

**UNIVERSITY OF MUMBAI**

No. UG/ 46 of 2018-19

**CIRCULAR:-**

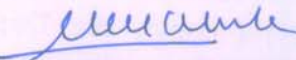
Attention of the Principals of the affiliated Colleges and Directors of the recognized Institutions in Science & Technology Faculty is invited to this office Circular No. UG/164 of 2017-18, dated 8<sup>th</sup> August, 2017 relating to syllabus of the Bachelor of Engineering (B.E.) degree course.

They are hereby informed that the recommendations made by the Board of Studies in Electrical Engineering at its meeting held on 9<sup>th</sup> April, 2018 have been accepted by the Academic Council at its meeting held on 5<sup>th</sup> May, 2018 **vide** item No. 4.57 and that in accordance therewith, the revised syllabus as per the (CBCS) for the T.E. and B.E. in Electrical Engineering (Bio-Medical Engineering) (Sem - V to VIII) has been brought into force with effect from the academic year 2018-19 and 2019-2020, accordingly. (The same is available on the University's website [www.mu.ac.in](http://www.mu.ac.in)).

MUMBAI – 400 032

25<sup>th</sup> June, 2018

To

  
(Dr. Dinesh Kamble)  
I/c REGISTRAR

The Principals of the affiliated Colleges & Directors of the recognized Institutions in Science & Technology Faculty. (Circular No. UG/334 of 2017-18 dated 9<sup>th</sup> January, 2018.)

**A.C/4.57/05/05/2018**

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No. UG/ 46 -A of 2018

MUMBAI-400 032

25<sup>th</sup> June, 2018

Copy forwarded with Compliments for information to:-

- 1) The I/c Dean, Faculty of Science & Technology,
- 2) The Chairman, Board of Studies in Electrical Engineering,
- 3) The Director, Board of Examinations and Evaluation,
- 4) The Director, Board of Students Development,
- 5) The Co-Ordinator, University Computerization Centre,

  
(Dr. Dinesh Kamble)  
I/c REGISTRAR

AC  
Item No.

**UNIVERSITY OF MUMBAI**



**Revised Syllabus for the  
TE Biomedical Engineering  
(Third Year - Semester V and VI)**

(As per Choice Based Credit and Grading System  
with effect from the academic year 2018–2019)

**Program Structure for  
TE Biomedical Engineering  
University of Mumbai  
(With effect from academic year 2018 - 19)**

**Scheme for Semester V**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
BMC501	Diagnostic & Therapeutic Instruments	04	----	----	04	----	----	04
BMC502	Analog and Digital Circuit Design	04	----	----	04	----	----	04
BMC503	Principles of Communication Engineering	04	----	----	04	----	----	04
BMC504	Biomedical Digital Signal Processing	04	----	----	04	----	----	04
BMDLO501X	Department Level Optional Course – I	04	----	----	04	----	----	04
BML501	Business Communication and Ethics	----	02*+02	----	----	02	----	02
BML502	Diagnostic and Therapeutic Instruments	----	02	----	----	01	----	01
BML503	Integrated and Communication Circuit Design	----	02	----	----	01	----	01
BML504	Biomedical Digital Signal Processing	----	02	----	----	01	----	01
BMDLL501X	Department Level Optional Course Laboratory – I	----	02	----	----	01	----	01
Total		20	12	----	20	06	----	26

**\*2 hrs theory shall be taught to the entire class.**

### Examination Scheme for Semester V

Course Code	Course Name	Examination Scheme												Total Marks
		Theory				Term work		Practical		Oral		Pract./Oral		
		External (UA)		Internal (CA)										
		Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	
BMC501	Diagnostic & Therapeutic Instruments	80	32	20	8	---	---	---	---	---	---	---	---	100
BMC502	Analog and Digital Circuit Design	80	32	20	8	---	---	---	---	---	---	---	---	100
BMC503	Principles of Communication Engineering	80	32	20	8	---	---	---	---	---	---	---	---	100
BMC504	Biomedical Digital Signal Processing	80	32	20	8	---	---	---	---	---	---	---	---	100
BMDLO 501X	Department Level Optional Course – I	80	32	20	8	---	---	---	---	---	---	---	---	100
BML501	Business Communication and Ethics	---	---	---	---	50	20	---	---	---	---	---	---	50
BML502	Diagnostic and Therapeutic Instruments	---	---	---	---	25	10	---	---	25	10	---	---	50
BML503	Integrated and Communication Circuit Design	---	---	---	---	25	10	25	10	---	---	---	---	50
BML504	Biomedical Digital Signal Processing	---	---	---	---	25	10	---	---	---	---	25	10	50
BMDLL 501X	Department Level Optional Course Laboratory – I	---	---	---	---	25	10	---	---	25	10	---	---	50
Total		400	160	100	40	150	60	25	10	50	20	25	10	750

## Scheme for Semester VI

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
BMC601	Biomedical Monitoring Equipment	04	----	----	04	----	----	04
BMC602	Microprocessors and Microcontrollers	04	----	----	04	----	----	04
BMC603	Digital Image Processing	04	----	----	04	----	----	04
BMC604	Medical Imaging-I	04	----	----	04	----	----	04
BMDLO602X	Department Level Optional Course – II	04	----	----	04	----	----	04
BML601	Biomedical Monitoring Equipment	----	02	----	----	01	----	01
BML602	Microprocessors and Microcontrollers	----	02	----	----	01	----	01
BML603	Digital Image Processing	----	02	----	----	01	----	01
BML604	Medical Imaging-I	----	02	----	----	01	----	01
BMDLL602X	Department Level Optional Course Laboratory – II	----	02	----	----	01	----	01
Total		20	10	----	20	05	----	25

### Examination Scheme for Semester VI

Course Code	Course Name	Examination Scheme												Total Marks
		Theory				Term work		Practical		Oral		Pract./Oral		
		External (UA)		Internal (CA)										
		Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	
BMC601	Biomedical Monitoring Equipment	80	32	20	8	---	---	---	---	---	---	---	---	100
BMC602	Microprocessors and Microcontrollers	80	32	20	8	---	---	---	---	---	---	---	---	100
BMC603	Digital Image Processing	80	32	20	8	---	---	---	---	---	---	---	---	100
BMC604	Medical Imaging-I	80	32	20	8	---	---	---	---	---	---	---	---	100
BMDLO 602X	Department Level Optional Course – II	80	32	20	8	---	---	---	---	---	---	---	---	100
BML601	Biomedical Monitoring Equipment	---	---	---	---	25	10	---	---	---	---	25	10	50
BML602	Microprocessors and Microcontrollers	---	---	---	---	25	10	---	---	---	---	25	10	50
BML603	Digital Image Processing	---	---	---	---	25	10	---	---	---	---	25	10	50
BML604	Medical Imaging-I	---	---	---	---	25	10	---	---	25	10	---	---	50
BMDLL 602X	Department Level Optional Course Laboratory – II	---	---	---	---	25	10	---	---	25	10	---	---	50
Total		400	160	100	40	125	50	---	---	50	20	75	30	750

**Department Level Optional Courses**

<b>Course Code</b>	<b>Department level Optional Course - I</b>
<b>BMDLO5011</b>	Healthcare Database Management
<b>BMDLO5012</b>	Biostatistics
<b>BMDLO5013</b>	Rehabilitation Engineering

<b>Course Code</b>	<b>Department level Optional Course - II</b>
<b>BMDLO6021</b>	Healthcare Software
<b>BMDLO6022</b>	Lasers and Fibre Optics
<b>BMDLO6023</b>	Biological Modelling and Simulation

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
<b>BMC501</b>	<b>Diagnostic and Therapeutic Instruments (Abbreviated as DTI)</b>	<b>04</b>	<b>--</b>	<b>--</b>	<b>04</b>	<b>--</b>	<b>--</b>	<b>04</b>

Course Code	Course Name	Examination Scheme									
		Theory					Term work	Pract.	Oral	Pract. / Oral	Total
		Internal Assessment			End sem	Duration (hrs)					
		Test 1	Test 2	Av g.							
<b>BMC501</b>	<b>Diagnostic and Therapeutic Instruments (DTI)</b>	<b>20</b>	<b>20</b>	<b>20</b>	<b>80</b>	<b>03</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>100</b>

Course Code	Course Name	Credits
<b>BMC501</b>	<b>Diagnostic and Therapeutic Instruments</b>	<b>04</b>
<b>Course Objective</b>	<ul style="list-style-type: none"> <li>To understand the basic principles and working of diagnostic and therapeutic equipment.</li> <li>To develop skills enabling Biomedical Engineers to serve the health care industry</li> <li>To develop core competency and skill in the field of Biomedical Engineering, to design and develop new health care systems.</li> </ul>	
<b>Course Outcome</b>	Learner will be able to... <ul style="list-style-type: none"> <li>Understand principles of various analytical instruments used in hospital laboratories.</li> <li>Demonstrate the knowledge about various blood cell counting systems and blood gas analyzers.</li> <li>Demonstrate the knowledge about various automated drug delivery systems.</li> <li>Understand the basic mechanism of ventilation and analysis of pulmonary functions and demonstrate the use of ventilation therapy.</li> <li>Understand the basic principle and applications of physiotherapy and electrotherapy techniques.</li> <li>Understand the basic principle and working of hemodialysis machine.</li> </ul>	



Module	Contents	Hours
1	<b>Analytical Instruments</b> 1. Colorimeter 2. Spectrophotometer 3. Auto Analyzer 4. Electrophoresis apparatus 5. Chromatography 6. Chromatography 7. ELISA concepts (direct and indirect), reader & washer.	12
2	<b>Blood cell counter and Blood Gas Analyzer</b> Blood cell counter (Coulter and Pico-scale) Blood gas analyzer principle, pH, pO <sub>2</sub> and pCO <sub>2</sub> Electrodes and complete block diagram of Blood gas analyzer.	6
3	<b>Automated drug delivery systems</b> Infusion pumps, components of drug infusion systems, syringe and peristaltic pumps, Implantable infusion system and insulin pumps.	4
4	<b>Pulmonary Function Analyzer</b> Respiration measurement technique: Lung volume and capacities, Spirometry, pneumotachometers, Pulmonary function measurement, measurement of volume <b>Ventilators</b> Artificial ventilation, ventilator terms and its types, modes of ventilators, classification of ventilators, pressure volume flow and time diagrams. Microprocessor controlled ventilator	16
5	<b>Physiotherapy equipments</b> <b>Basic principle, working and technical specifications of</b> 1. <b>Shortwave Diathermy</b> 2. <b>Ultrasonic therapy unit</b> 3. <b>Microwave therapy unit</b> 4. <b>Nerve and Muscle Stimulator.</b>	6
6	<b>Hemodialysis machine</b> Basic principle of Dialysis and its type. Different types of dialyzer membrane, Portable type. Various monitoring circuits.	4

#### Assessment:

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

#### Books Recommended:

##### Text books:

1. Handbook of Biomedical Instrumentation (Third edition): R S. Khandpur. (PH Pub)
2. Medical Instrumentation, Application and Design: J G. Webster. (John Wiley)
3. Biomedical Instrumentation and measurements : Leslie Cromwell, Fred J. Weibell, Enrich A. Pfeiffer. (PHI Pub)

*Reference books:*

1. Introduction to Biomedical Equipment Technology: Carr –Brown. (PH Pub)
2. Encyclopedia of Medical Devices and Instrumentation: J G. Webster. Vol I- IV (PH Pub)
3. Various Instruments Manuals.
4. Various internet websites.

**Theory Examination:**

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein sub-questions of marks will be asked.
4. Remaining questions will be randomly selected from all the modules.

