

**Department of Biomedical Engineering  
JIS COLLEGE OF ENGINEERING  
M. Tech. in Biomedical Instrumentation**

**Course Structure and Scheme of Evaluation**

**First Semester**

Sl No	Subject code	Name of the Subject	Hrs/Week			Credits
			Lecturer	Tutorial	Practical	
<b>THEORY</b>						
1	MBMI 101	Advanced Engineering Mathematics	3	1	0	4
2	MBMI 102	Engineering Management	4	0	0	4
3	MBMI 103	Human Anatomy & Physiology	4	0	0	4
4	MBMI 104	Bio-Signal Acquisition & Conditioning System	4	0	0	4
5	MBMI 105	Elective I	4	0	0	4
Total of Theory						20
<b>SESSIONAL</b>						
6	MBMI 191	Biomedical Instrumentation Laboratory	0	0	4	2
7	MBMI 192	Physiological Parameter Monitoring Lab	0	0	4	2
8	MBMI 193	Seminar I	0	2	0	1
Total of Sessional						5
<b>Total of Theory &amp; Sessional</b>						<b>25</b>

**Second Semester**

Sl No	Subject code	Name of the Subject	Hrs/Week			Credits
			Lecturer	Tutorial	Practical	
<b>THEORY</b>						
1	MBMI 201	Clinical Instrumentation	4	0	0	4
2	MBMI 202	Medical Image Processing	4	0	0	4
3	MBMI 203	Modern Medical Instrumentation	4	0	0	4
4	MBMI 204	Elective II (any one)	4	0	0	4
5	MBMI 205	Elective III (any one)	4	0	0	4
Total of Theory						20
<b>SESSIONAL</b>						
6	MBMI 291	Medical Image Processing lab	0	0	4	2
7	MBMI 292	Seminar II	0	2	0	1
8	MBMI 293	Comprehensive Viva-Voce	0	0	0	4
Total of Sessional						7
<b>Total of Theory &amp; Sessional</b>						<b>27</b>

**Department of Biomedical Engineering  
JIS COLLEGE OF ENGINEERING  
M. Tech. in Biomedical Instrumentation**

**Third Semester**

Sl No	Subject code	Name of the Subject	Hrs/Sem			Credits
			Lecturer	Tutorial	Practical	
1	MBMI 301	Elective IV (any one)	4	0	0	4
1	MBMI 391	Pre-submission Defense of Dissertation	0	0	0	4
2	MBMI 392	Dissertation (Part - I)	0	0	24	18
<b>Total</b>						<b>26</b>

**Fourth Semester**

Sl No	Subject code	Name of the Subject	Hrs/Sem			Credits
			Lecturer	Tutorial	Practical	
1	MBMI 491	Dissertation (Completion)	0	0	24	18
2	MBMI 492	Post-submission Defense of Dissertation	0	0	0	6
<b>Total</b>						<b>24</b>

**Subjects of Examination**

**First Semester**

Sl No	Subject code	Name of the Subject	No of papers	Marks
<b>THEORY</b>				
1	MBMI 101	Advanced Engineering Mathematics	1	100
2	MBMI 102	Engineering Management	1	100
3	MBMI 103	Human Anatomy & Physiology	1	100
4	MBMI 104	Bio-Signal Acquisition & Conditioning System	1	100
5	MBMI 105	Elective I (any one)	1	100
Total of Theory				500
<b>SESSIONAL</b>				
6	MBMI 191	Biomedical Instrumentation Laboratory	1	100
7	MBMI 192	Physiological Parameter Monitoring Laboratory	1	100
8	MBMI 193	Seminar I	1	100
Total of Sessional				300
<b>Total of Semester</b>				<b>800</b>

**Department of Biomedical Engineering  
JIS COLLEGE OF ENGINEERING  
M. Tech. in Biomedical Instrumentation**

**Second Semester**

Sl No	Subject code	Name of the Subject	No of papers	Marks
<b>THEORY</b>				
1	MBMI 201	Clinical Instrumentation	1	100
2	MBMI 202	Medical Image Processing	1	100
3	MBMI 203	Modern Medical Instrumentation	1	100
4	MBMI 204	Elective II (any one)	1	100
5	MBMI 205	Elective III (any one)	1	100
Total of Theory				500
<b>SESSIONAL</b>				
6	MBMI 291	Medical Image Processing Lab	1	100
7	MBMI 292	Seminar II	1	100
8	MBMI 293	Comprehensive Viva-Voce	1	100
Total of Sessional				300
<b>Total of Theory &amp; Sessional</b>				<b>800</b>

**Third Semester**

Sl No	Subject code	Name of the Subject	No of papers	Marks
1	MBMI 391	Pre-submission Defense of Dissertation	1	100
2	MBMI 392	Dissertation (Part - I)	1	500
6	MBMI 393	Comprehensive Viva-Voce	1	100
<b>Total</b>				<b>700</b>

**Fourth Semester**

Sl No	Subject code	Name of the Subject	No of papers	Marks
1	MBMI 491	Dissertation (Completion)	1	500
2	MBMI 492	Post-submission Defense of Dissertation	1	200
<b>Total</b>				<b>700</b>

**Department of Biomedical Engineering  
JIS COLLEGE OF ENGINEERING  
M. Tech. in Biomedical Instrumentation**

**List of Papers**

	<b>Paper Code</b>	<b>Name of the Subject</b>
<b>Compulsory Subjects</b>	MBMI 101	Advanced Engineering Mathemataics
	MBMI 102	Engineering Management
	MBMI 103	Human Anatomy & Physiology
	MBMI 104	Bio-Signal Acquisition & Conditioning System

	<b>Paper Code</b>	<b>Name of the Subject</b>
<b>Elective I (Any one)</b>	MBMI 105A	Biomedical Sensor and MEMs technology
	MBMI 105B	Biomedical Laser Instrumentation
	MBMI 105C	Design and Fabrication of Artificial Joints and Organs

	<b>Paper Code</b>	<b>Name of the Subject</b>
<b>Compulsory Subjects</b>	MBMI 201	Clinical Instrumentation
	MBMI 202	Medical Image processing
	MBMI 203	Modern Medical Instrumentation

	<b>Paper Code</b>	<b>Name of the Subject</b>
<b>Elective II (Any one)</b>	MBMI 204A	Rehabilitation Aids & Instrumentation
	MBMI 204B	Computers in Medicine
	MBMI 204C	Artificial Devices for Cardiovascular and Renal Abnormalities

	<b>Paper Code</b>	<b>Name of the Subject</b>
<b>Elective III (Any one)</b>	MBMI 205A	Calibration, Repair and Maintenance of Biomedical Instruments
	MBMI 205B	Radiological Equipments
	MBMI 205C	Electrical Safety and Hazards of Biomedical Equipment

