

AC
Item No.

UNIVERSITY OF MUMBAI



Revised Syllabus for the
Biomedical Engineering
(Final Year – Semester VII and VIII)

(As per Choice Based Credit and Grading System
with effect from the academic year 2019–2020)

**Program Structure for
B.E. Biomedical Engineering
University of Mumbai
(With effect from academic year 2019 - 20)**

Scheme for Semester VII

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
BMC701	Life Saving and Surgical Equipment	04	----	----	04	----	----	04
BMC702	Basics of VLSI	04	----	----	04	----	----	04
BMC703	Medical Imaging-II	04	----	----	04	----	----	04
BMDLO703X	Department Level Optional Course – III	04	----	----	04	----	----	04
ILO101X	Institute Level Optional Course – I	03	----	----	03	----	----	03
BML701	Life Saving and Surgical Equipment	----	02	----	----	01	----	01
BML702	Basics of VLSI	----	02	----	----	01	----	01
BML703	Medical Imaging-II	----	02	----	----	01	----	01
BMDLL703X	Department Level Optional Course Laboratory – III	----	02	----	----	01	----	01
BML704	Project Stage I	----	06	----	----	03	----	03
Total		19	14	----	19	07	----	26

Examination Scheme for Semester VII

Course Code	Course Name	Examination Scheme												Total Marks
		Theory				Term work		Practical		Oral		Pract./Oral		
		External		Internal										
		(UA)		(CA)		Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	
BMC701	Life Saving and Surgical Equipment	80	32	20	8	---	---	---	---	---	---	---	---	100
BMC702	Basics of VLSI	80	32	20	8	---	---	---	---	---	---	---	---	100
BMC703	Medical Imaging-II	80	32	20	8	---	---	---	---	---	---	---	---	100
BMDLO 703X	Department Level Optional Course - III	80	32	20	8	---	---	---	---	---	---	---	---	100
ILE101X	Institute Level Optional Course – I	80	32	20	8	---	---	---	---	---	---	---	---	100
BML701	Life Saving and Surgical Equipment	---	---	---	---	25	10	---	---	25	10	---	---	50
BML702	Basics of VLSI	---	---	---	---	25	10	---	---	25	10	---	---	25
BML703	Medical Imaging-II	---	---	---	---	25	10	---	---	25	10	---	---	50
BMDLL 703X	Department Level Optional Course Laboratory – III	---	---	---	---	25	10	---	---	25	10	---	---	25
BML704	Project Stage I	---	---	---	---	25	10	---	---	25	10	---	---	50
Total		400	160	100	40	125	50	---	---	125	50			700

Scheme for Semester VIII

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
BMC801	Biomedical Microsystems	04	----	----	04	----	----	04
BMC802	Hospital Management	04	----	----	04	----	----	04
BMDLO804X	Department Level Optional Course – IV	04	----	----	04	----	----	04
ILO202X	Institute Level Optional Course – II	03	----	----	03	----	----	03
BML801	Biomedical Microsystems	----	02	----	----	01	----	01
BML802	Hospital Management	----	02	----	----	01	----	01
BMDLL804X	Department Level Optional Course Laboratory – IV	----	02	----	----	01	----	01
BML803	Project Stage II	----	12	----	----	06	----	06
Total		15	18	----	15	09	----	24

Examination Scheme for Semester VIII

Course Code	Course Name	Examination Scheme												Total Marks
		Theory				Term work		Practical		Oral		Pract./Oral		
		External		Internal										
		(UA)		(CA)		Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	
BMC801	Biomedical Microsystems	80	32	20	8	---	---	---	---	---	---	---	---	100
BMC802	Hospital Management	80	32	20	8	---	---	---	---	---	---	---	---	100
BMDLO 801X	Department Level Optional Course - IV	80	32	20	8	---	---	---	---	---	---	---	---	100
ILO202X	Institute Level Optional Course –II	80	32	20	8	---	---	---	---	---	---	---	---	100
BML801	Biomedical Microsystems	---	---	---	---	25	10	---	---	25	10	---	---	50
BML802	Hospital Management	---	---	---	---	25	10	---	---	25	10	---	---	50
BMDLL 801X	Department Level Optional Course Laboratory – IV	---	---	---	---	25	10	---	---	25	10	---	---	25
BML803	Project Stage II	---	---	---	---	50	20	---	---	---	---	50	20	100
Total		320	128	80	32	125	50	---	---	75	30	50	20	625