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
BMC502	Analog and Digital Circuit Design (Abbreviated as ADCD)	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme									
		Theory					Term work	Pract.	Oral	Pract. / Oral	Total
		Internal Assessment			End sem	Duration (hrs)					
		Test 1	Test 2	Avg.							
BMC502	Analog and Digital Circuit Design (ADCD)	20	20	20	80	03	--	--	--	--	100

Course Code	Course Name	Credits
BMC502	Analog and Digital Circuit Design	04
<b>Course objective</b>	<p>Students will be able to:</p> <ul style="list-style-type: none"> <li>To understand and provide knowledge of various Analog And Digital Circuits Such as Timer IC 555, PLL IC, VCO, 723 voltage regulator .</li> <li>To understand different types of filters and design them for the given specifications.</li> <li>To understand, learn and analyze fundamentals of Electronics and Digital circuits.</li> <li>To develop analytical aptitude and to understand basic electronic concepts related to engineering profession.</li> <li>To develop competency in terms of logical thinking and application skills.</li> <li>To design and develop various circuits for biomedical applications and to develop logical thinking of students.</li> </ul>	
<b>Course Outcome</b>	<p>Learner will be able to:</p> <ul style="list-style-type: none"> <li>Understand various waveform generation IC's and their applications and use it in projects.</li> <li>Apply the knowledge of various special function IC's and special purpose diodes for designing.</li> <li>Design active filters and their application in biomedical field and electronic circuit design</li> <li>Understanding power devices like power diode, SCR, DIAC and TRIAC, UJT and power MOSFET's and their applications in industry</li> <li>Applying the knowledge of voltage regulators, power supplies, and switches.</li> <li>Understand different types of ac and dc motors and how to select them for project design.</li> </ul>	

Module	Contents	Hours
1.	<b>Waveform Generation IC's:</b> <ul style="list-style-type: none"> <li>• IC 555 Functional Block diagram, Circuit diagram.</li> <li>• IC 555 in Astable Multivibrator(AMV) functional diagram, circuit diagram with application</li> <li>• IC 555 in Monostable Multivibrator (MMV) functional diagram, circuit diagram with application</li> <li>• PLL ( IC 565 or equivalent) circuit diagram and applications</li> <li>• VCO(IC 566) Circuit diagram and applications</li> </ul> Function Generator (IC 8038 or equivalent) Circuit diagram and its applications	<b>12</b>
2.	<b>Special Function IC's and Special function diodes:</b> <ul style="list-style-type: none"> <li>• F-V convertors and V-F convertors: Circuit diagram and its applications</li> <li>• Instrumentation Amplifier (AD 624 /AD 620) Circuit diagram and its applications,</li> <li>• Monolithic Isolation Amplifier module</li> <li>• Opto-couplers and Opto-isolators</li> <li>• Diodes (LED, photodiode, varactor, schottky)</li> </ul> PWM (SG 3525 or equivalent) Circuit diagram and its applications	<b>06</b>
3.	<b>Active Filters:</b> <ul style="list-style-type: none"> <li>• Frequency response, design of first order (Notch, LP, HP, BP) filter and applications.</li> <li>• Frequency response, design of 2<sup>nd</sup> order (Chebyshev, Butterworth, Elliptical filters) LP, HP, BP, All pass, Notch, band reject</li> <li>• Capacitor filter, switched capacitor filter.</li> </ul> Generalized Impedance Convertor (GIC)	<b>08</b>
4.	<b>Power Devices and Circuits:</b> <ul style="list-style-type: none"> <li>• SCR's: Basic structure, characteristics, Two transistor and Operations. series and parallel connections of SCRs.</li> <li>• DIAC and TRIAC: Basic Structure and characteristics, applications</li> <li>• Power diode</li> <li>• UJT: Operation, characteristics, parameters and UJT as a relaxation oscillator</li> </ul> Power MOSFET : Device structure, equivalent circuit and characteristics	<b>06</b>
5.	<b>Voltage Controllers and Regulators :</b> <ul style="list-style-type: none"> <li>• Analog switches, Relays : Basic Types</li> <li>• Functional block diagram of Voltage Regulators</li> <li>• Types of voltage regulators: Fixed voltage regulators (78XX and 79XX), Adjustable voltage regulator LM317, linear voltage regulator IC 723, Design of low voltage regulator and high voltage regulator using 723.</li> </ul> Switching Mode Power Supply (SMPS)	<b>10</b>
6.	<b>Motors And Drivers :</b> Stepper, Servo, DC/AC Motors drivers and geared motors (Basic operation and application)	<b>06</b>

**Assessment:**

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

**Books Recommended:***Text books:*

1. Op-Amps and linear integrated circuits – R. Gayakwad
2. Design with operational amplifiers and analog integrated circuits. Sergio Franco,
3. Integrated Circuits K.R.Botkar.
4. Power Electronics, Ned Mohan.
5. Power Electronics, M.H.Rashid.
6. Power Electronics, M.D.Singh and K.B.Khanchandani,

*Reference Books:*

1. Integrated Electronics –Millman & Halkias
2. Linear Integrated Circuits: Roy Chaudhary
3. Opamps and linear integrated circuits, Theory and Applications- James Fiore.
4. Power Electronics, P.C.Sen.
5. Power Electronics, Dr.P.S.Bimbhra,

**Theory Examination:**

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein sub-questions of marks will be asked.
4. Remaining questions will be randomly selected from all the modules.

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
BMC503	Principles of Communication Engineering (Abbreviated as PCE)	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme									
		Theory					Term work	Pract.	Oral	Pract. / Oral	Total
		Internal Assessment			End sem	Duration (hrs)					
		Test 1	Test 2	Avg.							
BMC503	Principles of Communication Engineering (PCE)	20	20	20	80	03	--	--	--	--	100

Course Code	Course Name	Credits
BMC503	Principles of Communication Engineering	04
Course Objective	<ul style="list-style-type: none"> <li>To provide concepts, principles and techniques used in analog and digital communications.</li> <li>To cover a range of digital modulation techniques which are frequently used in modern communication systems.</li> </ul>	
Course Outcome	<p>Learner will be able to:</p> <ul style="list-style-type: none"> <li>Demonstrate concept of electronic communication system with effect of noise and modeling of noise</li> <li>Have in depth knowledge of amplitude modulation and be able to compare different types of AM transmitters with analysis</li> <li>Analyze efficiently different types of AM receivers with characteristics, merits and demerits</li> <li>Exhibit basic operation of FM transmitter and receiver with types, analysis, advantages and disadvantages</li> <li>Apply sampling theorem and quantization process in digitizing analog signal with different types of analog and digital pulse modulation</li> <li>Understand and compare different types of digital transmission techniques and multiplexing techniques</li> </ul>	

<b>Module</b>	<b>Contents</b>	<b>Time</b>
<b>1</b>	<b>Introduction to communication system and noise:</b> <ul style="list-style-type: none"> <li>• Elements of communication system, types of communication system</li> <li>• Noise definition, types, Signal to Noise ratio, Noise factor, Noise figure, Noise Temperature</li> </ul>	<b>04</b>
<b>2</b>	<b>Amplitude Modulation Transmission:</b> <ul style="list-style-type: none"> <li>• Definition, Mathematical analysis of AM wave, Different types of AM, Spectrum, Bandwidth,</li> <li>• AM transmitter: High and low level AM transmitter</li> <li>• Generation: DSBFC AM (Grid, plate and collector modulated AM generator, DSBSC AM (Ring and FET balanced modulator) and SSB AM (Filter, phase shift and Third method)</li> <li>• Introduction to ISB and VSB transmitter</li> </ul>	<b>10</b>
<b>3</b>	<b>Amplitude Modulation Receiver:</b> <ul style="list-style-type: none"> <li>• Receiver characteristics: sensitivity, selectivity, fidelity, double spotting, Image frequency and its rejection, dynamic range</li> <li>• Types: TRF receiver, superretrodyne receiver, double conversion receiver</li> <li>• AM detectors –Simple and Practical Diode detector, Principles and types of tracking and AGC, SSB detector</li> </ul>	<b>08</b>
<b>4</b>	<b>Frequency Modulation Transmission and Receivers :</b> <ul style="list-style-type: none"> <li>• Principles of FM waveform, spectrum, Bandwidth</li> <li>• FM generation: Direct and Indirect FM transmitter</li> <li>• Principles of AFC, Effect of noise in FM, Noise Triangle, Pre-emphasis and De-emphasis</li> <li>• FM Receivers: Block diagram</li> <li>• Types: Simple Slope detector, Balanced slope detector, Foster Seeley discriminator, Ratio detector, Quadrature detector</li> <li>• Capture effect in FM receivers, Difference between AM and FM system</li> </ul>	<b>10</b>
<b>5</b>	<b>Analog and Digital Pulse Modulation Techniques :</b> <ul style="list-style-type: none"> <li>• Sampling Theorem for low pass signals and band pass signals, Proof of Sampling theorem, Concept of Aliasing, Quantization, Companding,</li> <li>• Analog modulation techniques: PAM, PWM,PPM – Generation, Detection, Advantages, disadvantages</li> <li>• Digital pulse modulation techniques: PCM, DPCM, DM and ADM– Generation, Detection, Advantages, disadvantages</li> </ul>	<b>08</b>
<b>6</b>	<b>Digital Transmission Techniques and Multiplexing :</b> <ul style="list-style-type: none"> <li>• Digital transmission types: ASK, FSK, PSK - Generation, Detection, Advantages Disadvantages</li> <li>• Multiplexing techniques: Concept of multiplexing, FDM, TDM, Hierarchy, Applications, Advantages Disadvantages</li> </ul>	<b>08</b>

### Assessment:

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

**Books Recommended:***Text books:*

1. Electronic communication system – Wayne Tomasi, Pearson Education
2. Electronic communication system – Roy Blake, Thomson Learning
3. Electronic communication system - Kennedy and Devis, TMH

*Reference Books:*

1. Digital and Analog communication system – Leon W Couch, Pearson Education
2. Principles of communication system – Taub and Schilling ,TMH

**Theory Examination:**

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein sub-questions of marks will be asked.
4. Remaining questions will be randomly selected from all the modules.



Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
<b>BMC504</b>	<b>Biomedical Digital Signal Processing (Abbreviated as BDSP)</b>	<b>04</b>	<b>--</b>	<b>--</b>	<b>04</b>	<b>--</b>	<b>--</b>	<b>04</b>

Course Code	Course Name	Examination Scheme									
		Theory					Term work	Pract.	Oral	Pract. / Oral	Total
		Internal Assessment			End sem	Duration (hrs)					
		Test 1	Test 2	Avg.							
<b>BMC504</b>	<b>Biomedical Digital Signal Processing (BDSP)</b>	<b>20</b>	<b>20</b>	<b>20</b>	<b>80</b>	<b>03</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>100</b>

Course Code	Course Name	Credits
<b>BMC504</b>	<b>Biomedical Digital Signal Processing</b>	<b>04</b>
<b>Course Objective</b>	<ul style="list-style-type: none"> <li>To build a strong base for developing algorithms for signal processing systems and Imaging systems.</li> <li>To develop competency in terms of logical thinking, programming and application skills.</li> <li>To train and motivate students for pursuing higher education and research for developing cutting edge technologies.</li> </ul>	
<b>Course Outcome</b>	Learner will be able to, <ul style="list-style-type: none"> <li>Understand the fundamental techniques and applications of digital signal Processing with emphasis on biomedical signals.</li> <li>2. Implement algorithms based on discrete time signals.</li> <li>3. Understand Circular and linear convolution and their implementation using DFT</li> <li>4. Understand efficient computation techniques such as DIT and DIF FFT algorithms</li> <li>5. Design FIR filters using window method, digital IIR filters by designing prototype analog filters and then applying analog to digital conversion.</li> </ul>	

<b>Module</b>	<b>Contents</b>	<b>Hours</b>
<b>1.</b>	Basic Elements of DSP, Discrete time signals and systems, DTFT, Z Transform(ZT) – Properties of ZT , Inverse ZT, solution of LCCDE with initial conditions – zero input response and zero state response -basic concept of BIBO stability, Application of ZT and IZT	<b>08</b>
<b>2.</b>	Introduction to DFT-Properties of DFT	<b>08</b>
<b>3.</b>	Introduction DIT and DIF FFT algorithms. Use of FFT in linear filtering,	<b>07</b>
<b>4.</b>	Review of Design of analog Butterworth and Chebyshev Filters, Frequency transformation in analog domain, Design of IIR Digital Filters using Impulse invariance method-Design of digital Filters using Bilinear transformation	<b>11</b>
<b>5.</b>	Structure of FIR filters-Linear phase filters –Filter design using window technique-Frequency sampling techniques . Realisation of FIR &IIR filters Direct ,cascade and parallel forms	<b>10</b>
<b>6.</b>	Introduction to Digital signal Processors–Architecture –Features-addressing formats –functional mode-introduction to commercial Processors. Application of DSP in Biomedical Applications	<b>04</b>

**Assessment:**

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

**Books Recommended:***Text books:*

1. Digital signal processing Principles Algorithms and Application –Proakis &Manolakis –Third edition PHI
2. Digital Signal Processing –Sanjit K. Mithra Tata Mc-graw Hill
3. Digital Signal Processing – S. Salivahanan, C.Gnanapriya, 2/ed Tata McGraw Hill

*Reference Books:*

1. Digital signal processing – A.V. Oppenheim and R.W.Schafer- PHI
2. Understanding Digital Signal Processing –Richard G. Lyons-3/ed Pearson Publication

**Theory Examination:**

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein sub-questions of marks will be asked.
4. Remaining questions will be randomly selected from all the modules.