	<b>Paper Code</b>	<b>Name of the Subject</b>
<b>Elective IV (Any one)</b>	MBMI 301A	Artificial Intelligence and Expert System
	MBMI 301B	Modeling, Simulation and Control of Physiological Systems
	MBMI 301C	Embedded System in Medicine

**Department of Biomedical Engineering  
JIS COLLEGE OF ENGINEERING  
M. Tech. in Biomedical Instrumentation**

**SYLLABI FOR THE PROPOSED COURSE**

**MBMI 101:** Advanced Engineering Mathematics

3-1-0 (4 credits)

**Advanced Engineering Mathematics:**

1. **Graph Theory:** Basic notions- Graph, Directed Graphs, walk, path, circuits, connected graphs, components, operation on graphs, isomorphism of graphs, trees, some important properties of trees, binary trees, spanning trees,, cutset, cut vertices, fundamental cut set, fundamental circuits 10L
2. **Vector Theory:** Vector space associated with graph, sets with one operation, sets with two operations, modular arithmetic and Galois field, vector space, subspace, Linear dependence and independence, Basis of vectors. 10L
3. **Matrix:** Rank of a Matrix, Eigenvalues and Eigenvectors of matrix, Solution of linear equations by Gauss elimination method, Matrix representation of graphs. 8L
4. **Fourier Transforms:** Discrete Fourier Transform, Fast Fourier Transform and their applications. 6L
5. **Fuzzy Theory:** Introduction to Fuzzy set theory, Fuzzy relation and Fuzzy graph with simple applications. 6L

**Text Books:**

1. Hoffman K and Kunze R – Linear Algebra, PHI
2. Golub G H and Van Loan C F – Matrix Computations, North Oxford Academic
3. Narsing Deo-Graph Theory, PHI
4. S Rajasekhara and G A vijaya Lakshmi Pai-Neural Networks, PHI
5. John Yen and Reza Langari-Fuzzy Logic: Intelligence, Control and Information, Pearson.
6. George J Klin and Bo Yuan-Fuzzy Sets and Fuzzy Logic (Theory and Applications), PHI.

**MBMI 102:** Engineering Management

4-0-0 (4 credits)

1. **Introduction** : Concept, process and significance of management; Managerial roles; An overview of functional areas of management; Development of management thought; Classical and neo-classical systems; Contingency approaches. 6L
2. **Planning** : Concept, process and types. Decision making – concept and process; Management by objectives; Corporate planning; Environment analysis; Strategy formulation. 6L
3. **Organizing** : Concept, nature, process and significance; Authority and responsibility relationships; Centralization and decentralization; Departmentation; Organization structure – forms and contingency factors. 6L
4. **Directing** : Motivation – Concept & Theories – (Maslow, Alderfer, Herzberg, McClelland, Porter & Lawler, Vroom); Financial and non-financial incentives of Motivation, Leadership – Leadership Theories, Leadership styles. Communication – Type, process and barriers. 8L
5. **Controlling** : Concept and process; Effective control system; Techniques of control. 6L
6. **Values** – Importance, Sources of Value Systems, Types, Values, Loyalty and Ethical Behaviour, Values across Cultures. 4L
7. **Business Ethics** – Nature, Characteristics and Needs, Ethical Practices in Management. 4L

**Text Books:**

1. Wehrich and Koontz, et al : Essentials of Management; Tata McGraw Hill

**Department of Biomedical Engineering**  
**JIS COLLEGE OF ENGINEERING**  
**M. Tech. in Biomedical Instrumentation**

2. Stoner J and Freeman RE : Management; Prentice-Hall

**Reference Books**

1. Daft, RL : Management, Thomson
2. V.S.P Rao & Hari Krishna : Management-Text & Cases,Excel Books
3. ramaswami T; Principles of Mgmt., Himalaya Publishing
4. Chandan, JS : Management – Concepts and Strategies, Vikas Publishing
5. Robbins, SP : Management, Prentice Hall
6. S. K. Chakraborty : Values and Ethics in Organisation, OUP
7. A. N. Tripathi : Human Values, New Age International

**MBMI 103: Human Anatomy & Physiology**

4-0-0 (4 credits)

**Introduction to cell.**

1. **Blood:** Characteristics of blood, physiology of blood clotting. 2L
2. **Heart (Circulatory System):** Anatomy of heart and blood vessels, origin and conduction of heart beat, cardiac cycle, electrocardiogram, blood pressure, control of cardiac cycle. 6L
3. **Respiratory System:** Anatomy of respiratory system, physiology of respiration in the alveolar and tissue capillaries, control of respiration. 6L
4. **Digestive system:** Anatomy of digestive system, nerve and blood supply, physiology of digestion. 3L
5. **Kidney and Urinary system:** Anatomy of urinary system and kidney, physiology of water and electrolyte balance, acid-base regulation. 4L
6. **Muscle Tissues:** Anatomy, types of muscles, physiology of muscle contraction, generation of action potential, rhythmicity of cardiac muscle contraction, properties of skeletal and Cardiac muscles. 6L
7. **Nervous system:** Neuron, anatomy and function of different parts of brain, spinal cord, autonomic nervous system, special sense organs for taste, smell, sight and hearing. Biological control concept and feed back mechanism. 7L
8. **Skeletal system:** Structure and properties of bone, skeletal joints, mechanics of the elbow, mechanics of shoulder, mechanics of spinal column, mechanics of hip, mechanics of knee, mechanics of ankle. 6L

**Text Books:**

1. Sujit K.Chaudhuri – Concise Medical Physiology – New Central Book agency, 1997
2. Arthur.C.Guyton – Textbook of Medical Physiology – Prism Book (p) Ltd. 1996.

**Reference Books:**

1. CL.Ghai – A textbook of Practical physiology – 5<sup>th</sup> Ed Jaypee Medical Publishers, 2003
2. Sarada Subramanyam, K.Madhavan Kutty and H.D.Singh – Text book of ‘Human Physiology – S.Chand & Company, 1996
3. Anatomy and Physiology by Wilson and Wanh
4. Human Physiology by A. V. James & D. L. Sherman

**MBMI 104: Bio-Signal Acquisition & Conditioning System:**

4-0-0 (4 credits)

1. **Introduction to biomedical Instrumentation:** Category of measurement, factors in making measurement, biometrics, problems encountered in measuring a living system. Definition of signals and noise, types of bio-signals and its sources, Sensor terminology, Electrodes for bio-physiological sensing and conditioning, Recording problems and its remedy. Transducers and other sensors, temperature, pressure, force, displacement, flow sensors. 14L
2. **Bioelectric amplifiers:** Different types and their principles of operation. 3L
3. **Bio-recorders:** Different types, construction and principle of operation, different types of cameras used for image recording systems, and its processing. 6L
4. **Recording of bioelectric events:**Recording of ECG, EMG & EEG signals. Holter monitor and cardiac stress test. 5L
5. **Medical Display Systems:** Functional numerical display, central monitoring console, principles of operation.

