UNIVERSITY OF MUMBAI

No. UG/245 of 2010

CIRCULAR:-

A reference is invited to the Ordinances, Regulations and syllabi relating to the Bachelor of Engineering (B.E.) degree course **vide** this office Circular No.UG/60 of 2004, dated 24th February, 2004 and the Principals of the affiliated Colleges in Engineering are hereby informed that the recommendation made by the faculty of Technology at its meeting held on 9th December, 2009 has been accepted by the Academic Council at its meeting held on 27th July, 2010 **vide** item No. 4.4 and that, in accordance therewith, the revised syllabus of Fourth Year (Semester VII & VIII) of the B.E. Degree Course in branch of Biomedical Engineering is as per **Appendix** and that the same has been brought into force with effect from the academic year 2010-2011.

MUMBAI-400 032
12th August, 2010

L. R. Mane
Offg. Registrar

To,

The Principals of the affiliated Colleges in Engineering.

A.C./4.4/27/07/2010

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No. UG/245-A of 2010, MUMBAI-400 032 12th August, 2010

Copy forwarded with compliments for information to:-

1) The Dean, Faculty of Technology,
2) The Chairman, Board of Studies in Electrical Engineering.
3) The Controller of Examinations,
4) The Co-Ordinator, University Computerization Centre,

(D. N. Jadhav)
Ag. Deputy Registrar
(UG/PG Section)

Copy to:-

The Director, Board of College and University Development, the Deputy Registrar (Eligibility and Migration Section), the Director of Students Welfare, the Executive Secretary to the to the Vice-Chancellor, the Pro- Vice-Chancellor, the Registrar and the Assistant Registrar, Administrative sub-center, Ratnagiri for information.

The Controller of Examinations (10 copies), the Finance and Accounts Officer (2 copies), Record Section (5 copies), Publications Section (5 copies), the Deputy Registrar, Enrolment, Eligibility and Migration Section (3 copies), the Deputy Registrar, Statistical Unit (2 copies), the Deputy Registrar (Accounts Section), Vidyanagari (2 copies), the Deputy Registrar, Affiliation Section (2 copies), the Professor-cum- Director, Institute of Distance and [illegible] the Director, University Computer Center (IDE Building), Vidyanagari,

Enclosure to Item No.4.4
27/07/2010

UNIVERSITY OF MUMBAI

Revised Syllabus for the Final Year (Semester VII & VIII) of the B.E. Degree Course in Biomedical Engineering

(With effect from the academic year 2010-2011)

University of Mumbai

Syllabus Structure (R-2007)

B.E. Biomedical Engineering

Semester-VII

Sr. No.	Subject	Scheme of Instructions Periods per Week (Each 60 min.)		Scheme of Evaluation					
		Theory	Practical/ Tutorial	Paper		TW	Practical /Oral	Oral	Total Marks
				Hours	Marks				
1.	Medical Imaging-II	04	02	3	100	25	---	50	175
2.	Biomedical Instrumentation-III	04	02	3	100	25	---	25	150
3.	Principles of Image Processing	04	02	3	100	25	50	---	175
4.	Networking and Information System in Medicine	04	02	3	100	25	---	25	150
5.	Installation, Maintenance and Servicing	04	---	---	---	50	---	50	100
6.	Project Stage-I	--	04	---	---	25	---	25	50
	Total	20	12	---	400	175	50	175	800

Semester-VIII

S. No.	Subject	Scheme of Instructions Periods per Week (Each 60 min.)		Scheme of Evaluation					
		Theory	Practical/ Tutorial	Paper		TW	Practical / Oral	Oral	Total Marks
				Hours	Marks				
1.	Nuclear Medicine	04	02	3	100	25	---	25	150
2.	Basics of VLSI	04	02	3	100	25	---	25	150
3.	Biomedical Microsystems	04	02	3	100	25	---	25	150
4.	Elective	04	02	3	100	25	---	25	150
5.	Project stage-II	---	08	---	---	50	---	50	100
	Total	16	16		400	150	---	150	700

Electives:

1. Hospital Management
2. Digital Imaging and Communication in Medicine
3. Robotics in Medicine

B.E. (BIOMEDICAL ENGINEERING)
SEMESTER - VII

University of Mumbai		
Class: B.E.	**Branch:** Biomedical Engineering	**Semester: VII**

Subject: MEDICAL IMAGING- II

Periods per Week (Each 60 min.)	Lecture	04	
	Practical	02	
	Tutorial	---	
		Hours	Marks
Evaluation System	Theory	03	100
	Practical & Oral	--	--
	Oral	02	50
	Term Work	---	25
	Total	05	175