Course Code	Department level Optional Course – III
BMDLO7031	Networking and Information in Medical System
BMDLO7032	Advanced Image Processing
BMDLO7033	Embedded Systems

Course Code	Department level Optional Course – IV
BMDLO8041	Health Care Informatics
BMDLO8042	Robotics in Medicine
BMDLO8043	Nuclear Medicine

Course Code	Institute level Optional Course – I
ILO1011	Product Lifecycle Management
ILO1012	Reliability Engineering
ILO1013	Management Information System
ILO1014	Design of Experiments
ILO1015	Operation Research
ILO1016	Cyber Security and Laws
ILO1017	Disaster Management and Mitigation Measures
ILO1018	Energy Audit and Management

Course Code	Institute level Optional Course - II
ILO2021	Project Management
ILO2022	Finance Management
ILO2023	Entrepreneurship Development and Management
ILO2024	Human Resource Management
ILO2025	Professional Ethics and Corporate Social Responsibility (CSR)
ILO2026	Research Methodology
ILO2027	IPR and Patenting
ILO2028	Digital Business Management
ILO2029	Environmental Management

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
BMC701	Life Saving and Surgical Equipment (Abbreviated as LSSE)	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.							
BMC701	Life Saving and Surgical Equipment (LSSE)	20	20	20	80	03	--	--	--	--	100

Course Code	Course Name	Credits
BMC701	Life Saving Equipment	04
Course Objectives	<ul style="list-style-type: none"> To understand the basic principles and working of life Saving Equipment. To develop skills enabling Biomedical Engineers to serve the health care industry To develop core competency and skill in the field of Biomedical Engineering, to design and develop new health care systems. 	
Course Outcomes	<p>Learner will be able to...</p> <ul style="list-style-type: none"> Distinguish between the types of pacemakers on the basis of ICHD code and analyze the various circuits. Apply the knowledge of electronics to analyze defibrillator circuits. Explain the importance of use of Anesthesia machine and Capnograph during Surgery. Explain the basic principle, working and applications of surgical equipment with safety aspects. Explain the importance of measurement of oxygen saturation in human body and application of heart lung machine during surgery. Demonstrate the knowledge of lithotripsy technique. 	

Module	Contents	Hours
1	Cardiac Pacemakers Need for a pacemaker, modes of operation, Classification codes for pacemaker, External and Implantable Pacemaker, programmable pacemaker, Power sources for pacemakers, leads and electrodes, recent developments of Implantable Pacemakers.	10
2	Cardiac Defibrillator Need for Defibrillator, DC defibrillator, Modes of operation and electrodes, Performance aspects of dc-defibrillator, Implantable defibrillator, cardioverter.	10
3	Anesthesia Need for anesthesia, Anesthesia machine: Gas supply, flow and delivery system Vapor delivery and humidification and patient breathing Capnography.	06
4	Surgical equipment Operation theatre Lights and Table. Surgical Diathermy machine, automated electrosurgical systems, electrodes used with surgical diathermy, safety aspects in electronic surgical units.	10
5	Oximeters + Heart Lung machine Basics of oximeter, In-vitro and In-vivo oximetry, ear oximetry, pulse oximetry, skin reflectance oximeters, intravascular oximeters, Heart Lung Machine and types of oxygenators	08
6	Lithotriptors The stone disease problem, the shock-wave, the first lithotripter machine, modern lithotripter system, LASER Lithotripsy	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. 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 : Leislie 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
BMC702	Basics of VLSI (Abbreviated as BVLSI)	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.							
BMC702	Basics of VLSI (BVLSI)	20	20	20	80	03	--	--	--	--	100

Course Code	Course Name	Credits
BMC702	Basics of VLSI	04
Course Objectives	<ul style="list-style-type: none"> To introduce to various fabrication technologies for electronic devices. To expose to hardware description language which will help them to understand and design various tools for the devices. 	
Course Outcomes	<p>A Learner will be able to</p> <ul style="list-style-type: none"> Understand hardware description language used to model circuits Implement some basic digital circuits using HDL Understand the physics of MOS devices Understand the implementation of inverter circuits using CMOS devices and noise in these circuits Understand the fabrication technology used in IC fabrication and how system clocking is designed. Understand the design rules and layouts for various digital gates 	

Module	Contents	Hours
1.	Introduction to VHDL hardware description language, core features of VHDL, data types, concurrent and sequential statements, data flow, behavioral, structural architecture.	04
2.	Combinational and Sequential Logic design using VHDL .Using VHDL combinational circuit design examples- multipliers, decoders and encoders, cascading comparator. VHDL sequential circuit design features.	08