**Department of Biomedical Engineering**  
**JIS COLLEGE OF ENGINEERING**  
**M. Tech. in Biomedical Instrumentation**

- 4L
- 6. Biotelemetry:** ECG and physiological telemetry, Radio telemetry system, Portable telemetry system, Land-line telemetry system. 4L
- 7. Electrical safety consideration:** Physiological effects of electrical current, methods of accident prevention, methods of radiation prevention. 4L

**Textbooks:**

1. A.K.Sawhney, "A Course in Electrical and Electronic measurements and Instruments", Dhanpat Rai and Sons, 2000. (UNIT I, II)
2. Leshie Cromwell, Fred. J. Weibell and Erich. A. Pfeiffer, "Biomedical Instrumentation and Measurements", 2nd Edition, PHI, 2003. (UNIT III, IV)
3. John G. Webster, Medical Instrumentation: Application and Design, 3rd edition, John Wiley & Sons, New York, 1998. (UNIT V)

**Reference Books:**

1. R.Anandanatarajan, "Biomedical Instrumentation", PHI Learning, 2009.
2. M. Arumugam, "Biomedical Instrumentation", Anuradha Agencies Publishers, Vidayal Karuppar, 612 606, Kumbakonam, R.M.S: 1992
3. Introduction to Biomedical Technology by J. J. Karr & J. M. Brown, Pearson Education
4. Handbook of Biomedical Instrumentation by R. S. Khandpur , TMH 1995

**MBMI 105A:** Biomedical Sensor and MEMS Technology 4-0-0 (4 credits)

**1. Sensor architecture and Classification:** Medically significant measurands, functional specifications of medical sensors; Sensor characteristics : linearity, repeatability, hysteresis, drift; Sensor models in the time & frequency domains. Sensors for physical measurands: strain, force, pressure, acceleration, flow, volume, temperature and biopotentials. Sensors for measurement of chemicals: potentiometric sensors, ion selective electrodes, ISFETS; Amperometric sensors, Clark Electrode; Biosensors, Catalytic biosensors, immunosensors ; 10L

**2. Biological Sensors:** Introduction to wearable medical devices and bio-sensing technologies. Design of on-body and in-body biosensors. Communication topologies, protocols, standards and media of body sensor networks (BSN). Usages and roles of BSN in real-life applications. Selected issues in state-of-the-art development of BSN, e.g. information security, signal interference, energy scavenging, multi-sensor fusion and context-aware sensing. 8L

**3. Biopotential electrodes:** Microelectrodes, body surface electrodes, needle electrodes. Reference electrodes: hydrogen electrodes, silver-silver chloride electrodes, Calomel electrodes. Recording electrodes for ECG, EEG, and EMG. Transducers for the measurement of ions and dissolved gases, pH electrode. specific ion electrodes. Bio sensors: Ion exchange membrane electrodes, enzyme electrode, glucose sensors, immunosensors. Basic principles of MOSFET biosensors & BIOMEMS. 10L

**4. MEMS technology:** An introduction to Microsensors and MEMS, Evolution of Microsensors & MEMS, Microsensors & MEMS applications, Microelectronic technologies for MEMS, Micromachining Technology, Surface and Bulk Micromachining, Micromachined Microsensors, Mechanical, Inertial, Biological, Chemical, Acoustic, Microsystems Technology, Integrated Smart Sensors and MEMS, Interface Electronics for MEMS, MEMS Simulators, MEMS for RF Applications, Bonding & Packaging of MEMS. 12L

**Textbooks :**

1. *Handbook of Biosensors and Electronic Noses: Medicine, Food and the Environment:* CRC-Press; 1 edition;1996
2. Steven S. Saliterman, *Fundamentals of BioMEMS and Medical Microdevices* ,SPIE Press Monograph Vol. PM153, 2006

**Reference :**

1. *Biosensors:* Oxford University Press, USA; 2 edition, 2004
2. D. L. Wise, *Biosensors: Theory and Applications*, CRC Press,1993
3. Rao & Guha, *Principles of Medical Electronics & Biomedical Instrumentation*, Orient

**Department of Biomedical Engineering**  
**JIS COLLEGE OF ENGINEERING**  
**M. Tech. in Biomedical Instrumentation**

Longman.2001

4. Gerald Urban, *ioMems*, Springer; 1 edition, 2006

**MBMI 105B:** Biomedical Laser Instrumentation

4-0-0 (4 credits)

- 1. Elements of fiber optic transmission system:** Basic optical laws, Fiber types, Ray optics representation, Modes, power flows, Coherent bundle, Incoherent bundle, Splices and Connectors. 6L
- 2. Fiber fabrication:** Fiber materials, Preform fabrication, Attenuations, Dispersions in optical fibers. 4L
- 3. Optical sources:** LED, LASER diodes, Materials, Structures, Efficiencies, Solid lasers, Gas lasers, lasers, Metal vapour lasers, Nitrogen lasers, Excimer lasers. 8L
- 4. Photodetectors:** PIN, APD, Responsivity, Quantum efficiency, Noises, Materials, Photomultiplier, Phototransistors. 5L
- 5. Fiber optic sensors:** Intensity, phase and polarization modulated sensors, Evanescent wave sensors, Fiber refractometers, Interferometric sensors, Basic principle, Mach Zender type, Febyry perot type, Michelson type & Sagnac interferometers, Fiber optic Thermometer, Fiber optic Endoscope, Laser Doppler velocimeter. 8L
- 6. Laser- tissue interactions & Laser treatment:** Laser caused photochemical, photothermal & photodecomposition effects, Laser acupuncture and wound healing, Laser photodynamic therapy, basic idea and the optical energy transfer scheme. 4L
- 7. Laser Surgery:** Principles, Laser angioplasty, laser dentistry, Tissue welding, Advantages and applications of Holmium and Erbium lasers in medicine. Holography and its application in medicine. 5L

**Textbooks**

1. Raymond W. Waynant (Editor), "**Lasers in Medicine**", CRC press, Jan 2002.

**REFERENCE:**

1. Julian D.C. Jones Collin E. Webb (Editor), "**Handbook of Laser Technology and Applications**".
2. Carr Ruth and Others, "**Medical Lasers**".