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
BMDLO 5011	Department Level Optional Course – I Healthcare Database Management (Abbreviated as HCDM)	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme									
		Theory					Term work	Pract.	Oral	Pract. / Oral	Total
		Internal Assessment			End sem	Duration (hrs)					
		Test 1	Test 2	Avg.							
BMDLO 5011	Department Level Optional Course – I Healthcare Database Management (HCDM)	20	20	20	80	03	--	--	--	--	100

Course Code	Course Name	Credits
BMDLO5011	Healthcare Database Management	04
<b>Course Objective</b>	<ul style="list-style-type: none"> <li>Learn and practice data modelling using the entity-relationship and developing database designs.</li> <li>Understand the use of Structured Query Language (SQL) and learn SQL syntax.</li> <li>To create, display, validate and search XML files</li> <li>To create windows applications using standard .NET controls.</li> <li>To acquire knowledge of client side scripting language thereby to reduce the load on server and minimize the response time.</li> <li>To create, validate and display web data.</li> </ul>	
<b>Course Outcome</b>	<p>Learner will be able to,</p> <ul style="list-style-type: none"> <li>Design data models and schemas in DBMS and apply the features of database management systems and Relational database.</li> <li>Construct tables and retrieve data from the database by using SQL- the standard language of relational databases.</li> <li>Implement client side scripting and validation.</li> <li>Create XML documents using XML schema and XSL elements.</li> </ul>	

	<ul style="list-style-type: none"> <li>• Using operators, variables, and control structures in JavaScript</li> <li>• Designing of windows applications using VB.NET</li> </ul>
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Module	Contents	Hours
1	<b>Introduction Database Concepts and Entity Relationship Data Model:</b> Introduction, Characteristics of databases, File system V/s Database system, DBMS system architecture, Database Administrator, Types of Models, Phases of Database Modelling, The Entity-Relationship (ER) Model, Generalization, specialization	05
2	<b>Structured Query Language (SQL) :</b> Overview of SQL , Data Definition Commands, Set operations , aggregate function , null values, , Data Manipulation commands, Data Control commands , Views in SQL, Nested and complex queries	10
3	<b>Transactions Management and Concurrency:</b> Transaction concept, Transaction states, ACID properties	06
4	<b>JavaScript</b> Introduction, Variables and its Scope, Comments, Operators (Arithmetic and Assignment), Data Types, JavaScript language constructs (if, if-else, while, do-while, for, switch), Functions, Objects (Properties, Methods and Events), Built-in Objects (Array, Number, Date, Math, String, RegEx), Browser Objects (Window, Document, Location, History, Cookies) DOM (Document Object Model), Manipulation, Form Validation	08
5	<b>Web Extensions:</b> XML Documents, XML Elements, Attributes XML Schema, Namespaces , Style Sheets, XPath, Introduction to X-Query	08
6	<b>Programming with VB.Net :</b> Variables, Comments, Constants, Keywords, DataTypes, Conditional Statements, Select Case Statement, Loops (For Loop, while Loop, do Loop, For Each Loop), Arrays, Option Explicit, Option Strict, Standard Controls - Windows Application	11

**Assessment:**

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

**Books Recommended:***Text books:*

1. G. K. Gupta :”Database Management Systems”, McGraw – Hill.
2. Korth, Sliberchatz,Sudarshan, :”Database System Concepts”, 6th Edition, McGraw – Hill
3. Elmasri and Navathe, “ Fundamentals of Database Systems”, 5thEdition, PEARSON Education.
4. Peter Rob and Carlos Coronel, “ Database Systems Design, Implementation and Management”, Thomson Learning, 5th Edition
5. Crockford, Douglas, “JavaScript: The Good Parts”, Shroff
6. Heather Williamson, “XML: The Complete Reference”, McGraw Hill Education

7. Imar Spaanjaars, "Beginning ASP.NET 4.5.1 in C# and VB", Wiley

*Reference Books:*

1. Dr. P.S. Deshpande, SQL and PL/SQL for Oracle 10g, Black Book, Dreamtech Press
2. Mark L. Gillenson, Paulraj Ponniah, "Introduction to Database Management", Wiley
3. Sharaman Shah, "Oracle for Professional", SPD.
4. Raghu Ramkrishnan and Johannes Gehrke, "Database Management Systems", TMH
5. Debabrata Sahoo "Database Management Systems" Tata McGraw Hill, Schaum's Outline

**Theory Examination:**

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein sub-questions of marks will be asked.
4. Remaining questions will be randomly selected from all the modules.

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
BMDLO 5012	Department Level Optional Course – I Biostatistics (Abbreviated as BIOSTATS)	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme									
		Theory					Term work	Pract.	Oral	Pract. / Oral	Total
		Internal Assessment			End sem	Duration (hrs)					
		Test 1	Test 2	Avg.							
BMDLO 5012	Department Level Optional Course – I Biostatistics (BIOSTATS)	20	20	20	80	03	--	--	--	--	100

Course Code	Course Name	Credits
BMDLO5012	BIOSTATISTICS	04
Course Objective	<ul style="list-style-type: none"> <li>To cover basic concepts and theory related to statistics.</li> <li>To focus on various statistical abilities such as analysis of variance, hypothesis testing, estimation, etc.</li> </ul>	
Course Outcome	A learner will be able to <ul style="list-style-type: none"> <li>Apply statistical methods to sample data and analyse it.</li> <li>Develop a strong foundation for designing algorithms for computation.</li> </ul>	

Module	Contents	Hours
1.	Descriptive statistics and probability Frequency distribution, Measures of central tendency, Measures of dispersion Basic probability and Bayes theorem.	04
2.	Probability and Sampling Distributions Discrete probability distributions Continuous probability distributions - Binomial, poisson and normal distributions Sampling distributions – sample mean, difference between two sample means, sample proportions, difference between two sample proportions	10
3.	Estimation t- distribution Confidence intervals for - population mean, difference between two population means, population proportion, difference between two population proportions, variance of normally	07

	distributed population, ratio of variances of two normally distributed populations Determination of sample size for estimating mean and proportions	
4.	Hypothesis testing Hypothesis testing for – Population mean, difference between two population means, population proportions, difference between two population proportions, population variance, ratio of two population variances Type – I and II error and power of test	07
5.	Analysis of variance Completely randomized design, Randomized complete block design, repeated measures design, factorial experiment. Regression and Correlation Simple linear regression, correlation model, correlation coefficient, multiple regression, multiple correlation	13
6.	Chi square distribution and analysis of frequency Chi-square distribution – properties Test of goodness of fit, independence and homogeneity	07

**Assessment:**

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

**Books Recommended:***Text books:*

1. Biostatistics – A foundation for analysis in health sciences by Wayne W. Daniel, Seventh edition, Wiley India
2. Fundamentals of mathematical statistics by S. C. Gupta and V. K. Kapoor, second edition, Sultan Chand Publisher
3. Probability and statistics for engineers by J. Ravichandran, Wiley /india

*Reference Books:*

1. Biostatistics – How it works by Steve selvin, Pearson education
2. An Introduction to Biostatistics by Sunder Rao and J. Richard, Third Edition, Prentice Hall of India
3. Probability and Statistics by Schaum's series

**Theory Examination:**

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein sub-questions of marks will be asked.
4. Remaining questions will be randomly selected from all the modules.

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
BMDLO 5013	Department Level Optional Course – I Rehabilitation Engineering (Abbreviated as RE)	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme									
		Theory					Term work	Pract.	Oral	Pract. / Oral	Total
		Internal Assessment			End sem	Duration (hrs)					
Test 1	Test 2	Avg.									
BMDLO 5013	Department Level Optional Course – I Rehabilitation Engineering (RE)	20	20	20	80	03	--	--	--	--	100

Course Code	Course Code	Credits
BMDLO5013	Rehabilitation Engineering	04
<b>Course Objectives</b>	To introduce learners to basics of Kinetics and Kinematics, Flow properties of blood and give overview of Rehabilitation Engineering.	
<b>Course Outcomes</b>	A learner will be able to Build foundation for learners enabling the learners to pursue higher studies with specialization in Rehabilitation Engineering.	

Module	Contents	Hours
1.	<b>Introduction and socio-legal aspects of Rehabilitation Engineering:</b> Medical Rehabilitation, Epidemiology of Rehabilitation, preventive Rehabilitation, Impairment Disability and Handicap. Delivery of Rehabilitation Care: The team-Medical, Paramedical , Socio-vocational	06
2.	<b>Orthotics, Amputation, and Prosthetics, Activities of Daily Living (ADL):</b> Orthotics: General Principles of Orthotics, Biomechanics of orthotics, Classification: Upper & Lower Extremity orthotics, spinal Orthotics Amputation & Prosthetics: Causes of Amputation, Types of Amputation, and Levels of Amputation for upper and lower Extremity. Preoperative and post-operative period. Pre-prosthetic stage. Endo & Exo-skeletal Prosthetics. Classification: Upper & lower limb Prosthetics Activities of Daily Living: ADL grouping, Barthel's Index of ADL. Functional	13



	Independence, Measures, Environmental control system, communication, ADL training.	
3.	<b>Mechanical principles of Kinematics and Kinetics:</b> Planar classification of position and motion, Rotary and translatory motion, Degree of freedom, Kinematic Chain Theories of motion, Levers, Torque, Parallel force, Resolution of force, Calculation of muscle and joint forces Clinical application on weight and center of gravity ,applied weights and resistance, muscle force and leverage, joint forces, Clinical application on stretching versus joint mobilization	08
4.	<b>Flow properties of blood:</b> An outline of Blood Rheology, Constitutive equation of blood based viscometric Data and Casson's equation, laminar flow of blood in a tube, fluid mechanical interaction of RBCs with a solid wall, thrombus formation and dissolution, medical application of Blood Rheology	08
5.	<b>Common deformities and role of surgery in rehabilitation engineering.</b> Types of deformities, Management of 1 <sup>st</sup> and 2 <sup>nd</sup> degree deformities. Common deformities of lower limb. Treatment for partial foot deformities. Deformities of the foot. Arm deformities. Torticollis	05
6.	<b>An overview of rehabilitation of muscular dystrophy, paraplegia, and quadriplegia:</b> Muscular Dystrophy, Duchenne Muscular Dystrophy, Rehabilitation, facioscapulohumeral Muscular Dystrophy Paraplegia: Etiology, mechanism of injury, Identification of level of lesion, Management of active spinal cord injury, Rehabilitation, Gait training Quadriplegia: Mobility, Training, Level of injury & outcome, Management	08

**Assessment:**

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

**Books Recommended:***Text books:*

1. BRUNNSTROM'S CLINICAL KINESIOLOG, By Laura K Smith, Elizabeth Laurance Weiss; Jaypee brothers Publication
2. Mechanical properties of living tissues by Y. C. Fung

*Reference Books:*

1. Textbook of Rehabilitation by S. Sundar,3rd edition Jaypee publication

**Theory Examination:**

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein sub-questions of marks will be asked.
4. Remaining questions will be randomly selected from all the modules.

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
BML501	Business Communication and Ethics (Abbreviated as BCE)	--	04	--	--	02	--	02

Course Code	Course Name	Examination Scheme								
		Theory				Term work	Pract.	Oral	Pract. / Oral	Total
		Internal Assessment			End sem					
		Test 1	Test 2	Avg.						
BML501	Business Communication and Ethics (BCE)	--	--	--	--	50	--	--	--	50

Course Code	Course Name	Credits
BMC501	Business Communication and Ethics	02
<b>Course Objective</b>	1. To inculcate professional and ethical attitude at the workplace. 2. To enhance effective communication and interpersonal skills. 3. To build multidisciplinary approach towards all life tasks. 4. To hone analytical and logical skills for problem-solving.	
<b>Course Outcome</b>	A learner will be able to 1. Design a technical document using precise language, suitable vocabulary and apt style. 2. Develop the life skills/ interpersonal skills to progress professionally by building stronger relationships. 3. Demonstrate awareness of contemporary issues knowledge of professional and ethical responsibilities. 4. Apply the traits of a suitable candidate for a job/higher education, upon being trained in the techniques of holding a group discussion, facing interviews and writing resume/SOP. 5. Deliver formal presentations effectively implementing the verbal and non-verbal skills.	

<b>Module</b>	<b>Detailed Contents</b>	<b>Hrs.</b>
<b>01</b>	<b>Report Writing</b>	<b>05</b>
1.1	Objectives of Report Writing	
1.2	Language and Style in a report	
1.3	Types : Informative and Interpretative (Analytical, Survey and Feasibility)and Formats of reports (Memo, Letter, Short and Long Report )	
<b>02</b>	<b>Technical Writing</b>	<b>03</b>

2.1	Technical Paper Writing (IEEE Format)	
2.2	Proposal Writing	
<b>03</b>	<b>Introduction to Interpersonal Skills</b>	<b>09</b>
3.1	Emotional Intelligence	
3.2	Leadership and Motivation	
3.3	Team Building	
3.4	Assertiveness	
3.5	Conflict Resolution and Negotiation Skills	
3.6	Time Management	
3.7	Decision Making	
<b>04</b>	<b>Meetings and Documentation</b>	<b>02</b>
4.1	Strategies for conducting effective meetings	
4.2	Notice, Agenda and Minutes of a meeting	
4.3	Business meeting etiquettes	
<b>05</b>	<b>Introduction to Corporate Ethics</b>	<b>02</b>
5.1	Professional and work ethics (responsible use of social media - Facebook, WA, Twitter etc.)	
5.2	Introduction to Intellectual Property Rights	
5.4	Ethical codes of conduct in business and corporate activities (Personal ethics, conflicting values, choosing a moral response and making ethical decisions)	
<b>06</b>	<b>Employment Skills</b>	<b>07</b>
6.1	Group Discussion	
6.2	Resume Writing	
6.3	Interview Skills	
6.4	Presentation Skills	
6.5	Statement of Purpose	
		28

**List of Assignments:**

1. Report Writing (Theory)
2. Technical Proposal
3. Technical Paper Writing (Paraphrasing a published IEEE Technical Paper )
4. Interpersonal Skills (Group activities and Role plays)
5. Interpersonal Skills (Documentation in the form of soft copy or hard copy)
6. Meetings and Documentation (Notice, Agenda, Minutes of Mock Meetings)
7. Corporate ethics (Case studies, Role plays)
8. Writing Resume and Statement of Purpose

**Term Work:**

Term work shall consist of all assignments from the list. The distribution of marks for term work shall be as follows:

Book Report.....(10) Marks

Assignments .....	(10) Marks
Project Report Presentation.....	(15) Marks
Group Discussion.....	(10) Marks
Attendance .....	(05) Marks
<b>TOTAL: .....</b>	<b>(50) Marks</b>

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

#### References

1. Fred Luthans, “*Organizational Behavior*”, McGraw Hill, edition
2. Lesiker and Petit, “*Report Writing for Business*”, McGraw Hill, edition
3. Huckin and Olsen, “*Technical Writing and Professional Communication*”, McGraw Hill
4. Wallace and Masters, “*Personal Development for Life and Work*”, Thomson Learning, 12th edition
5. Heta Murphy, “*Effective Business Communication*”, Mc Graw Hill, edition
6. Sharma R.C. and Krishna Mohan, “*Business Correspondence and Report Writing*”, Tata McGraw-Hill Education
7. Ghosh, B. N., “*Managing Soft Skills for Personality Development*”, Tata McGraw Hill. Lehman,
8. Dufrene, Sinha, “BCOM”, Cengage Learning, 2<sup>nd</sup> edition
9. Bell, Smith, “Management Communication” Wiley India Edition, 3<sup>rd</sup> edition.
10. Dr. Alex, K., ”Soft Skills”, S Chand and Company
- 11 Subramaniam, R., “Professional Ethics” Oxford University Press.
12. Robbins Stephens P., “Organizational Behavior”, Pearson Education
13. <https://grad.ucla.edu/asis/agep/advsopstem.pdf>

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
BML502	Diagnostic and Therapeutic Instruments (DTI)	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme									
		Theory				End sem	Term work	Pract.	Oral	Pract. / Oral	Total
		Internal Assessment									
		Test 1	Test 2	Avg.							
BML502	Diagnostic and Therapeutic Instruments (DTI)	--	--	--	--	25	--	25	--	50	

Course Code	Course Name	Credits
BML502	Diagnostic & Therapeutic Instrumentation	01
<b>Course Objective</b>	<ul style="list-style-type: none"> <li>To demonstrate the application technique of diagnostic and therapeutic equipment.</li> <li>To implement the basic circuits used in diagnostic and therapeutic equipment.</li> </ul>	
<b>Course Outcome</b>	<p><b>Learner will be able to...</b></p> <ul style="list-style-type: none"> <li>Appreciate the importance of wavelength selection for measurement of various ions present in the sample.</li> <li>Understand principles of various analytical instruments used in hospital laboratories.</li> <li>Design and Implement power supply of regulated v</li> <li>Understand the basic principle and applications of physiotherapy and electrotherapy techniques.</li> <li>Compare the applications of various types of physiotherapy equipments.</li> <li>Understand the basic principle and working of hemodialysis machine.</li> </ul>	

**Syllabus: Same as that of BMC501 Diagnostic and Therapeutic Instruments.**

**List of Experiments: (Any Seven)**

1. Selection of wavelength for Colorimeter and spectrophotometer
2. Find out the concentration of unknown sample using colorimeter and spectrophotometer.
3. Design and Implementation of 6V , 1 Amp regulated power supply
4. Design and Implementation of temperature controller circuit for hemodialysis machine.
5. Demonstration of shortwave diathermy.
6. Demonstration of ultrasonic diathermy.
7. Demonstration of nerve and muscle stimulator.
8. Industry / Hospital visit to be conducted.

Any other experiment based on syllabus which will help learner to understand topic/concept.

Group Presentation on the latest technology in hospitals based on the topics covered in the syllabus.

**Assessment:**

***Term Work:***

Term work shall consist of minimum 7 experiments.

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments) : 10 Marks

Laboratory work (Journal) : 05 Marks

Presentation : 05 Marks

Attendance : 05 Marks

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

**Books Recommended:**

*Text books:*

1. Handbook of Biomedical Instrumentation (Third edition): R S. Khandpur. (PH Pub)
2. Medical Instrumentation, Application and Design: J G. Webster. (John Wiley)
3. Biomedical Instrumentation and measurements : Leslie Cromwell, Fred J. Weibell, Enrich A. Pfeiffer. (PHI Pub)

*Reference books:*

1. Introduction to Biomedical Equipment Technology: Carr –Brown. (PH Pub)
2. Encyclopedia of Medical Devices and Instrumentation: J G. Webster. Vol I- IV (PH Pub)
3. Various Instruments Manuals.
4. Various internet websites

**Oral examination will be based on suggested practical list and entire syllabus.**

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
BML503	Integrated and Communication Circuit Design (ICCD)	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme								
		Theory				Term work	Pract.	Oral	Pract. / Oral	Total
		Internal Assessment			End sem					
		Test 1	Test 2	Avg.						
BML503	Integrated and Communication Circuit Design (ICCD)	--	--	--	--	25	25	--	--	50

Course Code	Course Name	Credits
BMC503	Integrated and Communication Circuit Design	01
Course Objective	<ul style="list-style-type: none"> <li>To understand, analyze and design integrated circuits.</li> <li>To analyze various analog modulation techniques.</li> </ul>	
Course Outcome	Learner will be able to, <ul style="list-style-type: none"> <li>Apply the knowledge of various special function IC's, filters, power devices, voltage regulators and motors for designing.</li> <li>Implement and design various analog modulator and demodulator circuits.</li> </ul>	

**Syllabus: Same as that of BMC502 Analog and Digital Circuit Design (ADCD) and BMC503 Principles of Communication Engineering (PCE).**

**Suggested Experiments for Integrated Circuit Design (ICD): (Any four)**

1. Design AMV and MMV and their applications.
2. To design a voltage regulator.
3. Function Generator IC 8038
4. VCO and PLL ICs and their applications.
5. Design for Band pass /Band reject
6. Design of Notch filter / Twin T filter
7. Design of Low Pass Filter/ High pas Filter
8. Experiments on SCR/DIAC/TRIAC/UJT relaxation oscillator.



**Suggested Experiments for Communication Circuit Design (CCD): (Any four)**

1. DSB-SC, DSB-FC, SSB AM generation and detection
2. FM generation and detection
3. Pre-emphasis and De-emphasis
4. Sampling and reconstruction
5. PAM generation and detection
6. PWM generation and detection
7. PPM generation and detection
8. Time/Frequency division multiplexing

**Assessment:****Term Work:**

Term work consists of minimum eight experiments based on the syllabus (four experiments on “Integrated Circuit Design” and four experiments on “Communication Circuit Design”).

The distribution of the term work shall be as follows:

Laboratory work (Experiments and Journal on ICD) : 10 marks

Laboratory work (Experiments and Journal on CCD) : 10 marks

Attendance : 05 marks

The final certification and acceptance of term-work ensures the satisfactory performance of laboratory work and completion of journal. Term work assessment must be based on the overall performance of the learner.

**Books Recommended:***Text books:*

1. Op-Amps and linear integrated circuits – R. Gayakwad
2. Linear Integrated Circuits: Roy Chaudhary
3. Design with operational amplifiers and analog integrated circuits. Sergio Franco,
4. Integrated Circuits K.R.Botkar.
5. Power Electronics, Ned Mohan.
6. Power Electronics, M.H.Rashid.
7. Power Electronics, M.D.Singh and K.B.Khanchandani,
8. Electronic communication system – Wayne Tomasi, Pearson Education
9. Electronic communication system – Roy Blake, Thomson Learning
10. Electronic communication system - Kennedy and Devis, TMH

*Reference Books:*

1. Integrated Electronics –Millman & Halkias
2. Opamps and linear integrated circuits, Theory and Applications- James Fiore.
3. Power Electronics, P.C.Sen.
4. Power Electronics, Dr.P.S.Bimbhra,
5. Digital and Analog communication system – Leon W Couch, Pearson Education
6. Principles of communication system – Taub and Schilling ,TMH

**Practical examination will be based on suggested practical list.**

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
BML504	Biomedical Digital Signal Processing (BDSP)	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme								
		Theory				Term work	Pract.	Oral	Pract. / Oral	Total
		Internal Assessment			End sem					
		Test 1	Test 2	Avg.						
BML504	Biomedical Digital Signal Processing (BDSP)	--	--	--	--	25	--	--	25	50

Course Code	Course Name	Credits
BML504	Biomedical Digital Signal Processing	01
<b>Course Objective</b>	<ul style="list-style-type: none"> <li>To build a strong base for developing algorithms for signal processing systems and Imaging systems.</li> <li>To develop competency in terms of logical thinking, programming and application skills.</li> <li>To train and motivate students for pursuing higher education and research for developing cutting edge technologies.</li> </ul>	
<b>Course Outcome</b>	<p>Learner will be able to,</p> <ul style="list-style-type: none"> <li>Understand the fundamental techniques and applications of digital signal processing with emphasis on biomedical signals.</li> <li>Implement algorithms based on discrete time signals.</li> <li>Understand Circular and linear convolution and their implementation using DFT</li> <li>Understand efficient computation techniques such as DIT and DIF FFT algorithms</li> <li>Design FIR filters using window method, digital IIR filters by designing prototype analog filters and then applying analog to digital conversion.</li> </ul>	

**Syllabus: Same as that of BMC504 Biomedical Digital Signal Processing (BDSP)**

**Suggested Experiments: (Any Seven)**

1. Basics of Programming
2. Simulations of standard signals
3. Operations on Signals
4. Concept of Aliasing
5. Linear convolution circular convolution
6. Sampling Theorem
7. Z-Transform
8. Discrete Fourier Transform(DFT )
9. Fast Fourier Transform (FFT)
10. Design and simulation of FIR filter
11. IIR filters using Butterworth approximation
12. IIR filter using Chebyshev approximation

**Assessment:*****Term Work:***

Term work shall consist of minimum 7 experiments.

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments) : 10 Marks

Laboratory work (Journal) : 10 Marks

Attendance : 5 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. Digital signal processing Principles Algorithms and Application –Proakis &Manolakis –Third edition PHI
2. Digital Signal Processing –Sanjit K. Mithra Tata Mc-graw Hill
3. Digital Signal Processing – S. Salivahanan, C.Gnanapriya, 2/ed Tata McGraw Hill

**Reference Books:**

1. Digital signal processing – A.V. Oppenheim and R.W.Schafer- PHI
2. Understanding Digital Signal Processing –Richard G. Lyons-3/ed Pearson Publication

**Practical and oral examination will be based on suggested practical list and entire syllabus.**

Course Code	Course Name	Teaching scheme			Credits assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
BMDLL 5011	Department Level Optional Course – I Healthcare Database Management (Abbreviated HCDM)	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme								
		Theory				Term work	Pract.	Oral	Pract. / Oral	Total
		Internal Assessment			End sem					
		Test 1	Test 2	Avg.						
BMDLL 5011	Department Level Optional Course – I Healthcare Database Management (HCDM)	--	--	--	--	25	--	25	--	50

Course Code	Course Name	Credits
BMDLL5011	Healthcare Database Management	01
<b>Course Objective</b>	<ul style="list-style-type: none"> <li>Learn and practice data modelling using the entity-relationship and developing database designs.</li> <li>Understand the use of Structured Query Language (SQL) and learn SQL syntax.</li> <li>To create, display, validate and search XML files</li> <li>To create windows applications using standard .NET controls.</li> <li>To acquire knowledge of client side scripting language thereby to reduce the load on server and minimize the response time.</li> <li>To create, validate and display web data.</li> </ul>	
<b>Course Outcome</b>	<p>Learner will be able to,</p> <ul style="list-style-type: none"> <li>Design data models and schemas in DBMS and apply the features of database management systems and Relational database.</li> <li>Construct tables and retrieve data from the database by using SQL- the standard language of relational databases.</li> <li>Implement client side scripting and validation.</li> <li>Create XML documents using XML schema and XSL elements.</li> <li>Using operators, variables, and control structures in JavaScript</li> <li>Designing of windows applications using VB.NET</li> </ul>	

## **Syllabus: Same as that of BMDLO5011 Healthcare Database Management**

### **List of Experiments:**

1. To draw an ER diagram for a selected case study
2. Study of Basic SQL commands
3. Accessing & Modifying Data in Oracle
4. To study and implement Joins and Views
5. To study and implement Subqueries
6. Develop a simple calculator application in VB.Net using standard controls
7. Develop a console based application to demonstrate use of either conditional statements or loops
8. Create XML document, Schema and Validate it
9. X-Path

Any other experiment/tutorial/Assignment based on syllabus which will help learner to understand topic/concept.

### **Assessment:**

#### ***Term Work:***

Term work shall consist of minimum 7 experiments.