	Implementation of counters and registers in VHDL	
3.	Very Large Scale Integration (VLSI) Technology Physics of NMOS, PMOS, enhancement and depletion mode transistor, MOSFET, threshold voltage, flatband condition, linear and saturated operation, FET capacitance, short channel and hot electron effect.	08
4.	MOS Transistors, MOS transistor switches, Basic MOS inverter and its working, types of MOS invertors viz active load nMOS inverter, MOSFET Inverter with E-nMOS as pull up, MOSFET Inverter with D- nMOS as pull up, MOSFET Inverter with pMOS as pull up, CMOS inverter, voltage transfer characteristics, noise immunity and noise margins, power and area considerations ,Parameter measurement in MOS circuits	08
5.	Silicon Semiconductor Technology Wafer processing, mask generation, oxidation, epitaxy growth diffusion, ion implantation, lithography, etching, metalization, basic NMOS and PMOS processes. Latch up in CMOS and CMOS using twin tub process. Scaling of MOS circuits, types of scaling and limitations of scaling. Introduction to VLSI Clocking and System Design: Clocking: CMOS clocking styles, Clock generation, stabilization and distribution. Low Power CMOS Circuits: Various components of power dissipation in CMOS, Limits on low power design, low power design through voltage scaling.	10
6.	Design rules and Layout NMOS and CMOS design rules and layout, Design of NMOS and CMOS inverters, NAND and NOR gates. Interlayer contacts, butting and buried contacts, stick diagrams, layout of inverter, NAND and NOR gates. Design of basic VLSI circuits Design of circuits like multiplexer, decoder, Flip flops, using MOS circuits	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. Introduction to VLSI design, E. D. Fabricus, McGraw Hill Publications, first edition, 1990
2. Basic VLSI Design D.A. Pucknell and Eshraghian,
3. Digital Design Principles and Practises John F Wakerly,
4. CMOS Digital Integrated Circuits, Kang , Tata McGraw Hill Publications

Reference Books:

1. VHDL Programming by Examples Douglas Perry, , Tata McGraw Hill Publications, 2002
2. Principles of CMOS VLSI Design : A Systems Perspective Neil H.E. Weste, Kamran Eshraghian second edition, Addison Wesley Publications, 1993
3. Digital Integrated Circuits: A Design Perspective, Rabaey Jan M., Chandrakasan Anantha, Nikolic Borivoje, second edition, Prentice Hall of India

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
BMC703	Medical Imaging - II (Abbreviated as MI – II)	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.							
BMC703	Medical Imaging - II (MI – II)	20	20	20	80	03	--	--	--	--	100

Course Code	Course Name	Credits
BMC703	Medical Imaging II	04
Course Objectives	<ul style="list-style-type: none"> To familiarize the learners with the various Imaging techniques in medicine operating principles and quality control aspects of various imaging modalities. To keep the learners abreast with the technological developments in the field of Medical Imaging 	
Course Outcomes	<p>Learner will be able to...</p> <ul style="list-style-type: none"> Understand use of Ultrasound in medicine, distinguish various ultrasonic display system, understand the construction and operation of the ultrasonic transducer, understand the clinical applications of Doppler Techniques Apply the basic concepts of physics in understanding Physics of MRI Understand the hardware of MRI Machine, Spin echo Imaging, Pulse sequence, image reconstruction, resolution and SNR, Biological effects and clinical applications To understand the basic principle of Magnetic Resonance Spectroscopy To understand nuclear imaging techniques and positron emission tomography and apply the concepts to understand hybrid imaging To understand Endoscopy 	