**MBMI 105C:** Design and Fabrication of Artificial Joints and Organs

4-0-0 (4 credits)

- 1. Introduction:** Overview of human system, Vulnerable body parts, properties of Anatomical materials – hard tissue & Soft tissues 4L
- 2. Basics of Design Process :** Adoptive and Adaptive design, safety, Standardisation, manufacturability, customization, interchangeability 6L
- 3. Material selection:** Properties, Biocompatibility, Corrosion – Metal and alloys, Ceramics, Polymers and Composite Materials. 10L
- 4. Implants Design:** Dental and Oral implants, Orthopaedic implants. Joint Replacement: Shoulder, Hip, Elbow, Knee, Ankle, Bone repair and joint implants-long bone repair and joint replacements, dental implants- effects of material selection, effects of surface properties, surface chemistry. 10L
- 5. Organ Replacement: Organ system, eye and its replacement, Artificial Lungs, Artificial heart,** Artificial blood, Artificial liver, Artificial pancreas, Artificial skin 10L

**TEXT BOOK :**

1. "**Biomedical Engineering Handbook**" Volume1(2<sup>nd</sup> Edition),J.D.Bronzino(CRC Press /IEEE Press, 2000).
2. "**Biomedical Engineering Handbook**" Volume 2 (2<sup>nd</sup> Edition), J.D.Bronzino (CRC Press / IEEE Press, 2000)
3. "**Handbook of Biomedical Instrumentation**" (2<sup>nd</sup> Edition) R.S.Khandpur (Tata McGraw Hill, 2003)

**Reference Books :**

1. "Biomaterials science and engineering" 1984, Plenum press, New York, John Bu Park
2. "Biomaterial – an Interfacial approach" 1982, Academic press, New York, L.L. Hence & E.C. Ethridge.



**Department of Biomedical Engineering  
JIS COLLEGE OF ENGINEERING  
M. Tech. in Biomedical Instrumentation**

3. "Biomedical engineering principles – an introduction to fluid, heat and mass transport processors" 1976, Marcel Decker, New York, David D. Cooney
4. Introduction to Bio – Materials by J. Park.

**MBMI 191:** Biomedical Instrumentation Lab

0-0-4 (2 credits)

**List of Experiments:**

1. Plotting of human auditory response using audiometer
2. Performance and testing of surgical diathermy unit using diathermy analyzer.
3. Recording of EMG.
4. Measurement of Heart Sound using Phonocardiograph
5. Study of picker EEG machine
6. Electrical safety testing of equipment using international safety analyzer.
7. Study of magnetic recorder for recording and retrieval of bio-signals
8. Construction and testing of nerve stimulator.
9. Biosignal processing workstation and measurement of dynamic biosignals.
10. Speech signal acquisition and processing using FFT spectrum analyzer.

**MBMI 192:** Physiological Parameter monitoring Lab

0-0-4 (2 credits)

**List of Experiments:**

1. Patient monitoring system and biotelemetry
2. ECG monitoring
3. Blood pressure monitoring
4. Body Temp Monitoring
5. SpO2 Monitoring
6. Respiration Rate monitoring.
7. Blood ion conc.
8. Blood glucose monitoring

**MBMI 201:** Clinical Instrumentation

4-0-0 (4 credits)

**Bioelectric Signals and Electrodes :** Sources of biomedical signals, basic medical instrumentation system, PC based medical instruments, General constraints in design of medical instrumentation systems, origin of bioelectric signals, Electrocardiogram (ECG), Electroencephalogram (EEG), Electromyogram (EMG), Electrooculogram (EOG), Electroretinogram (ERG), Recording Electrodes – Electrode-tissue interface, polarization, skin contact impedance, motion artifacts, Silver-Silver Chloride electrodes, Electrodes for ECG, Electrodes for EEG, Electrodes of EMG, Electrical conductivity of electrode jellies and creams, microelectrodes. 6L

**Biomedical Recording Systems & Recorders :** Electrocardiograph-block diagram, ECG leads, effects of artifacts, multi-channel, ECG machine, Vectorcardiograph, Phonocardiograph-origin of heart sounds, microphones and amplifiers for PCG, Electroencephalograph- block diagram, computerized analysis of EEG, Electromyograph, biofeedback instrumentation. 4L

**Patient & Foetal Monitoring Systems:** Cardiac monitor, bedside patient monitoring system, measurement of heart rate-average and instantaneous heart rate meters, measurement of pulse rate, Blood pressure measurement: Direct method, indirect method-automatic pressure measurement using Korotkoff's method, differential auscultatory technique, oscillometric method, ultrasonic Doppler shift method, arrhythmia monitor, exercise stress testing-treadmill test & bicycle test, ambulatory monitoring-data recording, replay and analysis, Fetal monitoring-Abdominal fetal ECG, fetal phonocardiogram, FHR measurement from ultrasound. 8L

**Department of Biomedical Engineering**  
**JIS COLLEGE OF ENGINEERING**  
**M. Tech. in Biomedical Instrumentation**

**Oximeters, Blood Flow & Cardiac Output Measurement :** Oximetry- In-vitro & in-vivo, ear oximetry, pulse oximetry, skin reflectance oximeters, intravascular oximeter. Electromagnetic blood flowmeter- principle, square wave electromagnetic flowmeter, Doppler shift ultrasonic flowmeter, flow measurement by Doppler imaging, NMR & Laser Doppler flowmeter, Cardiac output measurement- Indicator & dye dilution technique, impedance method, ultrasound method. 8L

**Respiratory Diagnostic & Therapeutic Instruments :** Pulmonary function measurement measurements-respiratory volumes & capacities, compliance & related pressures, dynamic respiratory parameters, basic spirometer, ultrasonic spirometer, pneumotacometer- Fleish & turbine type, measurement of volume-flow volume curve, nitrogen washout technique. 4L

**Pacemakers & Defibrillator:** Need for cardiac pacemaker, external pacemaker, implantable pacemakers-types, ventricular synchronous demand pacemaker, programmable pacemaker, power sources for implantable pacemakers. Need for defibrillator, DC defibrillator, automatic external defibrillator, implantable defibrillators 4L

**Advanced Diagnostic & Therapeutic Instruments :** Principle of surgical diathermy & surgical diathermy machine, Electrodiagnosis-Electrotherapy-functional block diagram and working, interferential current therapy. Artificial kidney-Principle and haemodialysis machine. Lithotriptors- principle, modern lithotripter-block diagram and working. Anesthesia-Need for anesthesia, delivery of anesthesia, anesthesia machine. Infusion pumps-principle and programmable volumetric infusion pump. Principle of endoscopy and laparoscopy. 6L

**Text books :**

1. **“Handbook of Biomedical Instrumentation”** R.S.Khandpur, 2<sup>nd</sup> Edition, Tata McGraw Hill, 2003

**Reference Books:**

1. **“Biomedical Instrumentation and Measurement”** Leslie Cromwell, Fred J Weibell and Erich A. Pfeiffer, Prentice-Hall India Pvt. Ltd.
2. **“Biomedical Transducers and Instruments”** Tatsuo Togawa, Toshiyo Tamura and P. Ake Oberg, CRC Press, 1997.
3. **“Introduction to Biomedical Equipment Technology”** Joseph J. Carr and John M. Brown, 4<sup>th</sup> Edition, Prentice Hall, 2001.