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments) : 10 Marks

Laboratory work (Journal) : 10 Marks

Attendance : 5 Marks

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

### **Books Recommended:**

#### *Text books:*

1. G. K. Gupta : "Database Management Systems", McGraw – Hill.
2. Korth, Silberchatz, Sudarshan, : "Database System Concepts", 6th Edition, McGraw – Hill
3. Elmasri and Navathe, " Fundamentals of Database Systems", 5th Edition, PEARSON Education.
4. Peter Rob and Carlos Coronel, " Database Systems Design, Implementation and Management", Thomson Learning, 5th Edition
5. Crockford, Douglas, "JavaScript: The Good Parts", Shroff
6. Heather Williamson, "XML: The Complete Reference", McGraw Hill Education
7. Imar Spaanjaars, "Beginning ASP.NET 4.5.1 in C# and VB", Wiley

#### *Reference Books:*

1. Dr. P.S. Deshpande, SQL and PL/SQL for Oracle 10g, Black Book, Dreamtech Press
2. Mark L. Gillenson, Paulraj Ponniah, " Introduction to Database Management", Wiley
3. Sharaman Shah, "Oracle for Professional", SPD.
4. Raghu Ramkrishnan and Johannes Gehrke, " Database Management Systems", TMH
5. Debabrata Sahoo "Database Management Systems" Tata McGraw Hill, Schaum's Outline

**Oral examination will be based on suggested practical list and entire syllabus.**

Course Code	Course Name	Teaching scheme			Credits assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
BMDLL 5012	Department Level Optional Course – I Biostatistics (BIOSTATS)	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme								
		Theory				Term work	Pract.	Oral	Pract. / Oral	Total
		Internal Assessment			End sem					
		Test 1	Test 2	Avg.						
BMDLL 5012	Department Level Optional Course – I Biostatistics (BIOSTATS)	--	--	--	--	25	--	25	--	50

Course Code	Course Name	Credits
BMDLL5012	Biostatistics	01
<b>Course Objective</b>	<ul style="list-style-type: none"> <li>To conduct statistical analysis using Statistical tools.</li> </ul>	
<b>Course Outcome</b>	Learner will be able to <ul style="list-style-type: none"> <li>Apply statistical methods to sample data and analyse it using statistical tools.</li> </ul>	

**Syllabus: Same as that of BMDLO 5012 Biostatistics (BIOSTATS)**

**Laboratory experiments may be conducted using SCILAB or any other statistical Software**

**List of Laboratory Experiments: (Any Seven)**

1. Descriptive statistics and probability
2. Discrete probability distributions
3. Continuous probability distributions
4. Sampling distributions
5. Estimation
6. Hypothesis testing
7. Analysis of variance
8. Regression and Correlation
9. Chi square distribution and analysis of frequency

Any other experiment based on syllabus which will help learner to understand topic/concept

**Assessment:**

***Term Work:***

Term work shall consist of minimum 7 experiments.

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments) : 10 Marks

Laboratory work (Journal) : 10 Marks

Attendance : 5 Marks

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

**Books Recommended:**

*Text books:*

1. Biostatistics – A foundation for analysis in health sciences by Wayne W. Daniel, Seventh edition, Wiley India
2. Fundamentals of mathematical statistics by S. C. Gupta and V. K. Kapoor, second edition, Sultan Chand Publisher
3. Probability and statistics for engineers by J. Ravichandran, Wiley /india

*Reference Books:*

1. Biostatistics – How it works by Steve selvin, Pearson education
2. An Introduction to Biostatistics by Sunder Rao and J. Richard, Third Edition, Prentice Hall of India
3. Probability and Statistics by Schaum's series

**Oral examination will be based on suggested practical list and entire syllabus.**

Course Code	Course Name	Teaching scheme			Credits assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
<b>BMDLL 5013</b>	<b>Department Level Optional Course – I Rehabilitation Engineering (RE)</b>	--	<b>02</b>	--	--	<b>01</b>	--	<b>01</b>

Course Code	Course Name	Examination Scheme								
		Theory				Term work	Pract.	Oral	Pract. / Oral	Total
		Internal Assessment			End sem					
		Test 1	Test 2	Avg.						
<b>BMDLL 5013</b>	<b>Department Level Optional Course – I Rehabilitation Engineering (RE)</b>	--	--	--	--	<b>25</b>	--	<b>25</b>	--	<b>50</b>

Course Code	Course Name	Credits
<b>BMDLL5013</b>	<b>Rehabilitation Engineering</b>	<b>01</b>
<b>Course Objective</b>	To introduce learners to basics of Kinetics and Kinematics, Flow properties of blood and give overview of Rehabilitation Engineering.	
<b>Course Outcome</b>	A learner will be able to Build foundation for learners enabling the learners to pursue higher studies with specialization in Rehabilitation Engineering.	

**Syllabus: Same as that of BMDLO5013 Rehabilitation Engineering (RE)**

**Laboratory work:**

1. Demonstrations in hospital / Industry.
2. Discussion on research articles and recent developments in the field of medicine.
3. Group presentations on the latest technology in hospitals based on the topics covered in the syllabus.
4. 5 Assignments based on the entire syllabus.



**Assessment:*****Term Work:***

Term work shall consist of minimum 7 experiments.

The distribution of marks for term work shall be as follows:

Laboratory work : 10 Marks

Laboratory work (Documentation) : 5 Marks

Presentation : 5 Marks

Attendance : 5 Marks

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

**Books Recommended:***Text books:*

1. Handbook of Biomedical Instrumentation (Third edition): 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 books:*

1. Encyclopedia of Medical Devices and Instrumentation: J G. Webster. Vol I- IV (PH Pub)
2. Various Instruments Manuals.
3. Various internet resources.

**Oral examination will be based on suggested practical list and entire syllabus.**

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
<b>BMC601</b>	<b>Biomedical Monitoring Equipment (Abbreviated as BME)</b>	<b>04</b>	<b>--</b>	<b>--</b>	<b>04</b>	<b>--</b>	<b>--</b>	<b>04</b>

Course Code	Course Name	Examination Scheme									
		Theory					Term work	Pract.	Oral	Pract. / Oral	Total
		Internal Assessment			End sem	Duration (hrs)					
		Test 1	Test 2	Avg.							
<b>BMC601</b>	<b>Biomedical Monitoring Equipment (BME)</b>	<b>20</b>	<b>20</b>	<b>20</b>	<b>80</b>	<b>03</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>100</b>

Course Code	Course Name	Credits
<b>BMC601</b>	<b>Biomedical Monitoring Equipment</b>	<b>04</b>
<b>Course Objective</b>	<ul style="list-style-type: none"> <li>To understand the basic principles and working of patient monitoring system.</li> <li>To develop skills enabling Biomedical Engineers to serve the health care industry</li> <li>To develop core competency and skill in the field of Biomedical Engineering, to design and develop new health care systems.</li> </ul>	
<b>Course Outcome</b>	<p>Learner will be able to:</p> <ul style="list-style-type: none"> <li>Provide a better understanding about various bioelectrical signal recorders and patient safety</li> <li>Demonstrate the principles of electronics used in designing various biomedical monitoring equipment.</li> <li>Understand the basic principles and working of audiometry equipments and hearing aids</li> <li>Provide a better understanding about foetal and neonatal monitoring systems.</li> <li>Acquire the ability to explain the various blood flow and cardiac output measurement devices.</li> <li>Acquire in-depth knowledge about different streams in Biomedical Engineering with greater emphasis on health care Equipment and the advanced technologies such as Telemetry and Telemedicine.</li> </ul>	

Module	Contents	Hours
1	<b>Bioelectrical signals and recorders</b> ECG, EMG and EEG signals, LEAD configurations, 10-20 electrode system Measuring techniques for EOG, ERG and Phonocardiography, <b>Patient Safety:</b> Electric Shock Hazards, Leakage currents, safety codes for electro-medical equipment.	10
2	<b>Arrhythmia and Patient monitoring:</b> Cardiac Arrhythmias, waveforms and interpretation from them. Stress test measurement. Ambulatory monitoring instruments-Holter monitor. Measurement of Heart Rate, Pulse rate, Blood pressure, Temperature and Respiration rate, Apnoea Detector. Electrical Safety in Biophysical Measurements. Heart rate variability measurement and applications. <b>Point of care devices and their design considerations for homecare devices:</b> glucometer, lung function test.	16
3	<b>Audiometers and hearing aid</b> Basic audiometer, Pure tone and Speech audiometer, evoked response Audiometry, Conventional and Digital Hearing Aids, Cochlear Implants.	04
4	<b>Foetal and Neonatal Monitoring System:</b> Cardiotocograph, Methods of monitoring of Foetal Heart rate, Monitoring of labour activity, Incubator and Infant warmer, Non-stress test monitoring.	05
5	<b>Blood flow and Cardiac output</b> Electromagnetic, Ultrasonic, NMR and Laser Doppler flowmetry, Indicator Dilution, Dye Dilution and Thermal Dilution Techniques.	05
6	<b>Bio-Telemetry and Telemedicine</b> General Telemetry System, Single channel and Multi-channel, Landline and Radio-frequency Telemetry, Telemedicine, its essential parameters and delivery modes and its Applications.	08

**Assessment:**

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

**Books Recommended:***Text books:*

1. Handbook of Biomedical Instrumentation (Third edition): R S. Khandpur. (PH Pub)
2. Medical Instrumentation, Application and Design: J G. Webster. (John Wiley)
3. Biomedical Instrumentation and measurements : Leislle Cromwell, Fred J. Weibell, Enrich A. Pfeiffer. (PHI Pub)

*Reference books:*

1. Introduction to Biomedical Equipment Technology: Carr –Brown. (PH Pub)
1. Encyclopedia of Medical Devices and Instrumentation: J G. Webster. Vol I- IV (PH Pub)
2. Various Instruments Manuals.
3. Various internet websites.

**Theory Examination:**

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein sub-questions of marks will be asked.
4. Remaining questions will be randomly selected from all the modules.

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
BMC602	Microprocessors and Microcontrollers (Abbreviated as MPMC)	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme									
		Theory					Term work	Pract.	Oral	Pract. / Oral	Total
		Internal Assessment			End sem	Duration (hrs)					
		Test 1	Test 2	Avg.							
BMC602	Micro-processors and Micro-controllers (MPMC)	20	20	20	80	03	--	--	--	--	100

Course Code	Course Name	Credits
BMC602	Microprocessors and Microcontrollers	04
<b>Course Objective</b>	<ul style="list-style-type: none"> <li>To create a strong foundation by studying the basics of Microprocessors and Microcontroller interfacing to various peripherals which will lead to a well-designed Microprocessor/ Microcontroller System.</li> </ul>	
<b>Course Outcome</b>	<p>Learner will be able to:</p> <ul style="list-style-type: none"> <li>Understand the basic of Microprocessor and Microcontroller based systems and their architecture.</li> <li>Understand 8086 microprocessor along with its architecture and memory organization.</li> <li>Understand peripheral controller ICs used in interfacing.</li> <li>Understand 8051 Microcontroller architecture, memory organization, Interrupt structure, Port structure, Timers/Counters</li> <li>Understand assembly language and C compilers used to program 8051</li> <li>Design simple interfaces for keyboard LCD, ADC/DAC and Stepper motors</li> </ul>	

Module	Contents	Hours
1.	<b>Introduction to Microprocessor</b> Introduction to Microprocessor and Microcontroller, Microcomputer based system elements, Generalized block diagram of Microprocessor, RISC & CISC CPU Architectures, Harvard & Von-Neumann CPU architecture, Microprocessor Programming languages, Microcomputer System software, Evolution of Microprocessor ,machine cycle, T states and concepts of read write cycles.	04
2.	<b>Architecture of Intel 8086 Microprocessor</b> Major features of 8086 processor, 8086/88, CPU Architecture and the pipelined operation, Programmer's Model and Memory Segmentation	04
3.	<b>Peripheral Controllers for 8086 family and System Design:</b> Functional Block Diagram and description, Control Word Formats, Operating Modes and Applications of the Peripheral Controller namely 8255-PPI, , 8259- PIC and 8237-DMAC, 8279- Display and Keyboard driver, Interfacing of the above Peripheral Controllers. Keyboard and Display Interface.	08
4.	<b>MCS-51 Microcontroller</b> 8051 architecture ; its variants and comparison, comparison of microprocessor and microcontrollers, CPU timing and machine cycle, memory organisation, SFR's, integrated peripherals such as timers/counters, serial ports, parallel I/O ports, interrupt structure, memory interfacing power saving and power down modes.	10
5.	<b>8051programming</b> Assembly language programming process, programming tools, addressing modes, instruction set and Programming practice using assembly and C compilers	12
6.	<b>Microcontroller design and interfacing case studies</b> Interfacing with external memories, Interfacing with 8255, Interfacing with 7 segment display, Interfacing with keyboard, interfacing with LCD, Interfacing with ADC, DAC and Sensors, Interfacing with stepper motor Interfacing with PC using RS232	10

**Assessment:**

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

**Books Recommended:***Text Books:*

1. "8086/8088 family: "Design, Programming an Interfacing", John Uffenbeck: Prentice Hall, 2<sup>nd</sup> Edition
2. Microcomputer systems 8086/8088 family, Architecture, Programming and Design - Yu-Cheng Liu & Glenn A Gibson, 2nd Edition- July 2003, Prentice Hall of India.
3. "Advanced Microprocessor and Peripherals – Architecture, Programming and Interfacing", A.K.Ray & K.M Bhurchandi, Tata Mc Graw Hill , 2006.
4. The 8051 microcontrollers-Kenneth J Ayala

5. The 8051 Microcontroller and Embedded Systems Muhammad A Mazidi, , Pearson Education
6. Using MCS-51 Microcontroller Han-Way Huang,.
7. 8051 microcontroller hardware, software applications.V Udayashankara, M S Mallikarjunaswamy

*Reference Books:*

1. “Microprocessors and Interfacing : Programming and Hardware”, Douglas V.Hall, second edition , Tata Mc Graw Hill ,2006.
2. “ IBM PC Assembly language and programming”Peter Abel, , fifth edition
3. “Pentium Processor System Architecture”, Don Anderson, Tom Shanley: MindShare Inc., 2<sup>nd</sup> Edition.
4. Embedded System Design: A unified Hardware/Software Introduction Frank Vahid,Toney Givargis- John Wiley publication
5. “Microprocessors and Interfacing : Programming and Hardware”, Douglas V.Hall, second edition , Tata Mc Graw Hill ,2006.
6. “ IBM PC Assembly language and programming”Peter Abel, , fifth edition
7. “Pentium Processor System Architecture”, Don Anderson, Tom Shanley: MindShare Inc., 2<sup>nd</sup> Edition.
8. Embedded System Design: A unified Hardware/Software Introduction Frank Vahid,Toney Givargis- John Wiley publication.