Module	Content	Time (hrs)
1.	**Computed Tomography.**	
	Principle of Computed tomography	**02**
	Scanner configurations/generations, CT system: Scanning unit (gantry), detectors, data acquisition system, spiral CT, scanner parameters, CT Number	**08**
	Reconstruction techniques, Radon Transform, Filtered Back projection, Fourier Reconstruction Technique, Iterative reconstruction Technique, Image quality and artifacts, Clinical applications of CT	**08**
	Multi-detector computed tomography (MDCT), Flat panel detectors	**03**
	CT-Angiography	**01**
2.	**Magnetic Resonance Imaging** Physics of MRI, Relaxation Parameters and Spin Echoes, Magnetic Field Gradients, Slice selection and Frequency Encoding, Pulse sequences	**08**
	Hardware: Magnets, Gradient systems, RF coils,	**02**

	Fourier Reconstruction techniques, Image contrast, Resolution and Factors affecting signal-to-noise	04
	Safety Considerations/Biological Effects of MRI	02
3.	**Magnetic Resonance Spectroscopy (MRS)** Basic Principle of MRS and localization techniques, Chemical Shift Imaging, Single-voxel and Multivoxel MRS, Water Suppression techniques	06
4.	**Basics of Electrical Impedance Tomography**	02
5.	**Hybrid Imaging modalities and its clinical application**	02

Theory Examination:

1. Question paper will comprise of total 7 questions, each of 20 marks.
2. Only 5 questions need to be solved.
3. Q.1 will be compulsory and based on the entire syllabus.
4. Remaining questions will be mixed in nature.
5. In question paper weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

Oral Examination:

Oral will be based on entire subject for 25 marks and also on the basis of the Hospital/Industry visits for 25 marks separately.

Term work:

Term work will consist of at least Eight Assignments/ Laboratory Experiments based on the above syllabus and a written test. Test and Seminars be suitably graded by teachers and attached in the journal. The distribution of the term work shall be as follows,

Lab work (Assignments/ Laboratory Experiments & Seminar) :15marks
Test (at least one) :10 marks

The final certification and acceptance of term-work ensures the satisfactory performance of laboratory work and minimum passing in the term-work.

Text Books:

1. Christensen's Physics of Diagnostic Radiology, Lipimcott William, (willkins Publication)
2. Medical Imaging Physics William R. Hendee (Wiley-Liss Publication)

References:

1. Biomedical Technology and Devices Handbook by James Moore
George Zouridakis (CRC Press)

2. Biomedical Engineering Handbook by Bronzino (CRC Press)
3. Physics of Diagnostic Imaging –Dowsett

B.E. (BIOMEDICAL ENGINEERING)
SEMESTER - VII

University of Mumbai			
Class: B.E.	**Branch:** Biomedical Engineering	**Semester: VII**	
Subject: BIOMEDICAL INSTRUMENTATION -III			
Periods per Week (Each 60 min.)	Lecture	04	
	Practical	02	
	Tutorial	---	
		Hours	Marks
Evaluation System	Theory	03	100
	Practical & Oral	--	--
	Oral	02	25
	Term Work	---	25
	Total	05	150

Module	Content	Time (hrs)
1.	**Physiotherapy, Electrotherapy and Radiation Therapy Equipments:** Basic principle, working and technical specifications of Shortwave Diathermy, Ultrasonic therapy unit, Infrared and UV lamps, Nerve and Muscle Stimulator, Radiation and Physical therapy Units.	10
2.	**Surgical Instruments:** Surgical Diathermy machine, electrodes used with surgical diathermy, safety aspects in electronic surgical units, surgical diathermy analyzers.	07
3.	**Cardiac Pacemakers:** Modes of operation, leads and electrodes. Power supply sources. External and Implantable Pacemaker, Performance aspects of Implantable Pacemaker.	07
4.	**Cardiac Defibrillators:** DC defibrillator, Modes of operation and electrodes, Performance aspects of dc-defibrillator, defibrillator analyzers. Implantable defibrillator and defibrillator analyzer.	06
5.	**Hemodialysis Machine:** Basic principle of Dialysis. Different	04

	types of dialyzer membrane, Portable type.	
6.	**Laser Applications in Biomedical Engineering** Laser Classifications, Types of Lasers, Medical Applications, Laser Delivery Systems.	08
7.	**Heart rate variability measurement and applications.**	02

Theory Examination:

1. Question paper will comprise of total 7 questions, each of 20 marks.
2. Only 5 questions need to be solved.
3. Q.1 will be compulsory and based on the entire syllabus.
4. Remaining questions will be mixed in nature.
5. In question paper weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

Oral Examination:

Oral examination will be based on the entire subject.