**MBMI 202:** Medical image Processing 4-0-0 (4 credits)

**1. Image Fundamentals:** Image Perception, MTF of the visual system, image fidelity criteria, image model, image sampling and quantization – 2 dimensional sampling theory, image quantization, optimum mean square quantizer, image transforms- 2 D – DFT and other transforms. 8L

**2. Image preprocessing:** Image enhancement –point operation, histogram modeling, spatial operation, transforms operations. Image restoration- image degradation model, inverse and wiener filtering. 7L

**3. Image analysis and classification:** Image analysis- spatial feature extraction, edge detection, image segmentation classification technique- statistical methods, neural network approaches. 7L

**4. Reconstruction of CT and MRI Images:** Image reconstructions from projections-radon transforms, filter back projection algorithm, algebraic methods ,3D tomography, imaging methods of CT images, imaging methods in magnetic resonance imagers, Fourier reconstructions of Magnetic resonance images. 10L

**5. Transmission of Medical Images:** Medical Image , Data compression & transmission, Transform coding, pixel coding, predictive coding, interframe coding. 5L

**Department of Biomedical Engineering**  
**JIS COLLEGE OF ENGINEERING**  
**M. Tech. in Biomedical Instrumentation**

**6. Selected topics in Medical Image processing :** Application of Image Processing techniques in thermography, SPECT, PET, DSA. 3L

**REFERENCES:**

1. Albert Macovski, Medical Imaging Systems, Prentice Hall New Jersey, 1983.
2. Gonzalez R and Wintz P, Digital Image Processing Addison Wesley Publishing Co. USA, 1987.
3. Eric Krestel Imaging Systems for Medical diagnosis, Siemens Aktiengesellschaft, FRG, 199.
4. Alfred Horowitz MRI Physics for Radiologists – A Visual Approach, Springer Verlag, New York, II Edition, 1991.
5. Anil K. Jain, Fundamental of Digital Image Processing, Prentice Hall of India Pvt Ltd., New Delhi, 1995.
6. M.A. Sid Ahmed, Image Processing, theory Algorithms and Architectures, Mcgraw Hill Book Company Siongapore, 1995.7.G.W.
7. Awock and R. Thomas “ Applied Image Processing”, Mcgraw Hill book company, Singapore 1996.

**MBMI 203:        Modern Medical Instrumentation** 4-0-0 (4 credits)

1. **Monitoring Systems:** Microprocessor based ECG Machines . Holter monitoring. Exercise systems. Digital central monitoring systems for patient monitoring. Design concepts. Advanced Computer based arrhythmia detection system-software design protocols. 8L
2. **Evoked potential :** Stimulations - Recording - Amplifiers - Analysis and storage : Measurement of average auditory evoked potential - application - visual evoked potential measurement and application -Brain mappers - magneto encephalogram - principles and measurements. 10L
3. **Principles of electromyography detection & application** - Myoelectric control Introduction -Voluntary control of myoelectric signals - properties - myo electric signals - use of myo electric signal for control - signal processing and recording 8L
4. **Impedance Techniques :** Bipolar and tetrapolar circuits , detection of physiological activities using impedance techniques - cardiac output , neural activity , respiratory activity, impedance plethysmography- resistance and capacitance type. 6L
5. **Advanced analytical aids :** Fundamentals of NMR spectroscopy, X-ray spectrometers, mass spectrometers, Raman & Moss Beer spectroscopy. Principles of scanning and transmission electron microscopy. Principles of simple, compound and phase contrast microscopes. 8L

**Textbooks:**

1. R.Anandanatarajan, “Biomedical Instrumentation”, PHI Learning, 2009.
2. M. Arumugam, “Biomedical Instrumentation”, Anuradha Agencies Publishers, Vidyal Karuppar, 612 606, Kumbakonam, R.M.S: 1992
3. A M Halliday, " Evoked Potential in Clinical Testing", ( ed )
4. IEEE Medical Electronics Monograph Vol 7 to 12

**MBMI 204A:        Rehabilitation Aids & Instrumentation** 4-0-0 (4 credits)

1. **Engineering concepts in Rehabilitation:** Principles of application of Rehabilitation Technologies, Classification of Impairments, Disabilities and Handicaps, Socio-economic vis-à-vis Medical aspects of Rehabilitation, Prosthetic Feet: Various types of Prosthetic feet. Conventional foot. Rocker, SACH foot, ModifiedSACH Foot. Jaipur Foot, Seattle foot, Flex foot, Quantum foot, Peg Roelite foot, Carbon copy foot, Comparatives studies of prosthetic feet. Single axis, Double axis, Multi-axial foot, other kinds of feet etc. Heel Height adjustment, Adjustable ankle, various kinds of ankle mechanisms. 8L

**Department of Biomedical Engineering**  
**JIS COLLEGE OF ENGINEERING**  
**M. Tech. in Biomedical Instrumentation**

**2. Partial foot.:** Various types of Partial foot prosthesis. Biomechanics of Partial foot prosthesis, Prescription Principles, Materials used for partial foot prosthesis, various cast techniques of Partial foot prosthesis, Fabrication Technique for partial foot prosthesis. Syme's: Various types of Symes Prosthesis, Prosthetic components, Prescription criteria, Principles. Materials used for Symes prosthesis, Casting techniques. Cast modification. Fabrication Technique for Symes (P.T.B. type) prosthesis. Fabrication Technique for Conventional Symes Prosthesis. 8L

**3. Below Knee Prosthesis :** Various types of below knee (trans-tibial) prosthesis with a focus on endoskeletal prostheses. All types of Below knee Prosthetics Components – both conventional and modular. Below knee Prescription Criteria and principles. Materials used for Below Knee Prosthesis. Measurement and Casting techniques for PTB prosthesis. Cast modification. Fabrication Techniques for PTB prosthesis. Fabrication Technique for BK Conventional Prosthesis: Both Open and close ended socket, Different types of socket designs – PTB, PTS, PTBSC, PTB-SCSP, Different types of suspension. 8L

**5. Design & Approaches for Disabilities :** Equipment and appliances for evaluation of disability, Prostheses and orthoses for locomotor disabled, Mobility & reading aids for visually handicapped, Hearing aids, Externally powered limb prostheses, Sensory augmentation and substitution, Spinal orthoses, Devices for activities for daily living, Vocational training. Application of Principles of Robotics in development of Rehabilitation Aids and Appliances.