**Theory Examination:**

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein sub-questions of marks will be asked.
4. Remaining questions will be randomly selected from all the modules.

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
BMC603	Digital Image Processing (Abbreviated as DIP)	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme									
		Theory					Term work	Pract.	Oral	Pract. / Oral	Total
		Internal Assessment			End sem	Duration (hrs)					
		Test 1	Test 2	Avg.							
BMC603	Digital Image Processing (DIP)	20	20	20	80	03	--	--	--	--	100

Course Code	Course Name	Credits
BMC603	Digital Image Processing	04
<b>Course Objective</b>	<ul style="list-style-type: none"> <li>To introduce the learners the basic theory of digital image processing.</li> <li>To expose learners to various available techniques and possibilities of this field.</li> <li>To understand the basic image enhancement, transforms, segmentation, compression, morphology, representation, description techniques &amp; algorithms.</li> <li>To prepare learners to formulate solutions to general image processing problems.</li> <li>To develop hands-on experience in using computers to process images.</li> <li>To familiarize with MATLAB / C/ Labview / similar software for processing digital images.</li> </ul>	
<b>Course Outcome</b>	<p>Learner will be able to:</p> <ul style="list-style-type: none"> <li>Acquire the fundamental concepts of a digital image processing system such as image acquisition, enhancement, segmentation, transforms, compression, morphology, representation and description.</li> <li>Analyze images in the spatial domain.</li> <li>Analyze images in the frequency domain through the Fourier transform.</li> <li>Design and implement with MATLAB/C/Labview algorithms for digital image processing operations such as point processing, histogram processing, spatial and frequency domain filtering, denoising, transforms, compression, and morphological processing.</li> </ul>	



Module	Detailed Contents	Hours
1.	<b>Basics of Image Processing:</b> Image acquisition, Processing, Communication, Display; Electromagnetic spectrum; Elements of visual perception - Structure of the human eye, Image formation in the eye, Brightness adaptation and discrimination, Image formation model, Uniform and non-uniform sampling, Quantization, Image formats.	<b>05</b>
2.	<b>Image Enhancement:</b> Spatial domain - Point processing techniques, Histogram processing, Neighbourhood processing, Frequency domain techniques - 2D-DFT, Properties of 2D-DFT, Low pass, High pass, Noise removal, Homomorphic filters,	<b>12</b>
3.	<b>Image Segmentation:</b> Basic relationships between pixels - Neighbours, Adjacency, Connectivity, Regions, Boundaries, Distance measures; Detection of discontinuities, Point, Line, Edge detection, Edge linking, Hough transform, Thresholding-based segmentation, Region-based segmentation.	<b>08</b>
4.	<b>Image Transforms:</b> DFT, FFT, DCT, DST, Hadamard, Walsh, Haar, Slant, K-L Transforms, Basis functions and basis images	<b>08</b>
5.	<b>Image Compression:</b> Fundamentals of image compression models, Lossless compression - RLE, Huffman, LZW, Arithmetic coding techniques. Lossy compression - IGS coding, Predictive coding, Transform coding, JPEG, JPEG 2000.	<b>08</b>
6.	<b>Morphology, Representation and Description:</b> Dilation, Erosion, Open, Close, Hit-or-miss, Boundary extraction, Region filling, Thinning and thickening; Chain Codes, Polygonal approximations, Signatures; Fourier descriptors, Moments.	<b>07</b>

**Assessment:**

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

**Books Recommended:***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-Prentice Hall India.

*Reference Books:*

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

**Theory Examination:**

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein sub-questions of marks will be asked.
4. Remaining questions will be randomly selected from all the modules.

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
BMC604	Medical Imaging - I (Abbreviated as MI - I)	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme									
		Theory					Term work	Pract.	Oral	Pract. / Oral	Total
		Internal Assessment			End sem	Duration (hrs)					
		Test 1	Test 2	Avg.							
BMC604	Medical Imaging - I (MI - I)	20	20	20	80	03	--	--	--	--	100

Course Code	Course Name	Credits
BMC604	Medical Imaging - I	04
<b>Course Objective</b>	<ul style="list-style-type: none"> <li>To familiarize the learners with the various Imaging techniques in medicine operating principles and quality control aspects of various imaging modalities.</li> <li>To keep the learners abreast with the technological developments in the field of Medical Imaging</li> </ul>	
<b>Course Outcome</b>	<p>Learner will be able to:</p> <ul style="list-style-type: none"> <li>Understand X ray imaging along with X ray tube construction, X ray generators and the total radiographic system.</li> <li>Understand Fluoroscopic Imaging and Digital Subtraction Angiography.</li> <li>Distinguish between CR and DR. Understand Mammography.</li> <li>Understand the technique of Computed tomography, the CT scanner configuration, reconstruction techniques and clinical applications.</li> <li>Apply the knowledge of CT and learn advancements in CT.</li> <li>Understand the applications of X-rays in the field of Radiotherapy.</li> </ul>	

Module	Detailed Contents	Hours
1.	<b>X- ray Imaging:</b> Properties of X rays, production of X rays, X ray interaction with matter, Attenuation Total radiographic System: X –ray tubes, Rating of X ray tubes, X –ray generators, Filters, Grids, Beam Restrictors, Control Panel, X ray Film	14
2.	<b>Fluoroscopic Imaging</b> and X ray Image Intensifier, Digital subtraction Angiography	05
3.	<b>Computed Radiography and Digital Radiography</b> <b>Mammography</b>	04

4.	<b>Principle of Computed tomography</b> Scanner configurations/generations, CT system: Scanning unit(gantry), detectors, CT Number ,Data Acquisition System, Spiral CT: technology and applications, Reconstruction Techniques:- Radon Transform, Iterative, Filtered back projection, Fourier reconstruction, CT artefacts, Clinical applications of CT	<b>14</b>
5.	<b>Advancements in CT</b> Multi-detector computed tomography (MDCT), Flat panel detectors CT-Angiography, Contrast agents in CT	<b>05</b>
6.	<b>Linear Accelerators:</b> Production and transport of the RF wave, Major components of linear accelerator, Clinical Applications.	<b>06</b>

**Assessment:**

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

**Books Recommended:**

*Text Books:*

1. Christensen's Physics of Diagnostic Radiology
2. Medical Imaging Physics William .R.Hendee
3. Practical Radiotherapy: Physics and equipment: Pam Cherry, Angela Duxbury

*Reference Books:*

1. Biomedical Technology and Devices by James Moore .
2. Biomedical Engineering Handbook by Bronzino
3. Physics of Diagnostic images –Dowsett

**Theory Examination:**

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein sub-questions of marks will be asked.
4. Remaining questions will be randomly selected from all the modules.

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
BMDLO 6021	Department Level Optional Course- II Healthcare Software (Abbreviated as HCS)	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme									
		Theory					Term work	Pract.	Oral	Prac t. / Oral	Total
		Internal Assessment			End sem	Dura tion (hrs)					
		Test 1	Test 2	Av g.							
BMDLO 6021	Department Level Optional Course - II Healthcare Software (HCS)	20	20	20	80	03	--	--	--	--	100

Course Code	Course Name	Credits
BMDLO6021	Healthcare Software	04
<b>Course Objective</b>	<ul style="list-style-type: none"> <li>To setup programming environment for ASP.NET programs</li> <li>To develop modular applications using object oriented methodologies</li> <li>To configure ASP.NET application and creating applications using standard .NET controls</li> <li>To develop data driven web application</li> <li>To connect different data sources and manage them</li> <li>To maintain session and controls related information in multi-user web applications</li> </ul>	
<b>Course Outcome</b>	Learner will be able to: <ul style="list-style-type: none"> <li>Understanding of Microsoft .NET Framework and ASP.NET page structure</li> <li>Designing of windows applications using C#.NET</li> <li>Designing of web applications using ASP.NET controls</li> <li>Creating database driven ASP.NET web applications using SQL Server</li> <li>Debugging and deploying ASP.NET web applications.</li> </ul>	

Module	Contents	Hours
1	<b>Introduction to .NET Programming:</b> <ul style="list-style-type: none"> <li>• .Net Concepts: Framework, Common Language Runtime, Base Class Library, Common Type System (CTS), Assemblies, Namespaces.</li> <li>• Programming with C#: Variables, Comments, Constants, Keywords, Data Types, Control Statements, Conditional Statements, Switch Statement, Loops, Jump, Statements, Goto, break, Continue, Return, Arrays.</li> <li>• Exception handling in C#</li> <li>• Object Oriented Programming (OOP): Class, Object, Encapsulation, Inheritance, Polymorphism, Constructors.</li> </ul>	12
2	<b>Developing Windows Forms Applications:</b> <ul style="list-style-type: none"> <li>• Standard Controls - Windows Application: Labels, Textboxes, Rich Text Box, Button, Check Box, Radio Button, Combo Box, Picture Box, List Box, Image List, List View, Tab Control, Menu Strip, Data Grid View, Date Picker</li> <li>• Event Handlers: Creating Event Handlers, Default Event Handlers, Associating Event Handlers at Run Time.</li> </ul>	06
3	<b>Developing Web Applications using ASP.NET and C#</b> <ul style="list-style-type: none"> <li>• Introduction to ASP.Net: From ASP to ASP.NET, ASP.NET Features, Web Forms Life Cycle, Request/Response Programming.</li> <li>• Web Applications Using Visual Studio: Using Visual Web Developer, Using Components, Using the Global.asax file.</li> <li>• State Management: Session State, Application State, Cookies.</li> <li>• Server Control: HTML Server Controls, Web Forms Server Controls, Rich Controls, Validation Controls.</li> <li>• Themes</li> <li>• Configuration: Using the machine. config file, Using the web. config file, Globalization and Localization.</li> </ul>	12
4	<ul style="list-style-type: none"> <li>• <b>Data access and manipulation with ADO.NET using SQL Server</b></li> </ul> Introduction to ADO.NET, Data Providers in .NET, Connected and Disconnected architecture, ADO.NET Architecture, Command Object, Data Adapter and Data Set, Data Tables and Data Views, Updating the Dataset.	10
5	<b>Security, Deployment, &amp; Introduction to advanced concepts</b> <ul style="list-style-type: none"> <li>• Security: Authentication, Authorization, Impersonation, Code Access Security</li> <li>• Deployment.</li> </ul>	04
6	<b>Introduction to advanced concepts of .Net framework:</b> Windows Presentation Foundation (WPF), Windows Communication Foundation (WCF), Windows Workflow Foundation (WWF), Windows Card Space (WCS).	04

**Assessment:**

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

**Books Recommended:***Text Books:*

1. ASP.NET 3.5 Unleashed (Sams) - Stephen Walther
2. Microsoft ASP.NET Step by Step (Microsoft Press) - G. Andrew Duthrie

*Reference Books:*

1. Designing Microsoft ASP.NET Applications (Microsoft Press) - Jonathon Goodyear, Brian Peek, Brad Fox
2. Deploying and Managing Microsoft .NET Web Farms (Sams) - Barry Bloom

**Theory Examination:**

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3. Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining question will be randomly selected from all the modules.