Term work:

Term work will consist of at least Six Laboratory Experiments based on the above syllabus and a written test. Test and Assignments/Seminars be suitably graded by teachers and attached in the journal. The distribution of the term work shall be as follows,

Laboratory work (Experiments and Journal) :15 marks
Test (at least one) :10 marks

The final certification and acceptance of term-work ensures the satisfactory performance of laboratory work and minimum passing in the term-work.

Text Books:

1. Handbook of Biomedical Instrumentation: R S. Khandpur. (PH Pub)
2. Medical Instrumentation, Application and Design: J G. Webster. (John Wiley)
3. Introduction to Biomedical Equipment Technology: Carr –Brown. (PH Pub)

Reference:

1. Encyclopedia of Medical Devices and Instrumentation: J G. Webster. Vol I,II,III,IV (PH Pub)
2. Various Instruments Manuals.

B.E. (BIOMEDICAL ENGINEERING)
SEMESTER - VII

University of Mumbai			
Class: B.E.	**Branch:** Biomedical Engineering	**Semester: VII**	
Subject: Principles of Image Processing			
Periods per Week (Each 60 min.)	Lecture	04	
	Practical	02	
	Tutorial	---	
		Hours	Marks
Evaluation System	Theory	03	100
	Practical and Oral	02	50
	Oral	---	---
	Term Work	---	25
	Total	05	175

Module	Content	Time (hrs)
1	**Basics of Image processing**: Image acquisition, Processing, communication, display, Electromagnetic Spectrum, Visual perception, structure of the human eye, image formation in the eye, uniform and Non-Uniform Sampling, Quantization, Image formats	**05**
2	**Image Enhancement**: Spatial Domain-Point processing techniques, histogram processing, Neighbourhood processing; Frequency Domain techniques- 2D-DFT, Properties of 2 D-DFT, Low pass, High pass, Noise removal, Homomorphic filters, Basics of Colour image processing	**14**
3	**Image Segmentation**: Detection of discontinuities, point line, edge detection, Edge linking, Hough transform, Region Based segmentation	**08**
4	**Image transforms**: DFT, FFT, DCT, DST, Hadamard, Walsh, Haar, Slant, K-L Transforms, Basis Functions and basis images	**07**

Text Books:

1. Digital Image Processing, Gonzalez and Woods- Pearson Education
2. Fundamentals of Digital Image Processing, A.K. Jain –P.H.I.
3. Digital Image Processing and Analysis, Chanda Majumder- Printice Hall India.

Reference:

1. Digital Image Processing and Computer Vision, Sonka, Hlavac,Boyle- Cenage learning.
2. Digital Image Processing, William Pratt- John Wiley

B.E. (BIOMEDICAL ENGINEERING)
SEMESTER - VII

University of Mumbai			
Class: B.E.	**Branch:** Biomedical Engineering	**Semester:** VII	
Subject: NETWORKING AND INFORMATION SYSTEM IN MEDICINE			
Periods per Week (Each 60 min.)	Lecture	04	
	Practical	02	
	Tutorial	---	
		Hours	Marks
Evaluation System	Theory	03	100
	Practical & Oral	---	---
	Oral	02	25
	Term Work	---	25
	Total	05	150

Module	Contents	Time
1	Networking technology WAN/LAN, T1, ISDN, DSL, Internet (http, url, domains), ISO model, Ethernet, TCP/IP, Packet switching, circuit switching, Throughput, bandwidth, level of service parameters	6
2	Basic Security Concepts System security in general, Authentication, Authorization, Confidentiality, Integrity	3
3	Radiology Imaging basics Principles of different modalities (CR, DR, XR, XA, RF, US, MR, NM, CT), Image characteristics for each modality	4
4	Workflow Steps in Radiology and Planning, Designing and Implementing film less Hospital	4
5	Introduction to RIS and PACS and HIS/RIS/PACS integration	4
6	Reengineering workflow: Focus on personnel and process Interoperability and Workflow integration issues	3
7	Reengineering workflow: Radiologist's Perspective	3
8	Image acquisition and compression	3
9	PACS Architecture Networking and Security	10
10	Server and operating system	2
11	Storage and Enterprise Archiving	2
12	Image Displays	2

13	Tele-radiology	2
15	Legal Issues and formal policies	2

Theory Examination:

1. Question paper will comprise of total 7 questions, each of 20 marks.
2. Only 5 questions need to be solved.
3. Q.1 will be compulsory and based on the entire syllabus.
4. Remaining questions will be mixed in nature.
5. In question paper wightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

Oral Examination:

Oral exam will be based on entire subject.