Module	Contents	Hours
1	Ultrasound in Medicine: Introduction , Production and Characteristics of Ultrasound Display System: A mode, B mode and M Mode, TM mode display and applications. Ultrasound transducers and Instrumentation. Real time Ultrasound ,Continuous wave and Pulsed Doppler, 2D-Echo Clinical applications	12
2	Physics of MRI: Magnetic Dipole Moments, Relaxation Parameters, Spin Echo, Magnetic Field Gradients, Slice selection, Phase and Frequency Encoding	06
3	Magnetic Resonance Imaging Hardware: Magnets, Gradient coils, RF coils, Spin Echo Imaging, Inversion Recovery Pulse Sequence, Image Reconstruction, Resolution and Factors affecting signal-to-noise. Safety Considerations and Biological Effects of MRI, Clinical applications	12
4	Magnetic Resonance Spectroscopy (MRS) Basic Principle of MRS and localization techniques, Chemical Shift Imaging, Single-voxel and Multivoxel MRS, Water Suppression techniques	06
5	Hybrid Imaging Introduction, Principles and applications of PET and SPECT, Introduction to Hybrid Modalities: PET/CT, SPECT/CT Clinical Applications	08
6	Endoscopy Equipment , Imaging and its applications	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. Christensen's Physics of Diagnostic Radiology
2. Medical Imaging Physics William .R.Hendee
3. The essential physics of Medical Imaging- Jerrold T. Bushberg, J. Anthony Seibert, Edwin L, John Boone

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
BMDLO7031	Department Level Optional Course - III: Networking and Information in Medical Systems (Abbreviated as NIMS)	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 7031	Networking and Information in Medical Systems (NIMS)	20	20	20	80	03	--	--	--	--	100

Course Code	Course Name	Credits
BMDLO7031	Networking and Information in Medical Systems	04
Course Objectives	<ul style="list-style-type: none"> To understand the fundamental component of computer Networking. To understand the functioning and configuration of various networking devices and components. To understand a concept about network security. Understand various Information system used in Healthcare System To understand the healthcare IT infrastructure Understand various IHE domains 	
Course Outcomes	Learners will be able to: <ul style="list-style-type: none"> Understand the fundamental components of computer networks and networking protocols. Understand IP addressing, functioning and configuration of various networking devices and components Understand concepts about network security Understand the PACS components, architecture and PACS tele radiology 	

	<ul style="list-style-type: none"> • Understand HIS, RIS integration of HIS/RIS/PACS, PACS archive and servers • Understand IHE and IHE domains
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Module	Contents	Hours
	Networking Technology	
1	Performance of network/device parameters: Bandwidth, Throughput, Jitter, Latency Network Technology, Types of cables and connectors, Crossover and straight through cables, Colour coding of cables, OSI Model, TCP/IP, Addressing types (IP, MAC & Port)	08
2	IP V4 addressing, Subnetting, Supernetting, IP V6, Detailed working of networking equipment: HUB, Switch, Router, Modem, Bridge; Packet switching, Circuit switching.	08
3	Basic Security Concepts Security Mechanism and security services, Authentication, Authorization, Confidentiality, Integrity, Symmetric and Asymmetric Key cryptography, RSA algorithm	06
	Information Systems in Medicine	
4	PACS Components, Generic workflow, PACS architectures: stand-alone, client-server, and Web-based, PACS and Teleradiology, Enterprise PACS and ePR System with Image Distribution	10
5	Introduction to RIS and HIS, HIS/RIS/PACS integration, PACS Archive Storage: RAID, PACS Server, Fault Tolerant PACS, HIPPA	08
6	Integrating Healthcare Enterprise: IHE Workflow Model, IHE Domains, IHE Patient Information Reconciliation Profile, IHE Radiology Information Integration Profile	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. PACS and Imaging Informatics by Huang, Second Edition, Wiley and Blackwell
2. PACS Guide to Digital Revolution by Keith J. Dreyer (Springer)
3. Data Communication and Networking by Behrouz A. Forouzan McGraw Hill
4. Computer Networks by A.S. Tanenbaum, Pearson Education

Reference Books:

1. Governance of Picture Archiving and Communications Systems by Carrison K.S. Tong (Medical

Information Science Reference)

2. Practical Imaging Informatics, By Barton F. Branstetter, Springer
3. PACS fundamentals- By Herman Oosterwijk
4. Cryptography and Network Security By William Stalling, Pearsons

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
BMDLO7032	Department Level Optional Course - III: Advanced Image Processing (Abbreviated as AIP)	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 7032	Advanced Image Processing (AIP)	20	20	20	80	03	--	--	--	--	100

Course Code	Course Name	Credits
BMDLO7032	Advanced Image Processing	04
Course Objectives	<ul style="list-style-type: none"> To introduce the learners to advanced theory of digital image processing. To expose learners to various available techniques and possibilities of this field. To understand the various techniques & algorithms such as Colour imaging, Feature extraction, Restoration, Texture and Application To prepare learners to formulate solutions to Complex image processing Algorithms To develop programming skills to solve complex Image Processing Problems 	
Course Outcomes	<p>Learner will be able to ...</p> <ul style="list-style-type: none"> Acquire the advanced concepts of a digital image processing system such as Colour imaging, Feature extraction, Restoration, Texture and Application Extract feature and classify images. Design Image restoration and segmentation using various complex algorithms. Strategize and implement with MATLAB/C/SCILAB algorithms for advanced digital image processing operations. 	

