Matlab& TMS320C6713 Processor

20EEC723:Biomedical Instrumentation Lab

1) Study and recording of ECG with Unipolar Limb leads
2) Study and recording of ECG with bipolar limb leads
3) Study and recording of EEG and EMG
4) Instrumentation amplifier design for ECG, EEG and EMG
5) Notch filter design for ECG, EEG and EMG
6) Study and recording of pulse rate and respiration rate
7) Study and recording of heart sounds using phono cardio graph
8) PC based data acquisition
9) Study and comparison of biomedical signals using ECG, EEG & EMG simulators
10) Study of biotelemetry system

20EEC724Soft Computing Lab

1. Write a program in MATLAB to plot various membership functions.
2. Use Fuzzy toolbox to model tip value that is given after a dinner which can be-not good, satisfying, good and delightful and service which is poor, average or good and the tip value will range from Rs. 10 to 100.
3. Implement FIS Editor.
4. Generate AND, NOT function using McCulloch-Pitts neural net by MATLAB program.
5. Generate XOR function using McCulloch-Pitts neural net by MATLAB program.
6. Write a MATLAB program for Perceptron net for an AND function with bipolar inputs and targets.
7. Write a MATLAB program for Hebb Net to classify two dimensional input patterns in bipolar with their given targets
8. Write a program of Perceptron Training Algorithm
9. Write a program to implement Hebb's rule
10. Write a program of Back Propagation Algorithm.

20EEC726: Biomedical Signal Conditioning Lab

List of Experiments

1. Study of linear applications of op-amp.
2. Study and design of active filters using op-amp
3. Study A/D and D/A converter using op-amps.
4. Characteristics of bio-potential amplifier for ECG& EMG signals
5. Isolation of bio-signal (EMG / ECG)
6. ECG processing and analysis.
7. EEG processing and analysis.
8. Detection of QRS component from ECG signals.
9. Study of nonlinear application of op-amp.
10. Noise removal from ECG/EMG/EEG signals.

20EEC891: PROJECT WORK – I

L	T	P	C
0	0	26	13

20EEC892: PROJECT WORK – II

L	T	P	C
0	0	26	13