Term work:

Term work consists of minimum two assignments and a written test. The distribution of the term work shall be as follows,

Laboratory work (Assignments and Journal) :15 marks
Test (at least one) :10 marks

The final certification and acceptance of term-work ensures the satisfactory performance of laboratory work and minimum passing in the term-work.

Text Book:

1. PACS Guide to Digital Revolution by Keith J. Dreyer (Springer)
2. Governance of Picture Archiving and Communications Systems by Carrison K.S. Tong (Medical Information Science Reference)
3. PACS and Imaging Informatics by H.K. Huang, John Wiley
4. Data Communication and Networking by Behrouz A. Forouzan McGrow Hill

Reference Book:

1. Computer Networks by A.S. Tanenbaum, Pearson Education
2. Practical_Imaging_Informatics.pdf
3. PACS fundamentals- By Herman Oosterwijk
4. DICOM Standard (http://www.dclunie.com/dicom-status/status.html)

B.E. (BIOMEDICAL ENGINEERING)

SEMESTER - VII

University of Mumbai		
Class: B.E.	**Branch:** Biomedical Engineering	**Semester:** VII
Subject: Installation, Maintenance and Servicing		
Periods per Week (Each 60 min.)	Lecture/Demo	04
	Practical	--
	Tutorial	---

Evaluation System		Hours	Marks
	Theory	---	--
	Practical & Oral	---	---
	Oral	02	50
	Term Work	---	50
	Total	02	100

Module	Contents	Time
1	• Importance of Biomedical engineering Department in the hospital • Role of Biomedical Engineer in the hospital	4
2	• Various jobs carried out by Biomedical engineer in the industry such as – Sales and Marketing, Servicing and Maintenance, Research and development, Application specialist	3
3	Installation Techniques and / or methods: • Pre-installation techniques • Precautions to be taken • Assembly of instrument / system • Testing of instrument before final handover.	4
4	Installation of medical equipments in various departments such as • Cardiac Equipments • O. T. and O.T. equipments • Radiology equipments • Pathology equipments • Life saving equipments • I.C.U., I.C.C.U., N.I.C.U. etc. • Medical Gas	16
5	Maintenance and Servicing	8

	• Preventive Maintenance and Calibration checks • Types of Maintenance contracts – CMC and AMC • Overall maintenance, Servicing and safety precautions of Medical and Non-medical equipments • Insurance of Medical Equipments	
6	Introduction to System operating protocol (SOP) for • ISO certification • NABH certification	2

Oral Examination:

Oral exam will be based on entire subject and the expert should be called from Hospitals/Industries.

Term work:

Term work consists of assignments based on the syllabus and demonstration etc.
The final certification and acceptance of term-work ensures the satisfactory performance of laboratory work and minimum passing in the term-work.

Text books & Reference books

- **Manuals of various equipments**

B.E. (BIOMEDICAL ENGINEERING)
SEMESTER - VIII

University of Mumbai			
Class: B.E.	**Branch:** Biomedical Engineering	**Semester: VIII**	
Subject: Nuclear Medicine			
Periods per Week (Each 60 min.)	Lecture	04	
	Practical	02	
	Tutorial	---	
		Hours	Marks
Evaluation System	Theory	03	100
	Practical & Oral	--	

	Oral	02	25
	Term Work	---	25
	Total	05	150

Module	Content	Time (hrs)
1.	Basics of Nuclear Physics: Radioactivity, Radioactive Decay Law, Units of Radioactivity Measurement, Interaction of Radiation with Matter	03
2.	Detectors in Nuclear Medicine: Scintillation Detectors, and Solid State detectors	04
3.	Basic Instrumentation in NM: Co incidence and Anti co incidence circuits, Single and Multi Channel Pulse Height Analyzers, Gamma Ray Spectrometry.	06
4.	In Vivo Techniques: General Principle, Radiopharmaceuticals – selection and localization, Uptake Monitoring system, Rectilinear Scanner, Gamma Camera Fundamentals, Position Circuitry and working, Computer Interface, Performance parameters, Quality Control Functions	10
5.	Emission Tomography Techniques: Introduction, Principles and applications of SPECT, Principles and applications of PET, System performance parameters and Quality Control Functions	10
6.	In Vitro techniques(Brief Description): Introduction, Single and Double Isotope method, Radioimmunoassay, RIA Counting System, Liquid scintillation Counting system, RIA Applications.	08
7.	Radiation Safety: External radiation Hazards & prevention, Internal radiation Exposure, Biological effects of radiation exposure, Disposal of Biological waste	07

Theory Examination:

6. Question paper will comprise of total 7 questions, each of 20 marks.
7. Only 5 questions need to be solved.
8. Q.1 will be compulsory and based on the entire syllabus.
9. Remaining questions will be mixed in nature.
10. In question paper weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

Oral Examination:

Oral exam will be based on entire subject.