Module	Contents	Hours
1	Colour Image Processing: Introduction, Physics of Colour, Colour Models, Pseudo Colouring, Colour Histograms, Colour Segmentation	08
2	Feature recognition and classification: Object recognition and classification, Connected components labelling, Features, Object recognition and classification, Statistical classification, Structural/syntactic Classification, Applications in medical image analysis. Three-dimensional: visualization: Image visualization , Surface rendering, Volume rendering,	10
3	Image restoration: Image degradation, Noise, Noise-reduction filters, Blurring, Modeling image degradation, Geometric degradations, Inverse filtering, Wiener Filter, Geometric Mean filter, Geometric Transformation	08
4	Advanced Image of Image Segmentation: Canny edge detectors, Clustering methods, Classifiers, Watershed Algorithm, Top Hat and Bottom Hat Transformation	10
5	Texture: Grey Level Co-Occurrence Matrix, Energy, entropy, maximum probability, Laplacian and Gaussian pyramid, Texels and Texel based descriptors.	06
6	Wavelet Transform and Application: Basics of 1-D, 2-D DWT, Wavelet Pyramids, Computer-aided diagnosis in mammography, Tumour imaging and treatment, Angiography, Bone strength and osteoporosis, Tortuosity	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. Digital Image Processing for Medical Applications, GEOFF DOUGHERTY, Cambridge University Press.
2. Digital Image Processing, Gonzalez and Woods, Pearson Education
3. Image Processing analysis and Machine Vision, Milind Sonka et.al Cengage

Reference Books:

1. Computer Vision, Linda Shapiro et.al Addison-Wesley
2. Computer Vision a Modern Approach, David A. Forsyth, Jean Ponce, Pearson

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
BMDLO7033	Department Level Optional Course - III: Embedded Systems (Abbreviated as ES)	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 7033	Embedded Systems (ES)	20	20	20	80	03	--	--	--	--	100

Course Code	Course Name	Credits
BMDLO7033	Embedded Systems in Biomedical Engineering	04
Course Objectives	<ul style="list-style-type: none"> To provide an introduction to modern embedded systems To understand the design, implementation and programming of modern real time embedded systems. 	
Course Outcomes	<p>Learner will be able to</p> <ul style="list-style-type: none"> To become aware of the embedded hardware and software components in an embedded system, classification, skills required for an embedded system designer and applications of modern embedded systems. To analyse the design and development process of embedded systems. To understand the I/O devices, communication buses and distributed networked embedded architecture. To understand the concepts of device drivers and interrupt service mechanisms To understand RTOS. To understand the basic design and programming using RTOS. 	

Module	Contents	Hours
1	Introduction to Embedded System	05

	Definition, Processor Embedded into a system, Embedded Hardware, Embedded Software, Embedded-system Design, Embedded-system Architecture, Embedded-system Model, Classification, Skills required for an ES designer, Examples of Embedded-system	
2	Embedded System Design & Development Process Embedded System-On-Chip, Complex System Design and Processors, Build Process, Design Process, Design Challenges and Optimization of Design Metrics, Embedded-Software Development Challenges, Hardware Software Co-Design, Formalism of System Design, Design Process and Design Examples	10
3	I/O Devices, Communication Buses and Distributed Networked Embedded Architecture I/O Types and Examples, Serial Communication Devices, Parallel Device Ports, Sophisticated Interfacing Features, Wireless Devices, Timer and Counting Devices, Distributed Network ES Architecture, Serial Bus Communication Protocols, Parallel Bus Device Protocols- Using ISA, PCI, PCI-X and Advanced Buses, Internet Enabled Systems, Wireless and Mobile System Protocols	08
4	Device Drivers and Interrupts Service Mechanism Port for Device Accesses without Interrupts Servicing Mechanism, Interrupt Driven I/O, Interrupt Service Routine, Interrupt Sources, Hardware and Software Interrupts, Interrupt-servicing Mechanism, Multiple Interrupts, Interrupt Service Threads, Context and Period for Context Switching, Interrupt Latency, Interrupt-Service Deadline, Classification of Interrupt Service Mechanism, Direct Memory Access Driven I/O	07
5	Introduction to RTOS Introduction to Round Robin, Round Robin with Interrupts, Real-Time Operating System Architecture, Selecting an Architecture, Task and Task States and Data, Semaphores and Shared Data	08
6	Basic Design using RTOS & Programming Overview, Principles, Encapsulating Semaphores and Queues, Hard Real-Time Scheduling Considerations, Saving Memory Space, Saving Power, Case Study	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. Embedded System Architecture, Programming & Design (Third Edition)- Raj Kamal
2. An Embedded Software Primer- David E. Simon