**TEXT BOOK :**

1. **“Biomedical Engineering Handbook”** Volume1 (2<sup>nd</sup> Edition), J.D.Bronzino (CRC Press / IEEE Press, 2000).
2. **“Biomedical Engineering Handbook”** Volume 2 (2<sup>nd</sup> Edition), J.D.Bronzino (CRC Press / IEEE Press, 2000)
3. **“Handbook of Biomedical Instrumentation”** (2<sup>nd</sup> Edition) R.S.Khandpur (Tata McGraw Hill, 2003)

**MBMI 204B: Computers in Medicine**

4-0-0 (4 credits)

**1. OVERVIEW OF COMPUTER HARDWARE PC-AT**

8L

8086 architecture, system connections, Instruction set & programming, Microcontrollers, Motherboard and its logic, RS232-C and IEEE bus standards, CRT controllers, FDC, HDC and Post sequence, PC based video card, modems and networking.

**2. SYSTEM DESIGN**

8L

Multichannel computerised ECG, EMG and EEG data acquisition, storage and retrieval, transmission of signal and images.

**3. COMPUTERS IN PATIENT MONITORING**

8L

Physiological monitoring, automated ICU, computerised arrhythmia monitoring, information flow in a clinical lab, computerised concepts, interfacing to HIS.

**4. COMPUTERS IN MEDICAL SYSTEMS MODELLING**

8L

Radiotherapy, drug design, drug delivery system, physiological system modelling and simulation.

**5. COMPUTERS IN MEDICAL RESEARCH**

8L

Role of expert systems, pattern recognition techniques in medical image classification, ANN concepts.

**TEXT BOOKS**

1. R.D.Lee, “Computers in Medicine”, Tata McGraw-Hill, New Delhi, 1999.
2. Douglas V.Hall, “Microprocessors and Interfacing : Programming and hardware”, McGraw-Hill, Singapore, 1999.

**MBMI 204C: Artificial Devices for Cardiovascular and Renal Abnormalities**

4-0-0 (4 credits)

**1. Cardiopulmonary Instrumentation:**

2L

Heart valves, artificial heart valves, biological and mechanical valves development, testing of artificial heart valves.

**Department of Biomedical Engineering**  
**JIS COLLEGE OF ENGINEERING**  
**M. Tech. in Biomedical Instrumentation**

2. **Pathophysiology and Techniques of Cardio pulmonary bypass:** Artificial heart-lung devices. Pumps, Oxygenators, Cardiotomy reservoirs, Tubing, filters. Oxygenation- [Bubble oxygenation ] Compartments of bubble oxygenators, Clinical use of bubbles oxygenators, The future of bubble oxygenators. Membrane oxygenation – Introduction, History of membrane lung, Assessment of membrane devices, Extra corporeal membrane oxygenation. 10L

3. **Cardiovascular and Renal Parameter Monitoring :** ECG, Arterial blood pressure, CXVP, LAP & PA Wedge, Arterial pump flow rate, suction pump flow, Temperature, Biochemistry , Cerebral function, computer linked monitoring. 6L

4. **Renal Abnormalities and Instrumentation:**. Anatomy of kidney, Physiology of urine formation, Physiology of Micturation, Renal function tests, Renal failure, its mechanism, effect and treatment, renal pharmacology. 5L

5. **Renal Dialysis:** Indication for dialysis, Dialysis techniques, Peritoneal dialysis. Hemodialysis, The equipment, Dialysis membrane, Indications, The circuit, Cannulation, Monitoring, Flow rate, Temperature maintenance, Dialysate, Composition, complications. Continuous Renal Replacement Therapy (CRRT), The Hemofilter, Types of membrane, Principle, Priming, anticoagulation, Ultrafiltration, convection, Hemofiltration, Filtrate removal, Monitoring and calculation. 9L

6. **Maintenance of Fluid balance:** Advantages of CAVH, Use of pump, Complications. Solutions: Solutions, Solvent, solute Crystallloid, Colloid, Suspension, Morality, Molality, Equivalency, Normality, Osmolarity, Tonicity. Concentrations. Concentration changes, Priming fluids, Constituents of various priming fluids. Selection of priming fluids. Oxygen carrying capacity. Hemodilution. 6L

**Textbooks:**

- Cardiopulmonary Bypass by Kenneth. M. Taylor
- Hand book of Dialysis by J. T. Daugirdas

**MBMI 205A:** Calibration, Repair and Maintenance of Biomedical Instruments 4-0-0 (4 credits)

1. **Fundamentals of Medical Instrumentation:** Bioelectric Signals and Physiological Transducers. Related Anatomy and Physiology.

2. **Operation, functional circuit details:** Patient Safety, Repair, Service and Maintenance of a range of medical equipment

3. **Mechanical Equipment:** BP Apparatus, Suction Machine and Microscope.

Recording and Monitoring Equipment: ECG and EEG Machines, Pulse, Oximeter, Cardiac Monitor and Audiometer.

4. **Clinical Lab Equipment:** Colorimeter, Spectrophotometer, Semi-Auto Analyzer, Centrifuge and Oven. Imaging Systems : X-Ray and Ultrasound Machines.

5. **Therapeutic Equipment :** Cardiac Defibrillator, Short wave and Ultrasonic Diathermy. Anesthesia Machine.

6. **Maintenance of pc based medical equipment:** Introduction to - System configuration and BIOS, Identification & Troubleshooting of PC components viz-Motherboard, HDD, FDD, CD ROM, Monitor, Printers, Modems, Ports etc. Installation and operation of - Windows Operating System, Antivirus Software, Internetworking.

**TEXT BOOKS:**

1. R. S. Khandpur, Biomedical Instrumentation Technology and Applications, McGraw-Hill Professional, 2004 (UNIT I, II)
2. Raja Rao, C; Guha, S.K, Principles of Medical Electronics and Biomedical Instrumentation, Orient Longman Publishers (2000) (UNIT III, IV & V)

**REFERENCE BOOKS:**

1. R. Anandanatarajan, "Biomedical Instrumentation", PHI Learning, 2009.
2. John G. Webster, Medical Instrumentation: Application and Design, 3rd edition, John Wiley & Sons, New York, 1998.