Term work:

Term work consists of minimum two assignments and a written test. The distribution of the term work shall be as follows,

Laboratory work (Assignments and Journal) :15 marks
Test (at least one) :10 marks

The final certification and acceptance of term-work ensures the satisfactory performance of laboratory work and minimum passing in the term-work.

Text Books:

1. Textbook of Nuclear medicine: A.F.G. Rocha
2. Handbook of Nuclear medicine Instruments: Bairi, Singh, Rathod, Narurkar

References Books:

1. Medical Radiation physics: William Hendey
2. Instrumentation of Nuclear medicine: G. Hine.

B.E. (BIOMEDICAL ENGINEERING)
SEMESTER - VIII

University of Mumbai			
Class: B.E.	**Branch:** Biomedical Engineering	**Semester: VIII**	
Subject: Basics of VLSI			
Periods per Week (Each 60 min.)	Lecture	04	
	Practical	02	
	Tutorial	---	
		Hours	Marks
Evaluation System	Theory	03	100
	Practical & Oral	---	---
	Oral	02	25
	Term Work	---	25
	Total	05	150

Module	Content	Time (hrs)
1.	**Introduction to VHDL hardware description language**, core features of VHDL, data types, concurrent and sequential statements, data flow, behavioral, structural architecture. Architecture of Xilinx XC4000 FPGA family, Xilinx XC 9500 CPLD's family	08
2.	**Combinational and Sequential Logic design using VHDL** Using VHDL combinational circuit design examples- multipliers, decoders and encoders, barrel shifter, simple floating point encoder, cascading comparator. VHDL sequential circuit design features. Implementation of counters and registers in VHDL	08
3.	**Very Large Scale Integration (VLSI) Technology** Physics of NMOS, PMOS, enhancement and depletion mode transistor, MOSFET, threshold voltage, flatband condition, linear and saturated operation, FET capacitance, short channel and hot electron effect.	06
4.	**MOS Transistors**	10

	MOS transistor switches, Basic MOS inverter and its working, types of MOS invertors viz active load nMOS inverter, MOSFET Inverter with E-nMOS as pull up, MOSFET Inverter with D-nMOS as pull up, MOSFET Inverter with pMOS as pull up, Parameter measurement in MOS circuits viz voltage transfer characteristics, noise immunity and noise margins, power and area considerations.	
5.	**Silicon Semiconductor Technology** Wafer processing, mask generation, oxidation, epitaxy growth diffusion,ion implantation, lithography, etching, metalization, basic NMOS and PMOS processes. Latch up in CMOS and CMOS using twin tub process. Scaling of MOS circuits, types of scaling and limitations of scaling.	08
6.	**Design rules and Layout** NMOS and CMOS design rules and layout, Design of NMOS and CMOS inverters, NAND and NOR gates. Interlayer contacts, butting and buried contacts, stick diagrams, layout of inverter, NAND and NOR gates.	04
7.	**Design of basic VLSI circuits** Design of circuits like multiplexer, decoder, priority encoder, Flip flops, shift registers using MOS circuits	04

Theory Examination:

6. Question paper will comprise of total 7 questions, each of 20 marks.
7. Only 5 questions need to be solved.
8. Q.1 will be compulsory and based on the entire syllabus.
9. Remaining questions will be mixed in nature.
10. In question paper weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

Term work:

Term work will consist of at least Eight Assignments/ Laboratory Experiments, Presentations based on the above syllabus and a written test. Test and Seminars be suitably graded by teachers and attached in the journal. The distribution of the term work shall be as follows,

Lab work (Assignments/ Laboratory Experiments & Seminar) :15 marks
Test (at least one) :10 marks

The final certification and acceptance of term-work ensures the satisfactory performance of laboratory work and minimum passing in the term-work.

Text Books:

1. E. D. Fabricus, Introduction to VLSI design, McGraw Hill Publications, first edition, 1990
2. D.A. Pucknell and Eshraghian, Basic VLSI Design
3. John F Wakerly, Digital Design Principles and Practises

References:

3. Douglas Perry,VHDL Programming by Examples, Tata McGraw Hill Publications, 2002
4. Kang , CMOS Digital Integrated Circuits, Tata McGraw Hill Publications
5. Neil H.E. Weste, Kamran Eshraghian, Principles of CMOS VLSIDesign: A
6. Systems Perspective, second edition, Addison Wesley Publications, 1993
7. Rabaey Jan M., Chandrakasan Anantha, Nikolic Borivoje, Digital Integrated
8. Circuits: A Desiqn Perspective, second edition, Prentice Hall of India
9. John P Uyemura, Introduction to VLSI circuits and systems, John Wiley & Sons
10. Volnei A. Pedroni, Circuit Design with VHDL, Prentice Hall of India