Reference Books:

1. Embedded Real time Systems Programming- Sriram V Iyer, Pankaj Gupta

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
ILO1011	Institute Level Optional Course - I: Product Life Cycle Management	03	--	--	03	--	--	03

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.							
ILO1011	Institute Level optional Course -I: Product Life Cycle Management	20	20	20	80	03	--	--	--	--	100

Course Code	Course Name	Credits
ILO1011	Product Life Cycle Management	03
Course Objectives	<ul style="list-style-type: none"> To familiarize the students with the need, benefits and components of PLM To acquaint students with Product Data Management & PLM strategies To give insights into new product development program and guidelines for designing and developing a product To familiarize the students with Virtual Product Development 	
Course Outcomes	<p>Learner will be able to...</p> <ul style="list-style-type: none"> Gain knowledge about phases of PLM, PLM strategies and methodology for PLM feasibility study and PDM implementation. Illustrate various approaches and techniques for designing and developing products. Apply product engineering guidelines / thumb rules in designing products for moulding, machining, sheet metal working etc. Acquire knowledge in applying virtual product development tools for components, machining and manufacturing plan 	

Module	Contents	Hours
01	<p>Introduction to Product Lifecycle Management (PLM):Product Lifecycle Management (PLM), Need for PLM, Product Lifecycle Phases, Opportunities of Globalization, Pre-PLM Environment, PLM Paradigm, Importance & Benefits of PLM, Widespread Impact of PLM, Focus and Application, A PLM Project, Starting the PLM Initiative, PLM Applications</p> <p>PLM Strategies: Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy , Change management for PLM</p>	12
02	<p>Product Design: Product Design and Development Process, Engineering Design, Organization and Decomposition in Product Design, Typologies of Design Process Models, Reference Model, Product Design in the Context of the Product Development Process, Relation with the Development Process Planning Phase, Relation with the Post design Planning Phase, Methodological Evolution in Product Design, Concurrent Engineering, Characteristic Features of Concurrent Engineering, Concurrent Engineering and Life Cycle Approach, New Product Development (NPD) and Strategies, Product Configuration and Variant Management, The Design for X System, Objective Properties and Design for X Tools, Choice of Design for X Tools and Their Use in the Design Process</p>	09
03	<p>Product Data Management (PDM):Product and Product Data, PDM systems and importance, Components of PDM, Reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation</p>	06
04	<p>Virtual Product Development Tools: For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques, Digital mock-up, Model building, Model analysis, Modeling and simulations in Product Design, Examples/Case studies</p>	06
05	<p>Integration of Environmental Aspects in Product Design: Sustainable Development, Design for Environment, Need for Life Cycle Environmental Strategies, Useful Life Extension Strategies, End-of-Life Strategies, Introduction of Environmental Strategies into the Design Process, Life Cycle Environmental Strategies and Considerations for Product Design</p>	06
06	<p>Life Cycle Assessment and Life Cycle Cost Analysis: Properties, and Framework of Life Cycle Assessment, Phases of LCA in ISO Standards, Fields of Application and Limitations of Life Cycle Assessment, Cost Analysis and the Life Cycle Approach, General Framework for LCCA, Evolution of Models for Product Life Cycle Cost Analysis</p>	06

Assessment:

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.