**Department of Biomedical Engineering**  
**JIS COLLEGE OF ENGINEERING**  
**M. Tech. in Biomedical Instrumentation**

**MBMI 205B: Radiological Equipments**

4-0-0 (4 credits)

**X-rays:** Principle and production of soft X rays, Selection of anodes, heel pattern, Scattered radiation, porter-Bucky systems, Cooling systems, Testing of various parameters of the unit, principles of Angiography and Fluoroscopic techniques, Image Intensifiers, single plane and biplane recording units, digital subtraction angiography, dental X ray units. 8L

**Tomography:** Principle, plane of movement, multisection radiography, computerized axial tomography, tryeps of detection, image reconstruction, spiral CT, Transverse tomography. 7L

**Nuclear Magnetic Resonant:** Principle, NMR scanner, Imaging different sections of the body, tissue characterization, NMR spectroscopy. 6L

**Isotopes:** Alpha, beta, gamma emission, different types of Radiation detectors, GM and proportional counter, pulse height analyzer, isotopic scanners, Diagnosis of RBC Destruction rate, GI bleeding, Iron concentration, Liver functions, function of gamma camera, PET, SPECT. 8L

**Therapy using Xrays and Isotopes:** Direct and indirect effects of Radiation, units for radiation exposure, depth dose curves, linear accelerator betatron, cobalt and cesium therapy, computation of absorbed dose level, automatic treatment planning. 7L

**Radiation Safety:** Safety precautions , hazardous effects of radiations, radiation measuring units, allowed levels , ICRP regulation protection methods, Radiological equipment specifications with respect to performance for RLE. 4L

**TEXTBOOKS**

1. Chesneys' Equipment for Student Radiographers, 4th Edition, 4e, Wiley-Blackwell Publiishers, 1994
2. Carr & Brown, "Introduction to Biomedical Equipment Technology" Pearson Education, Asia.
3. R. S. Khandpur, "Handbook of Bio-Medical Instrumentation", Tata McGraw Hill. 1997
4. J.Webster, "Bioinstrumentation", Wiley & Sons

**REFERENCE BOOKS**

1. Thayalan, Basic Radiological Physics, Jaypee Medical Publiishers, 2001
2. LC Gupta, Abhitabh Gupta, Radiophysics and darkroom procedure, Jaypee Medical Publiishers, 2002
3. Introduction to Biomedical Engineering - Endrele, Blanchard, Bronzino
4. Nuclear Diagnostic Imaging Practical Clinical Application by E. Edmund Kim & Thomas P. Haynie

**MBMI 205C: Electrical Safety and Hazards of Biomedical Equipment**

**4 Credits [3-1-0]**

**1. Review of biopotentials:** Electrodes as bioelectric transducers : The electrode-electrolyte interface; Specification and selection criteria for electrodes; Surface, needle, implanted electrodes; Polarizable and non-polarizable electrodes; Practical considerations : 8L

**2. Instrumentation for biopotential recording :** Practical considerations for optimum performance; Reduction of interference, grounding, safety. 4L

**3. Electrical Stimulation :** Use in generating evoked potentials, and for therapeutic correction (ECT, pacemakers, defibrillation); 4L

**4. Stimulation parameters:** Safety limits and precautions ; Safety : Hazards associated with the use of electrical / electronic instruments; Provisions for safety; Clinical safety norms. 4L

**5. Commonly measured biopotentials and their clinical interpretation:** ENG, ECG, EMG, Sensory evoked potentials (visual, auditory, somatosensory). 4L

**6. Radiation Hazards & Safety:** Retarded Potentials and concepts of radiation, Radiation from a small current element. Radiation resistance: Introduction to Electromagnetic Interference and Electromagnetic compatibility, EMI coupling modes, Methods of eliminating interference, shielding, grounding, conducted EMI, EMI testing: emission testing, susceptibility testing. 10L

**Department of Biomedical Engineering**  
**JIS COLLEGE OF ENGINEERING**  
**M. Tech. in Biomedical Instrumentation**

**7. Standards:** BIS standards, ISO regulations, electrical safety and safety and regulation to keep the hospital environment safe, medical ethics. 6L

**Text Books**

1. M.J. Aminoff , *Electrodiagnosis in Clinical Neurology*, 3rd edition, Churchill Livingstone, USA, 1992.
2. J.A. Delisa, H.J. Lee, E.M. Baran, K.S. Lai & N. Spielholz , *Manual of Nerve Conduction and Clinical Electrophysiology*, 3rd Edition, Academic Press, New York, 1993.

**References Books:**

1. J. Kimura (Ed.) : *Peripheral Neuropathy vol. 1*, W.B. Saunders & Co., Philadelphia, 1984
2. Cadick, Mary Capelli-Schellpfeffer, and Dennis K. Neitzel ; *Electrical Safety Handbook* by John 2005 , McGraw-Hill Professional; 3 edition

**MBMI 291:** Medical Image Processing Lab 0-0-4 (2 credits)

- 1) Display (Reading) of an image
- 2) Image Enhancement & Compression.
- 3) Image Segmentation.
- 4) Interpretation of Medical Images
- 5) Color Image Processing.
- 6) Morphological Image Processing
- 7) Motion analysis
- 8) Biomedical Image acquisition using X ray,
- 9) Biomedical Image acquisition using Thermal Imaging System
- 10) Biomedical Image acquisition using Ultrasonography and OCT

**MBMI 301 A:** Artificial Intelligence and Expert System 4-0-0 (4 credits)

**1. Overview of history and goals of AI:** Tentative definitions. Turing's test, knowledge Vs. Symbolic Level, Relations with other disciplines from Philosophy, to Linguistic to Engineering, Review of AL successes and failures. State Spaces, Production System and Search: State Space representation of problems, Problem solving search, Constraints, Definition and examples of Production Systems, Heuristic search techniques, Two person games. 6L

**2. Knowledge representation Issues:** Procedural Knowledge Representation Vs. Declarations Knowledge + reasoning, Facts, General Assertions, Meta knowledge, The Frame Problem. Using First-Order logic for Knowledge Representation: Propositional Logic, Semantics and Deduction, first Order Logic: Semantic and Deduction. Unification. Resolution-based theorem proving. Using theorem proving to answer questions about the truth of sentences or to identify individuals that satisfy complex constraints, Logic Programming. Weak Slot-and-Filler Structures: Semantic Nets and Frames, Scripts for representing prototypical combination of events and actions. 7L

**3. Rule-Based Systems:** Pattern-matching algorithms. He problem of Control in Rule based Systems. The Rete Algorithm. Statistical Reasoning: Use of Certainty factors in Rule Based Systems. Associating probabilities to assertions in first-order logic, Bayesian Networks, Fuzzy logic. Learning: Learning to classify concepts using features of their instances, Learning a concept (Introduction) from examples. Explanation-Based Learning. Version Spaces, Neural Nets with back propagation. 6L

**4. Introduction to Expert Systems:** Definition why build an expert system, application areas of expert system and how are expert systems used. Characteristics of Expert Systems, Structure of expert system, characteristics and phases and people involved in building an expert systems, Inference Techniques, Types of reasoning deductive, inductive, abductive, analogical, common-sense and non-monotonic, types of inference forward and backward chaining, search techniques, depth-first search, breadth-first search and best-first search. 6L