B.E. (BIOMEDICAL ENGINEERING)
SEMESTER - VIII

University of Mumbai			
Class: B.E.	**Branch:** Biomedical Engineering		**Semester: VIII**
Subject: BIOMEDICAL MICROSYSTEMS			
Periods per Week (Each 60 min.)	Lecture	04	
	Practical	02	
	Tutorial	---	
Evaluation System		Hours	Marks
	Theory	03	100
	Practical & Oral	--	
	Oral	02	25
	Term Work	---	25
	Total	05	150

Module	Content	Time (hrs)
1.	**OVERVIEW OF MEMS &MICRO SYSTEM** MEMS & Micro systems - typical MEMS & Micro system products. Introduction to the world of microsystems. Description of the design and fabrication of microsystems. Integration of fabrication processes.	01
2.	**MATERIALS FOR MEMS AND MICROSYSTEMS** Introduction- Substrates and Wafers, Active Substrate Materials – silicon as a substrate Material, Silicon Compounds, Polymers- photoresists and Packaging Materials.	03
3.	**MICROSYSTEMS FABRICATION PROCESSES** Photolithography, Photoresist, Mask design, Additive Processes - deposition, Subtractive Processes - etching, Modifying – doping, annealing, curing Thin Film Deposition: Spin-on Films, Physical Vapor Deposition (PVD), Chemical Vapor Deposition (CVD)	08

4.	**MICROMACHINING:** Bulk Micromachining, Surface Micromachining, High Aspect-Ratio Processes (LIGA), Polymer Micro/Nano Fabrication	04
5.	**MICRO-MOLDING TECHNIQUES** Rigid Mold: Micro contact Printing, Imprinting or hot embossing, Injection molding, Cast Molding (Replica Molding) Flexible Mold: Soft lithography	03
6.	**NANOLITHOGRAPHY AND NANOPATTERNING**	02
7.	**MICRO TOTAL ANALYSIS SYSTEMS (μTAS)** 1. Components, 2. Micro Fluidies and Fluid control components (channels, pumps, valves), 3. μ-TAS: sample handling – (Microactuators examples - microvalves, micropumps, micromotors, Micro mixers, Microactivation methods), 4. μ-TAS: separation components, 5. μ-TAS: detection	07
6.	**MICRO/ NANO BIOSENSORS** Classification of physical sensors, Integrated, Intelligent, or Smart sensors, Biosensing Principles and sensing methods, biosensors arrays and implantable devices	04
7.	**CELL CHIPS** Cell handling and characterization systems, systems for biotechnology and PCR, polynucleotide arrays and genetic screening,	03
8.	**MICROSURGICAL TOOLS and MICRONEEDLES**	03
9.	**DRUG DELIVERY and IMPLANTABLE DEVICES**	04
10.	**MICROSYSTEM PACKAGING** Micro Systems Packaging (Types) – Essential Packaging Technologies (Types)	06

Theory Examination:

1. Question paper will comprise of total 7 questions, each of 20 marks.
2. Only 5 questions need to be solved.
3. Q.1 will be compulsory and based on the entire syllabus.
4. Remaining questions will be mixed in nature.

5. In question paper weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

Oral Examination:
Oral examination will be based on the entire subject.

Term work:

Term work will consist of at least Six Assignments , Presentations based on the above syllabus and a written test. Test and Assignments/Seminars be suitably graded by teachers and attached in the journal. The distribution of the term work shall be as follows,

Laboratory work (Assignments)	:15 marks
Test (at least one)	:10 marks

The final certification and acceptance of term-work ensures the satisfactory performance of laboratory work and minimum passing in the term-work.

Text Books:

1. Marc Madou, "Fundamentals of Microfabrication" by, CRC Press, 1997.Gregory Kovacs,
2. "Micromachined Transducers Sourcebook" WCB McGraw-Hill, Boston, 1998.
3. Steven S. Saliterman, " Fundamentals of BioMEMS and Medical Microdevices", (SPIE Press Monograph Vol. PM153 by Wiley Interscience

Reference Books:

1. A. Manz and H. Becker, Eds. Microsystem Technology in Chemistry and Life Sciences Spronger-Verlag, New York, 1999. ISBN: 3-540-65555-7
2. Stephen D. Senturia, "Microsystem Design" by, Kluwer Academic Publishers, 2001.
3. M.-H. Bao, "Micromechanical Transducers: Pressure sensors, accelrometers, and gyroscopes" by Elsevier, New York, 2000.