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
BMDLO 6022	Department Level Optional Course- II Lasers and Fibre Optics (Abbreviated as LFO)	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme									
		Theory					Term work	Pract.	Oral	Pract. / Oral	Total
		Internal Assessment			End sem	Duration (hrs)					
Test 1	Test 2	Avg.									
BMDLO 6022	Department Level Optional Course - II Lasers and Fibre Optics (LFO)	20	20	20	80	03	--	--	--	--	100

Course Code	Course Name	Credits
BMDLO6012	Lasers and Fiber Optics	04
Course Objective	<ul style="list-style-type: none"> <li>To understand the fundamentals in Laser and Fiber Optics.</li> <li>To understand the applications of Laser and Fiber optics in health sector.</li> </ul>	
Course Outcome	Learner will be able to: <ul style="list-style-type: none"> <li>Understand the fundamentals and clinical applications of Laser and Fiber Optics.</li> <li>Correlate the knowledge of medicine and engineering for the wellness of human being.</li> <li>Understand the safety aspects while dealing with Laser and Fiber Optic Units.</li> </ul>	

Module	Contents	Hours
1.	<b>Lasers Fundamentals</b> Fundamental wave properties and quantum properties of light, Energy levels and Radiative properties, Absorption and Stimulated Emission, Laser Amplifiers, Laser Oscillation above threshold, Requirements for obtaining Population Inversion, Laser pumping requirements and techniques, Laser Resonators, Cavity modes, Laser interaction with tissue- Effects and principles, Thermal interaction between laser and tissue.	10



2.	<b>Laser Types, construction and working</b> Laser system involving low density gain medium: He-Ne laser, Argon Ion Laser, He-Cadmium laser, Carbon dioxide Laser, Excimer laser, Nitrogen Laser Laser system involving high density gain medium: Solid State laser like Ruby laser, Nd-YAG Laser, Titanium Sapphire Laser, Fiber Lasers, Semiconductor Diode Laser	10
3.	<b>Laser safety:</b> Practical Laser Safety requirements, Environmental safety, Equipment safety, personnel protection, Education/training for handling laser equipment, Role of Laser Safety officer, Standards of practice for the use of Laser in medicine and Surgery, Recommendation Regarding the Laser safety officer, Hospital Laser Committee	06
4.	<b>Optic Fibers Fundamentals</b> Light transmission in optical fibers- principles, optical properties of optical fibers, Fiber materials, Types of Optical fibers, Modes, Losses, Fabrication of optical fibers, Methods and Principle, Fiber Splicing, Fiber optic imaging, Biomedical Optical fibers, In vivo Applications.	10
5.	<b>Laser and Fiber Optics in surgery</b> Introduction, fiber optic laser systems in cardiovascular disease, gastroenterology, gynecology, neurosurgery, oncology, ophthalmology, orthopedics, otolaryngology (ENT), urology, and flow diagram for laser angioplasty, Laser and Fiber optics used in Skin	06
6.	<b>Endoscopy</b> Basic Principle, System components and functions, Types of endoscopes, Video Endoscopes, Accessories, Maintenance, Endoscopy Processing room requirements, Medical Application, Leakage tester and Trouble shooting	06

### Assessment:

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

### Books Recommended:

#### Text Books:

1. Lasers and Optical Fibers in Medicine – AbrahamCatzir Academic press 1998
2. Optical Fiber Communication by Gerd Keiser

#### Reference Books:

1. Therapeutic Lasers – G David Baxter – Churchill Living stone publications
2. Medical Laser and their safe use – David H Shiny Stiffen and L Trokel Springer Publications
3. Element of Fiber optics – S. L. Wymer Regents PHI
4. Lasers in Urologic Surgery – Joseph A.Smith,Jr, Barry S.Stein, Ralph C.BensonJr, Mosby Pub
5. Laser Fundamentals-William T.Silfvast, Cambridge University Press
- 6.Lasers in Medicine, Volume-1,Hans K. Koebner, John Wiley & Sons

**Theory Examination:**

3. Question paper will comprise of 6 questions, each carrying 20 marks.
4. Total four questions need to be solved.
3. Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining question will be randomly selected from all the modules.

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
BMDLO 6023	Department Level Optional Course- II Biological Modelling and Simulation (Abbreviated as BMS)	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme									
		Theory					Term work	Pract.	Oral	Pract. / Oral	Total
		Internal Assessment			End sem	Duration (hrs)					
		Test 1	Test 2	Avg.							
BMDLO 6023	Department Level Optional Course - II Biological Modelling and Simulation (BMS)	20	20	20	80	03	--	--	--	--	100

Course Code	Course Name	Credits
BMDLO6023	Biological Modelling and Simulation	04
<b>Course Objective</b>	<ul style="list-style-type: none"> <li>To provide in-depth knowledge of modelling of physiological systems.</li> <li>To understand basic concepts of modeling for designing biological model.</li> </ul>	
<b>Course Outcome</b>	Learner will be able to: <ul style="list-style-type: none"> <li>Explain the concepts, usage and process of physiological modelling</li> <li>Apply basic biophysical laws for calculation of membrane potential under different equilibrium conditions and develop simulation programs for understanding neuronal functions</li> <li>Understand the function of complex closed loop systems like temperature control using modelling.</li> <li>Understand the function of neuromuscular system with the help of various models.</li> <li>Understand the function of open loop system like eye movement system and differentiate open loop and closed loop system</li> <li>Understand the usage of, and the assumptions behind biological models (immune response, drug delivery and insulin glucose feedback) in the working life.</li> </ul>	

<b>Module</b>	<b>Detailed Contents</b>	<b>Hours</b>
<b>1.</b>	<b>Physiological Modelling:</b> Steps in Modelling, Purpose of Modelling, lumped parameter models, distributed parameter models, compartmental modelling, modelling of circulatory system and respiratory system.	<b>07</b>
<b>2.</b>	<b>Model of Neurons:</b> Biophysics tools, Equilibrium in a one ion system, Donnan Equilibrium, Space-Charge Neutrality, Membrane with no-zero permeability, GHK equation, Active Transport ( Pump), Action Potential, Electrical Equivalent model of a biological membrane, The H-H model, The iron-wire model, Channel Characteristics, Simulation of action potential, voltage propagation in a passive axon (cable equation).	<b>14</b>
<b>3.</b>	<b>Neuromuscular System:</b> modelling of skeletal muscle, mono and polysynaptic reflexes, stretch reflex, reciprocal innervations, two control mechanism, Golgi tendon, experimental validation, Parkinson's syndrome.	<b>06</b>
<b>4.</b>	<b>Eye Movement Model:</b> Eye movements, quantitative eye movement models, techniques for validating models, validation of other physiological systems	<b>12</b>
<b>5.</b>	<b>Thermoregulatory systems:</b> Thermoregulatory mechanisms, model of thermoregulatory system, controller model, validation and application.	<b>03</b>
<b>6.</b>	<b>Modelling of other physiological systems.</b> <b>Modelling the Immune response:</b> Behavior of the immune system, linearized model of the immune response. <b>Modelling of Drug delivery systems.</b> <b>Modelling of Insulin Glucose feedback system</b> and Pulsatile Insulin secretion.	<b>06</b>

**Assessment:**

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

**Books Recommended:***Text Books:*

1. Bioengineering, Biomedical, Medical and Clinical Engg.: A.Teri Bahil.
2. Signals and systems in Biomedical Engg.: Suresh R Devasahayam.
3. Bio-Electricity A quantitative approach by Barr and Ploncey

*Reference Books:*

1. Biomedical Engineering Handbook by Bronzino (CRC Press)

**Theory Examination:**

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein sub-questions of 5 marks will be asked.
4. Remaining questions will be randomly selected from all the modules.

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
BML601	Biomedical Monitoring Equipment (BME)	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme								
		Theory				Term work	Pract.	Oral	Pract. / Oral	Total
		Internal Assessment			End sem					
		Test 1	Test 2	Avg.						
BML601	Biomedical Monitoring Equipment (BME)	--	--	--	--	25	--	--	25	50

Course Code	Course Name	Credits
BML601	Biomedical Monitoring Equipment	01
<b>Course Objective</b>	<ul style="list-style-type: none"> <li>To understand the basic principles and working of patient monitoring system.</li> <li>To develop skills enabling Biomedical Engineers to serve the health care industry</li> <li>To develop core competency and skill in the field of Biomedical Engineering, to design and develop new health care systems.</li> </ul>	
<b>Course Outcome</b>	Learner will be able to: <ul style="list-style-type: none"> <li>Design and Implement filters for filtering of noise from signals.</li> <li>Design and Implement Instrumentation amplifier to amplify low amplitude signals.</li> <li>Design and Implement a regulated power supply.</li> <li>Design and Implement Pulse Width Modulator.</li> <li>Understand the working of ECG machine by recording ECG.</li> <li>Provide a better understanding about foetal monitoring systems.</li> <li>Test the hearing ability by use of an audiometry.</li> </ul>	

**Syllabus: Same as that of BMC601 Biomedical Monitoring Equipment(BME).**

**List of Laboratory Experiments: (Any Seven)**

1. Design of Instrumentation amplifier.
2. Implementation of notch filter.
3. Implementation of Bandpass filter
4. Design and implementation of regulated power supply.

5. Design and implementation of Pulse width modulator.
6. Demonstration of ECG machine / monitor.
7. Demonstration of foetal monitor.
8. Demonstration of Blood flow measurement.
9. Testing of hearing ability using Audiometer.
10. Industry / Hospital visit may to be conducted.

Any other experiment based on syllabus which will help learner to understand topic/concept.

Group Presentations on the latest technology in hospitals based on the topics covered in the syllabus.

### **Assessment:**

#### ***Term Work:***

Term work shall consist of minimum 7 experiments.

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments) : 10 Marks

Laboratory work (Journal) : 5 Marks

Presentation : 5 Marks

Attendance : 5 Marks

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

### **Books Recommended:**

#### ***Text books:***

1. Handbook of Biomedical Instrumentation (Third edition): R S. Khandpur. (PH Pub)
2. Medical Instrumentation, Application and Design: J G. Webster. (John Wiley)
3. Biomedical Instrumentation and measurements : Leislle Cromwell, Fred J. Weibell, Enrich A. Pfeiffer. (PHI Pub)

#### ***Reference books:***

1. Introduction to Biomedical Equipment Technology: Carr –Brown. (PH Pub)
2. Encyclopedia of Medical Devices and Instrumentation: J G. Webster. Vol I- IV (PH Pub)
3. Various Instruments Manuals.
4. Various internet websites

**Practical and Oral examination will be based on suggested practical list and entire syllabus.**

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
BML602	Microprocessors and Microcontrollers (MPMC)	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme								
		Theory				Term work	Pract.	Oral	Pract. / Oral	Total
		Internal Assessment			End sem					
		Test 1	Test 2	Avg.						
BML602	Microprocessors and Microcontrollers (MPMC)	--	--	--	--	25	--	--	25	50

Course Code	Course Name	Credits
BML602	Microprocessors and Microcontrollers	01
<b>Course Objective</b>	<ul style="list-style-type: none"> <li>To apply the theoretical concepts of Microcontroller to design practical circuits.</li> <li>To learn circuit simulation and software simulations and then convert into a working model.</li> </ul>	
<b>Course Outcome</b>	Learner will be able to: <ul style="list-style-type: none"> <li>Execute the program using microprocessor and microcontroller kits.</li> <li>Execute assembly and C language programs using simulator.</li> <li>Apply the knowledge of programming to implement a mini project.</li> </ul>	

**Syllabus: Same as that of BMC602 Microprocessors and Microcontrollers (MPMC).**

**List of Laboratory Experiments: (Any four and mini project)**

1. To study 8031\8086 kit.
2. To perform experiment on data transfer.
3. To study arithmetic operations.
4. To perform experiment on logical instructions.
5. To perform experiment on Timers\Counters.
6. To study and perform experiment on Square wave generation.
7. To implement LCD interfacing.
8. Mini Project.



Any other experiment based on syllabus which will help students to understand topic/concept

**Term Work:**

Term work shall consist of minimum 7 experiments. Every year at least 3 experiments should be changed from previous year experiments

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments and Journal) : 10 Marks

Mini Project (Implementation and Report) : 10 Marks

Attendance : 5 Marks

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

**Books Recommended:**

*Text Books:*

2. “8086/8088 family: “Design, Programming an Interfacing”, John Uffenbeck: Prentice Hall, 2<sup>nd</sup> Edition
3. Microcomputer systems 8086/8088 family, Architecture, Programming and Design - Yu-Cheng Liu & Glenn A Gibson, 2nd Edition- July 2003, Prentice Hall of India.
4. “Advanced Microprocessor and Peripherals – Architecture, Programming and Interfacing”, A.K.Ray & K.M Bhurchandi, Tata Mc Graw Hill , 2006.
5. The 8051 microcontrollers-Kenneth J Ayala
6. The 8051 Microcontroller and Embedded Systems Muhammad A Mazidi, , Pearson Education
7. Using MCS-51 Microcontroller Han-Way Huang,.
8. 8051 microcontroller hardware, software applications.V Udayashankara, M S Mallikarjunaswamy

*Reference Books:*

1. “Microprocessors and Interfacing : Programming and Hardware”, Douglas V.Hall, second edition , Tata Mc Graw Hill ,2006.
2. “ IBM PC Assembly language and programming”Peter Abel, , fifth edition
3. “Pentium Processor System Architecture”, Don Anderson, Tom Shanley: MindShare Inc., 2<sup>nd</sup> Edition.
4. Embedded System Design: A unified Hardware/Software Introduction Frank Vahid,Toney Givargis- John Wiley publication
5. “Microprocessors and Interfacing : Programming and Hardware”, Douglas V.Hall, second edition , Tata Mc Graw Hill ,2006.
6. “ IBM PC Assembly language and programming”Peter Abel, , fifth edition
7. “Pentium Processor System Architecture”, Don Anderson, Tom Shanley: MindShare Inc., 2<sup>nd</sup> Edition.
8. Embedded System Design: A unified Hardware/Software Introduction Frank Vahid,Toney Givargis- John Wiley publication.