**Department of Biomedical Engineering**  
**JIS COLLEGE OF ENGINEERING**  
**M. Tech. in Biomedical Instrumentation**

**5. Rule-Based Expert Systems:** Evolution, architecture of rule-based expert system, examples of rule-based systems, backward chaining and forward chaining rule based systems and task on designing backward and forward chaining rule based system. Approach to Inexact Reasoning, Probability theory, Bayesian theory: example, variation and Prospector: an expert system application that employed Bayesian approach , Certainty theory: overview uncertain evidence, uncertain rules, uncertain inferencing certainty factor and certainty factor example program. 7L

**6. Fuzzy Logic :** Overview a fuzzy logic, forming fuzzy set representation, hedges, set operations, inference of fuzzy logic and building a fuzzy logic expert system. Rule-Based Expert Systems: Overview, anatomy of a class, subclass, instance properties, inheritance, facts, methods, encapsulation, rules interaction with objects and design methodology for frame-based system. Define problem, analyze domain, define classes, instances , rules and object communications, design interface, evaluate system and expand system. 7L

**Text Books:**

1. "ARM system developers guide", Andrew N Sloss, Dominic Symes and Chris wright, Elsevier, Morgan Kaufman publishers, 2008.
2. "Embedded Systems", Rajkamal, Tata Mcgraw-Hill publishers, 2008

**Reference Books:**

1. "Embedded system design", Frank vahid/Tony givargis, John wiley & sons, 2003.
2. "Embedded/Real time systems, Real-Time systems", Dr.K.V.K.K Prasad, Dreamtech press, 2004.
3. "Embedded Linux system design and development", P Raghavan, Amol lad, Sriram Neellakandan, Auerbach publications 2006.

**MBMI 301B: Modelling, simulation and Control of Physiological systems**

4-0-0 (4 credits)

**1. Introduction to Physiological control systems:** Illustration- example of a physiological control system. Difference between engineering and physiological control systems. Feed back control system - homeostasis - Regulatory system - Servo mechanism biological control system - similarities and differences - components of living control system. 6L

**2. Art of modeling Physiological systems:** Linear models of physiological systems distributed parameters versus lumped parameter models. Principle of superposition. Mathematical approach , electrical analogues, etc. Introduction to various process controls like cardiac rate , blood pressure, respiratory rate . Blood - Glucose regulation. Pharmacology modelling - drug diffusion system. 7L

**3. Modelling of human thermal regulatory system :** Parameters involved, control system model etc. Biochemistry of digestion, types of heat loss from body, models of heat transfer between subsystems of human body like skin - core etc. and systems like within body, body environment, etc. 6L

**4. Respiratory system :** Modelling oxygen uptake by RBC and pulmonary capillaries , Mass balancing by lungs, Gas transport mechanisms of lungs, oxygen and carbon dioxide transport in blood and tissues. 5L

**5. Ultra filtration system :** Transport through cells and tubules, passive diffusion, facilitated diffusion and active transports. Methods of waste removal, counter current model of urine formation in nephron, model of Henle's loop. 5L

**6. Cardiovascular system modeling and simulation:** Theoretical basis, model development, heart model, circulatory model, computational flow diagram of the cardiac system, software development. Pulmonary mechanics modeling and simulation. Theoretical basis, model development, Lung tissue viscoelastance, chest wall, airways-full model of respiratory mechanics. Pulmonary system software development-computational flow diagram. Interaction of pulmonary and Cardiovascular models. Computational flow diagram for cardiopulmonary software development. 8L



**Department of Biomedical Engineering  
JIS COLLEGE OF ENGINEERING  
M. Tech. in Biomedical Instrumentation**

**7. Eye movement system:** Wetheimer's saccade eye model. Oculomotor muscle model. Linear muscle model. 3L

**Text Books :**

- 1)Rushmer, " Medical Engineering", Academic Press
- 2)Yukihito Nose, " The Artificial Kidney", C V Moshy Co
- 3)Kennedy & Blackie, " Electromedical Engineering"
- 4)Webstar, " Electronic Devices for Rehabilitation"

**Reference Books:**

- 1) Myers, " Engineering in Heart and Blood Vessels", Wiley International
- 2) David Cooney, " Advanced in Bio medical Engineering", Marcel Decker Publications
- 3) David Cooney , "Biomedical Engineering Principles", Marcel Decker Publications
- 4) Ibrall & Guyton , "Regulations and Control in Physiological Systems ", Instruments Society USA
- 5) Brown & Gann, " Engineering in Physiology Vol 1 & Vol 2 "

**MBMI 301 C: Embedded System in Medicine**

4-0-0 (4 credits)

1. **Definition and Classification :** Overview of Processors and hardware units in an embedded system – Software embedded into the system – Exemplary Embedded Systems – Embedded Systems on a Chip (SoC) and the use of VLSI designed circuits - Embedded Hardware Architecture, Communication Interface Standards, Embedded System Development Process, Embedded Operating systems, Types of Embedded Operating systems. 8L

2. **Intel MCS51 Architecture:** Derivatives - Special Function Registers (SFR), I/O pins, ports and circuits, Instruction set, Addressing Modes, Assembly Language Programming, Timer and Counter Programming, Serial Communication, Connection to RS 232, Interrupts Programming, External Memory interfacing , Introduction to 16 bit Microcontroller. Interfacing of 8051 with ADC, sensors, stepper motor, key board, & DAC. 8L

3. **PIC Microcontroller :** Introduction, CPU architecture, registers, instruction sets addressing modes Loop timing, timers, Interrupts, Interrupt timing, I/o Expansion, I 2C Bus Operation Serial EEPROM, Analog to digital converter, UART-Baud Rate-Data Handling-Initialisation, Special Features - serial Programming-Parallel Slave Port . 8L

4. **Embedded system evolution trends:** Round - Robin, robin with Interrupts, function-One-Scheduling Architecture, Algorithms. Introduction to-assembler-compiler-cross compilers and Intergrated Development Environment (IDE). Object Oriented Interfacing, Recursion, Debugging strategies, Simulators. Task and Task States, tasks and data, semaphores and shared Data Operating system Services-Message queues-Timer Function-Events-Memory Management, Interrupt Routines in an RTOS environment, basic design Using RTOS. 8L

5. **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: Ophthalmology - Glaucoma screening device, Medical Imaging Acquisition User Interface, Drug delivery systems, Patient monitoring Systems. 8L

**Text Books:**

1. Rajkamal, Embedded Systems Architecture, Programming and Design, TATA McGraw-Hill, First reprint Oct. 2003 (UNITS I, IV & V)
2. M A Mazidi & Mazidi, The 8051 micro controllers, Pearson Education (UNIT II)
3. TimWilmshurst, Designing Embedded Systems with PIC, Newnes publishing , 2007 (UNIT III)

**Reference Books**

1. Steve Heath, Embedded Systems Design, Second Edition-2003, Newnes,
2. David E.Simon, An Embedded Software Primer, Pearson Education Asia, First Indian Reprint 2000.