B.E. (BIOMEDICAL ENGINEERING)
SEMESTER - VIII

University of Mumbai			
Class: B.E.	**Branch:** Biomedical Engineering	**Semester: VIII**	
Subject: Hospital Management			
Periods per Week (Each 60 min.)	Lecture	04	
	Practical		
	Tutorial	02	
		Hours	Marks
Evaluation System	Theory	03	100
	Practical & Oral	--	--
	Oral	02	25
	Term Work	---	25
	Total	05	150

Module	Content	Time (hrs)
1.	**Process of management:** Principles of management, Leadership, Motivation, Time management, H.R. management (Recruitment, Performance appraisal, Reward management, Training and development, Conflict resolution and labor relations), Role of hospital administrator.	05
2.	**Hospital Planning:** Classification of hospitals based on various factors and associated norms, Guiding principles in planning hospital facilities and services, Planning a hospital , Planning of individual dept, Planning of supportive services, Planning of administrative services, Indices of measuring the efficiency of hospital	05
3.	**Hospital Functions and Services:**	
	a. **Clinical Services**: Emergency, IN patient, OUT patient, Intensive care unit, Operation Theatre, Nursing services.	06
	b. **Supportive services**: Laboratory, Radiology, Pharmacy, Blood Bank, Central Sterile Service Dept, Laundry, Medical social service Dept.	06
	c. **Auxiliary services:** Registration and indoor case records, Stores, Engineering and Maintenance services, Hospital security, Housekeeping, Laundry and Linen , Dietary (Food services), Waste management, Marketing Department, Medical Record, Disaster Management.	06

	d. **Ancillary services:** Medical Gas Management, Air conditioning system, Communication in hospitals, lifts, electrical backup	04
4.	**Engineering Depts.:** **Information Technology**: Hospital information System & Clinical support system. **Biomedical Dept.**: Need and responsibilities, Procurement Installation, Maintenance, Calibration. **Role of Civil Engg. Dept.** **Role of Mechanical Engg. Dept.** **Role of Electrical Engg. Dept.**	06
5.	**Hospital Economics:** Financial management/ aspects in a hospital: Economics and financial management in hospitals, Basics of hospital budgeting, General principles of accounting,	03
6.	**Legal Aspects in a hospital:** Health insurance, Quality assurance, medico legal aspects (with reference to Biomedical Engineer), accreditation, Risk management.	03

TERM WORK

Term work will consist of at least Eight Assignments duly graded based on the above syllabus, presentations and a written test. Test and Seminars be suitably graded by teachers and attached in the journal.

The distribution of the term work shall be as follows:

Lab work (Assignments/seminar) :15 marks
Test (at least one) :10 marks

The final certification and acceptance of term-work ensures the satisfactory performance of laboratory work and minimum passing in the term-work.

Text books:

1. Computers in Medicine: R. D. Lele (TMH Pub)
2. Hospital Planning, Designing and Managemnt: Kunders G D, Gopinath, A katakam (Private Pub Bangalore)

References books:

1. ABC of Hospital Management: Pragna Pai(National series).
2. Hospital Care and Hospital Managemnt AICTE Journal Vol. 1,2,3 by Dr. Kalanidhi. (AICTE Pub Bangalore)

B.E. (BIOMEDICAL ENGINEERING)
SEMESTER - VIII

University of Mumbai			
Class: B.E.	**Branch:** Biomedical Engineering	**Semester:** VIII	
Subject: Digital Imaging and Communication in Medicine			
Periods per Week (Each 60 min.)	Lecture	04	
	Practical	02	
	Tutorial	---	
		Hours	Marks
Evaluation System	Theory	03	100
	Practical & Oral	---	---
	Oral	02	25
	Term Work	---	25
	Total	05	150

Module	Contents	Time
1.	**DICOM standard** DICOM introduction and negotiation, DICOM architecture and background, Importance of Information model, AE, SCU/SCP, FSR/FSC/FSU, DICOM Objects, DICOM Information Hierarchy, Modules, IODs and Information Entities	**8 hrs**
2.	**DICOM image quality** 1. Pixel representation, Image pixel pipeline and presentation state GSDF,Overlays and Compression 2. DICOM BMPs, Image Compression, JPEG and JPEG 2000 standards	**12 hrs**
3.	**DICOM Communications** DICOM SOPs, Unit Identification on n/w, Services and Data, DIMSE Example: C-Echo, Storage, Query: Find, C-Find IOD, C-Find DIMSE, C-Cancel, Modality Worklist, Basic DICOM Retrieval: C-Get, Advanced DICOM Retrieval: C-Move, DICOM: Ping, Push and Pull	**5 hrs**
4.	**DICOM Associations**	**4 hrs**
5.	**DICOM Media: Files, Folders, and DICOMDIRs** DICOM File Format, DICOM File Services, Storing DICOM Data in PACS	**5 hrs**
6.	**DICOM Security** DICOM Hacking , Securing the Workflow, Securing the Data, Anonymization, Encryption , Encrypting the Data, Verifying Data Integrity, Validating Data Origin	**5 hrs**