**Practical and Oral examination will be based on mini project.**

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
BML603	Digital Image Processing (DIP)	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme								
		Theory				Term work	Pract.	Oral	Pract. / Oral	Total
		Internal Assessment			End sem					
		Test 1	Test 2	Avg.						
BML603	Digital Image Processing (DIP)	--	--	--	--	25	--	--	25	50

Course Code	Course Name	Credits
BML603	Digital Image Processing	01
<b>Course Objective</b>	<ul style="list-style-type: none"> <li>To introduce the learners the basic theory of digital image processing.</li> <li>To expose learners to various available techniques and possibilities of this field.</li> <li>To understand the basic image enhancement, transforms, segmentation, compression, morphology, representation, description techniques &amp; algorithms.</li> <li>To prepare learners to formulate solutions to general image processing problems.</li> <li>To develop hands-on experience in using computers to process images.</li> <li>To familiarize with MATLAB / C/ Labview/ similar software for processing digital images.</li> </ul>	
<b>Course Outcome</b>	Learner will be able to: <ul style="list-style-type: none"> <li>Acquire the fundamental concepts of a digital image processing system such as image acquisition, enhancement, segmentation, transforms, compression, morphology, representation and description.</li> <li>Analyze images in the spatial domain.</li> <li>Analyze images in the frequency domain through the Fourier transform.</li> <li>Design and implement with MATLAB/C/Labview algorithms for digital image processing operations such as point processing, histogram processing, spatial and frequency domain filtering, denoising, transforms, compression, and morphological processing.</li> </ul>	

**Syllabus: Same as that of BMC603 Digital Image Processing (DIP).**

**List of Laboratory Experiments (Any Seven)**

1. Point Processing techniques (At least 4 experiments).
2. Spatial domain Filtering.
3. Histogram Processing (Histogram Stretching and Equalisation).
4. Frequency Domain Filtering (Plotting 2D-DFT, Low pass and High Pass- Ideal, Butterworth and Gaussian Filters).
5. Segmentation-Gradient operators.
6. Transforms-DCT.
7. Morphology-Dilation Erosion.

Any other experiment based on syllabus which will help students to understand topic/concept

***Term Work:***

Term work shall consist of minimum 7 experiments. Every year at least 3 experiments should be changed from previous year experiments

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments) : 10 Marks

Laboratory work (programs / journal) : 10 Marks

Attendance : 5 Marks

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

**Books Recommended:**

*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-Prentice Hall India.

*Reference Books:*

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

**Practical and Oral examination will be based on suggested practical list and entire syllabus.**

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
BML604	Medical Imaging - I (MI – I)	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme								
		Theory				Term work	Pract.	Oral	Pract. / Oral	Total
		Internal Assessment			End sem					
		Test 1	Test 2	Avg.						
BML604	Medical Imaging - I (MI – I)	--	--	--	--	25	--	25	--	50

Course Code	Course Name	Credits
BML604	Medical Imaging – I	01
<b>Course Objective</b>	<ul style="list-style-type: none"> <li>To familiarize the learners with the various Imaging techniques in medicine operating principles and quality control aspects of various imaging modalities.</li> <li>To keep the learners abreast with the technological developments in the field of Medical Imaging.</li> </ul>	
<b>Course Outcome</b>	Learner will be able to: <ul style="list-style-type: none"> <li>Understand X ray imaging along with X ray tube construction, X ray generators and the total radiographic system.</li> <li>Understand Fluoroscopic Imaging and Digital Subtraction Angiography</li> <li>Distinguish between CR and DR. Understand Mammography.</li> <li>Understand the technique of Computed tomography, the CT scanner configuration, reconstruction techniques and clinical applications.</li> <li>Apply the knowledge of CT and learn advancements in CT.</li> </ul>	

**Syllabus: Same as that of BMC604 Medical Imaging – I (MI - I).**

**List of Laboratory Experiments (Any Seven)**

1. Study of X ray tube
2. Study of X ray Tube housing
3. To compare technical specifications of different X ray machines
4. To compare technical specifications of different CT Scanners
5. To generate Sinogram of the image
6. To perform CT windowing on an Image

7. To perform back projection on an Image
8. To generate pseudo colour image
9. To study Fluoroscopy Machine
10. Hospital Visit may be conducted to Radiology Department
11. Presentation on the given topic
12. To generate Research article on the advanced topic
13. Demonstrations/Experts talk

Any other experiment based on syllabus which will help students to understand topic/concept.

Group Presentations on the latest technology in hospitals based on the topics covered in the syllabus.

**Assessment:**

***Term Work:***

Term work shall consist of minimum 7 experiments.

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments) : 10 Marks

Laboratory work (Journal) : 10 Marks

Attendance : 5 Marks

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

**Books Recommended:**

*Text Books:*

1. Christensen's Physics of Diagnostic Radiology
2. Medical Imaging Physics William .R.Hendee
3. Practical Radiotherapy: Physics and equipment: Pam Cherry, Angela Duxbury

*Reference Books:*

1. Biomedical Technology and Devices by James Moore .
2. Biomedical Engineering Handbook by Bronzino
3. Physics of Diagnostic images –Dowsett

**Oral examination will be based on suggested practical list and entire syllabus.**

Course Code	Course Name	Teaching scheme			Credits assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
BMDLL 6021	Department Level Optional Course – II Healthcare Software (HCS)	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme								
		Theory				Term work	Pract.	Oral	Pract. / Oral	Total
		Internal Assessment			End sem					
		Test 1	Test 2	Avg.						
BMDLL 6021	Department Level Optional Course – II Healthcare Software (HCS)	--	--	--	--	25	--	25	--	50

Course Code	Course Name	Credits
BMDLL6021	Healthcare Software	01
<b>Course Objective</b>	<ul style="list-style-type: none"> <li>To setup programming environment for ASP.NET programs</li> <li>To develop modular applications using object oriented methodologies</li> <li>To configure ASP.NET application and creating applications using standard .NET controls</li> <li>To develop data driven web application</li> <li>To connect different data sources and manage them</li> <li>To maintain session and controls related information in multi-user web applications</li> </ul>	
<b>Course Outcome</b>	Learner will be able to: <ul style="list-style-type: none"> <li>Understanding of Microsoft .NET Framework and ASP.NET page structure</li> <li>Designing of windows applications using C#.NET</li> <li>Designing of web applications using ASP.NET controls</li> <li>Creating database driven ASP.NET web applications using SQL Server</li> <li>Debugging and deploying ASP.NET web applications</li> </ul>	

**Syllabus: Same as that of BMDLO6021 Healthcare Software (HCS).**

### **List of Laboratory Experiments (Any Seven)**

1. Develop an ASP.NET application to show all page events along with their order of execution.
2. Develop an ASP.NET application to demonstrate the use of standard ASP.NET controls (TextBox, CheckBox, RadioButton, Button, Image, ImageButton, etc).
3. Develop an ASP.NET application to demonstrate the use of rich ASP.NET controls (use the FileUpload control).
4. Develop an application to demonstrate the use of validation controls in ASP.NET (RequiredFieldValidator, RangeValidator, CompareValidator and RegularExpressionValidator).
5. Develop an ASP.NET web application to demonstrate page themes and master page.
6. Develop an ASP.NET web application to demonstrate session management across application.
7. Develop an ASP.NET web application with Databound controls (List, Tabular, and Hierarchical).
8. Develop an ASP.NET web application to demonstrate use of SQLDataSource control.
9. Develop an ASP.NET web application to demonstrate use of XMLDataSource control.
10. Develop any database driven web application using SQL Server (experiment should demonstrate creation, updating and deletion of records from the database).

Any other experiment based on syllabus which will help students to understand topic/concept.

### **Assessment:**

#### ***Term Work:***

Term work shall consist of minimum 7 experiments.

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments)	: 10 Marks
Laboratory work (Journal)	: 10 Marks
Attendance	: 5 Marks

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

### **Books Recommended:**

#### ***Text Books:***

1. ASP.NET 3.5 Unleashed (Sams) - Stephen Walther
2. Microsoft ASP.NET Step by Step (Microsoft Press) - G. Andrew Duthrie

#### ***Reference Books:***

1. Designing Microsoft ASP.NET Applications (Microsoft Press) - Jonathon Goodyear, Brian Peek, Brad Fox
2. Deploying and Managing Microsoft .NET Web Farms (Sams) - Barry Bloom

**Oral examination will be based on suggested practical list and entire syllabus.**

Course Code	Course Name	Teaching scheme			Credits assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
<b>BMDLL 6022</b>	<b>Department Level Optional Course – II Lasers and Fiber optics (LFO)</b>	--	<b>02</b>	--	--	<b>01</b>	--	<b>01</b>

Course Code	Course Name	Examination Scheme								
		Theory				Term work	Pract.	Oral	Pract. / Oral	Total
		Internal Assessment			End sem					
		Test 1	Test 2	Avg.						
<b>BMDLL 6022</b>	<b>Department Level Optional Course – II Lasers and Fiber optics (LFO)</b>	--	--	--	--	<b>25</b>	--	<b>25</b>	--	<b>50</b>

Course Code	Course Name	Credits
<b>BMDLL6022</b>	<b>Lasers and Fiber Optics</b>	<b>01</b>
<b>Course Objective</b>	<ul style="list-style-type: none"> <li>To understand the fundamentals in Laser and Fiber Optics.</li> <li>To understand the applications of Laser and Fiber optics in health sector.</li> </ul>	
<b>Course Outcome</b>	Learner will be able to: <ul style="list-style-type: none"> <li>Understand the fundamentals and clinical applications of Laser and Fiber Optics.</li> <li>Correlate the knowledge of medicine and engineering for the wellness of human being.</li> <li>Understand the safety aspects while dealing with Laser and Fiber Optic Units.</li> </ul>	

**Syllabus: Same as that of BMDLO6022 Lasers and Fibre Optics(LFO).**

**Laboratory work:**

1. Demonstrations in hospital / Industry.
2. Discussion on research articles and recent developments in the field of medicine.
3. Group presentations on the latest technology in hospitals based on the topics covered in the syllabus.
4. 5 Assignments based on the entire syllabus.



**Assessment:*****Term Work:***

Term work shall consist of minimum 7 experiments.

The distribution of marks for term work shall be as follows:

Laboratory work : 10 Marks

Laboratory work (Documentation) : 5 Marks

Presentation : 5 Marks

Attendance : 5 Marks

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

**Books Recommended:***Text Books:*

1. Lasers and Optical Fibers in Medicine – Abraham Catzir Academic press 1998
2. Optical Fiber Communication by Gerd Keiser

*Reference Books:*

1. Therapeutic Lasers – G David Baxter – Churchill Living stone publications
2. Medical Laser and their safe use – David H Shiny Stiffen and L Trokel Springer Publications
3. Element of Fiber optics – S. L. Wymer Regents PHI
4. Lasers in Urologic Surgery – Joseph A. Smith, Jr, Barry S. Stein, Ralph C. Benson Jr, Mosby Pub
5. Laser Fundamentals-William T. Silfvast, Cambridge University Press
6. Lasers in Medicine, Volume-1, Hans K. Koebner, John Wiley & Sons

**Oral examination will be based on entire syllabus**

Course Code	Course Name	Teaching scheme			Credits assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
BMDLL 6023	Department Level Optional Course – II Biological Modelling and Simulation (BMS)	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme								
		Theory				Term work	Pract.	Oral	Pract. / Oral	Total
		Internal Assessment			End sem					
		Test 1	Test 2	Avg.						
BMDLL 6023	Department Level Optional Course – II Biological Modelling and Simulation (BMS)	--	--	--	--	25	--	25	--	50

Course Code	Course Name	Credits
BMDLL6023	Biological Modelling and Simulation	01
<b>Course Objective</b>	<ul style="list-style-type: none"> <li>To understand basic approach of modeling for designing biological model.</li> <li>To simulate physiological processes for better understanding.</li> <li>To develop competency in terms of logical thinking, programming and application skills</li> <li>To train and motivate students for pursuing higher education and research for developing cutting edge technologies.</li> </ul>	
<b>Course Outcome</b>	Learner will be able to: <ul style="list-style-type: none"> <li>Apply concept of physiological modelling to model thermometer system.</li> <li>Virtually understand biophysical laws for calculation of membrane potential under different equilibrium conditions and develop simulation programs for understanding neuronal functions.</li> <li>Simulate mathematical model for the eye movement</li> <li>Electrically simulate model of thermoregulatory system</li> <li>Understand the usage of, and the assumptions behind biological models</li> </ul>	

	(immune response, drug delivery and insulin glucose feedback) in the working life.
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**Syllabus: Same as that of BMDLO6023 Biological Modelling and Simulation (BMS).**

**List of Laboratory Experiments (Any Seven)**

1. Simulations thermometer system using MATLAB
2. Simulation of Nernst/Goldman Equation using MATLAB
3. Simulation of eye movement using MATLAB
4. Simulation using HHSim (**Two practicals**)
5. Simulation using Neurons in Action (**Two practicals**)
6. Developing a model of a neuron using NEURON
7. Electrical simulation of thermoregulatory model

Any other experiment / assignment / presentation based on syllabus which will help students to understand topic/concept.

**Assessment:**

***Term Work:***

Term work shall consist of minimum 7 experiments.

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments) : 10 Marks

Laboratory work (Journal) : 10 Marks

Attendance : 5 Marks

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

**Books Recommended:**

*Text Books:*

1. Bioengineering, Biomedical, Medical and Clinical Engg.: A.Teri Bahil.
2. Signals and systems in Biomedical Engg.: Suresh R Devasahayam.
3. Bio-Electricity A quantitative approach by Barr and Ploncey

*Reference Books:*

1. Biomedical Engineering Handbook by Bronzino (CRC Press)

**Oral examination will be based on suggested practical list and entire syllabus**