REFERENCES:

1. John Stark, “Product Lifecycle Management: Paradigm for 21st Century Product Realisation”, Springer-Verlag, 2004. ISBN: 1852338105
2. Fabio Giudice, Guido La Rosa, Antonino Risitano, “Product Design for the environment- A life cycle approach”, Taylor & Francis 2006, ISBN: 0849327229
3. Saaksvuori Antti, Immonen Anselmie, “Product Life Cycle Management”, Springer, Dreamtech, ISBN: 3540257314
4. Michael Grieve, “Product Lifecycle Management: Driving the next generation of lean thinking”, Tata McGraw Hill, 2006, ISBN: 0070636265

Theory Examination:

Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ILO1012	Institute Level Optional Course- I: Reliability Engineering	03	--	--	03	--	--	03

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.							
ILO1012	Institute Level Optional Course -I: Reliability Engineering	20	20	20	80	03	--	--	--	--	100

Course Code	Course Name	Credits
ILO1012	Reliability Engineering	03
Course Objectives	<ul style="list-style-type: none"> To familiarize the students with various aspects of probability theory To acquaint the students with reliability and its concepts To introduce the students to methods of estimating the system reliability of simple and complex systems To understand the various aspects of Maintainability, Availability and FMEA procedure. 	
Course Outcomes	<p>Learner will be able to</p> <ul style="list-style-type: none"> Understand and apply the concept of Probability to engineering problems Apply various reliability concepts to calculate different reliability parameters Estimate the system reliability of simple and complex systems Carry out a Failure Mode Effect and Criticality Analysis 	

Module	Contents	Hours
01	<p>Probability theory: Probability: Standard definitions and concepts; Conditional Probability, Baye's Theorem.</p> <p>Probability Distributions: Central tendency and Dispersion; Binomial, Normal, Poisson, Weibull, Exponential, relations between them and their significance.</p> <p>Measures of Dispersion: Mean, Median, Mode, Range, Mean Deviation, Standard Deviation, Variance, Skewness and Kurtosis.</p>	10
02	<p>Reliability Concepts: Reliability definitions, Importance of Reliability, Quality Assurance and Reliability, Bath Tub Curve.</p> <p>Failure Data Analysis: Hazard rate, failure density, Failure Rate, Mean Time To Failure (MTTF), MTBF, Reliability Functions.</p> <p>Reliability Hazard Models: Constant Failure Rate, Linearly increasing, Time Dependent Failure Rate, Weibull Model. Distribution functions and reliability analysis.</p>	10
03	<p>System Reliability</p> <p>System Configurations: Series, parallel, mixed configuration, k out of n structure, Complex systems.</p>	05
04	<p>Reliability Improvement</p> <p>Redundancy Techniques: Element redundancy, Unit redundancy, Standby redundancies. Markov analysis.</p> <p>System Reliability Analysis – Enumeration method, Cut-set method, Success Path method, Decomposition method.</p>	10
05	<p>Maintainability and Availability</p> <p>System downtime, Design for Maintainability: Maintenance requirements, Design methods: Fault Isolation and self-diagnostics, Parts standardization and Interchangeability, Modularization and Accessibility, Repair Vs Replacement.</p> <p>Availability – qualitative aspects.</p>	05
06	<p>Failure Mode, Effects and Criticality Analysis: Failure mode effects analysis, severity/criticality analysis, FMECA examples. Fault tree construction, basic symbols, development of functional reliability block diagram, Fault tree analysis and Event tree Analysis</p>	05

Assessment:

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.

REFERENCES:

1. L.S. Srinath, "Reliability Engineering", Affiliated East-Wast Press (P) Ltd., 1985.
2. Charles E. Ebeling, "Reliability and Maintainability Engineering", Tata McGraw Hill.
3. B.S. Dhillon, C. Singh, "Engineering Reliability", John Wiley & Sons, 1980.
4. P.D.T. Connor, "Practical Reliability Engg.", John Wiley & Sons, 1985.
5. K.C. Kapur, L.R. Lamberson, "Reliability in Engineering Design", John Wiley & Sons.
6. Murray R. Spiegel, "Probability and Statistics", Tata McGraw-Hill Publishing Co. Ltd.

Theory Examination:

Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

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4. Only Four question need to be solved.

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ILO1013	Institute Level Optional Course - I: Management Information System	03	--	--	03	--	--	03

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.							
ILO1013	Institute Level Optional Course -I: Management Information System	20	20	20	80	03	--	--	--	--	100