7	**DICOM SR** Introduction to DICOM SR Comparing conformance statements Gap Analysis	**6 hrs**
8	**DICOM conformance statement**	**3 hrs**

Theory Examination:

11. Question paper will comprise of total 7 questions, each of 20 marks.
12. Only 5 questions need to be solved.
13. Q.1 will be compulsory and based on the entire syllabus.
14. Remaining questions will be mixed in nature.
15. In question paper weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

Oral Examination:

Oral exam will be based on entire subject.

Term work:

Term work consists of minimum two assignments and a written test. The distribution of the term work shall be as follows,

Laboratory work (Assignments and Journal) :15 marks
Test (at least one) :10 marks

The final certification and acceptance of term-work ensures the satisfactory performance of laboratory work and minimum passing in the term-work.

List of Experiments:

1. Creating structure for various patient identities
2. C Echo generation
3. Extraction of patient information from DICOM file
4. JPEG 2000 and JPEG

Text Book:

1. Digital Imaging and Communications in Medicine by Oleg S. Pianykh (Springer)
2. DICOM Basics (Third Edition) OTech Publishing

Reference Book:

1. DICOM Structured Reporting Pixmed Publishing

University of Mumbai			
Class: B.E.	**Branch:** Biomedical Engineering		**Semester:** VIII
Subject: Robotics in Medicine			
Periods per Week (Each 60 min.)	Lecture	04	
	Practical	02	
	Tutorial	---	
		Hours	Marks
Evaluation System	Theory	03	100
	Practical & Oral	---	---
	Oral	02	25
	Term Work	---	25
	Total	05	150

Module	Contents	Time
1.	**Introduction** Automation and Robots, Classification, Application, Specification, Notations.	6 hrs
2.	**Direct Kinematics** Dot and cross products, Coordinate frames, Rotations, Homogeneous coordinates Link coordination arm equation, (Five-axis robot, Four-axis robot, Six-axis robot).	8 hrs
3.	**Inverse Kinematics** General properties of solutions tool configuration Five axis robots, Three-Four axis, Six axis robot(Inverse Kinematics). Workspace analysis and trajectory planning work envelope and examples, workspace fixtures, Pick and place operations, Continuous path motion, Interpolated motion, Straight-line motion.	8 hrs
4.	**Robot Vision** Image representation, Template matching, Polyhedral objects, Shane analysis, Segmentation (Thresholding, region labeling, Shrink operators, Swell operators, Euler numbers, Perspective transformation, Structured illumination, Camera calibration).	8 hrs
5.	**Task Planning** Task level programming, Uncertainty, Configuration, Space, Gross motion, Planning, Grasp Planning, Fine-motion planning, Simulation of planar motion, Source and Goal scenes, Task Planner simulation.	8 hrs
6.	**Applications in Biomedical Engineering** Application in rehabilitation, Clinical and Surgery	8 hrs

Theory Examination:

1. Question paper will comprise of total 7 questions, each of 20 marks.
2. Only 5 questions need to be solved.
3. Q.1 will be compulsory and based on the entire syllabus.
4. Remaining questions will be mixed in nature.
5. In question paper weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

Practical & Oral Examination:

Oral exam will be based on entire subject.

Term work:

Term work consists of minimum eight assignments and a written test. The distribution of the term work shall be as follows,

Laboratory work (Assignments and Journal). :15 marks

Test (at least one) :10 marks

The final certification and acceptance of term-work ensures the satisfactory performance of laboratory work and minimum passing in the term-work.

Text Books:

1. Robert Schilling, Fundamentals of Robotics-Analysis and control, Prentice Hall of India.
2. Fu,Gonzales and Lee, Robotics, McGraw Hill
3. J.J,Craig,Introduction to Robotics, Pearson Education

References:

1. Staughard, Robotics and AI, Prentice Hall Of India.
2. Grover, Wiess, Nagel, Oderey, "Industrial Robotics", McGraw Hill.
3. Walfram Stdder, Robotics and Mechatronics.
4. Niku, Introduction to Robotics, Pearson Education.
5. Klafter, Chmielewski, Negin, Robot Engineering, Prentice Hall Of India.
6. Mittal, Nagrath, Robotics and Control, Tata McGraw Hill publications.