Course Code	Course Name	Credits
ILO1013	Management Information System	03
Course Objectives	<ul style="list-style-type: none"> The course is blend of Management and Technical field. Discuss the roles played by information technology in today's business and define various technology architectures on which information systems are built Define and analyze typical functional information systems and identify how they meet the needs of the firm to deliver efficiency and competitive advantage Identify the basic steps in systems development Define and analyze various MIS management responsibilities, including planning, budgeting, project management, and personnel management Discuss critical ethical and social issues in information systems 	
Course Outcomes	<p>Learner will be able to</p> <ul style="list-style-type: none"> Explain how information systems Transform Business Identify the impact information systems have on an organization Describe IT infrastructure and its components and its current trends Understand the principal tools and technologies for accessing information from databases to improve business performance and decision making Identify the types of systems used for enterprise-wide knowledge management 	

	and how they provide value for businesses
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Module	Detailed Contents	Hours
01	Introduction To Information Systems (IS): Computer Based Information Systems, Impact of IT on organizations, Importance of IS to Society. Organizational Strategy, Competitive Advantages and IS.	07
02	Data and Knowledge Management: Database Approach, Big Data, Data warehouse and Data Marts, Knowledge Management. Business intelligence (BI): Managers and Decision Making, BI for Data analysis and Presenting Results	09
03	Ethical issues and Privacy: Information Security. Threat to IS, and Security Controls	06
04	Social Computing (SC): Web 2.0 and 3.0, SC in business-shopping, Marketing, Operational and Analytic CRM, E-business and E-commerce – B2B B2C. Mobile commerce.	07
05	Computer Networks Wired and Wireless technology, Pervasive computing, Cloud computing model.	06
06	Information System within Organization: Transaction Processing Systems, Functional Area Information System, ERP and ERP support of Business Process. Acquiring Information Systems and Applications: Various System development life cycle models.	10

Assessment:

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.

REFERENCES:

1. Management Information Systems: Kelly Rainer, Brad Prince by Wiley
2. Management Information Systems: Managing the Digital Firm (10th Edition). K.C. Laudon and J.P. Laudon, Prentice Hall, 2007.

3. Managing Information Systems: Strategy and Organization, D. Boddy, A. Boonstra, Prentice Hall, 2008

Theory Examination:

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4. Only Four question need to be solved.

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ILO1014	Institute Level Optional Course - I: Design of Experiments	03	--	--	03	--	--	03

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.							
ILO1014	Institute Level Optional Course -I: Design of Experiments	20	20	20	80	03	--	--	--	--	100

Course Code	Course Name	Credits
ILO1014	Design of Experiments	03
Course Objectives	<ul style="list-style-type: none"> To understand the issues and principles of Design of Experiments (DOE). To list the guidelines for designing experiments. To become familiar with methodologies that can be used in conjunction with experimental designs for robustness and optimization 	
Course Outcomes	<p>Learner will be able to</p> <ul style="list-style-type: none"> Plan data collection, to turn data into information and to make decisions that lead to appropriate action. Apply the methods taught to real life situations. Plan, analyze, and interpret the results of experiments 	

Module	Detailed Contents	Hours
01	Introduction: Strategy of Experimentation, Typical Applications of Experimental Design, Guidelines for Designing Experiments, Response Surface Methodology.	06
02	Fitting Regression Models: Linear Regression Models, Estimation of the Parameters in Linear Regression Models, Hypothesis Testing in	08

	Multiple Regression, Confidence Intervals in Multiple Regression, Prediction of new response observation, Regression model diagnostics, Testing for lack of fit.	
03	Two-Level Factorial Designs: The 2^2 Design, The 2^3 Design, The General 2^k Design, A Single Replicate of the 2^k Design, The Addition of Center Points to the 2^k Design, Blocking in the 2^k Factorial Design, Split-Plot Designs.	07
04	Two-Level Fractional Factorial Designs: The One-Half Fraction of the 2^k Design, The One-Quarter Fraction of the 2^k Design, The General 2^{k-p} Fractional Factorial Design, Resolution III Designs, Resolution IV and V Designs, Fractional Factorial Split-Plot Designs.	07
05	Conducting Tests: Testing Logistics, Statistical aspects of conducting tests, Characteristics of good and bad data sets, Example experiments, Attribute Vs Variable data sets.	07
06	Taguchi Approach: Crossed Array Designs and Signal-to-Noise Ratios, Analysis Methods, Robust design examples.	04

Assessment:

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.

REFERENCES:

1. Raymond H. Myers, Douglas C. Montgomery, Christine M. Anderson-Cook, Response Surface Methodology: Process and Product Optimization using Designed Experiment, 3rd edition, John Wiley & Sons, New York, 2001
2. D.C. Montgomery, Design and Analysis of Experiments, 5th edition, John Wiley & Sons, New York, 2001
3. George E P Box, J Stuart Hunter, William G Hunter, Statics for Experimenters: Design, Innovation and Discovery, 2nd Ed. Wiley
4. W J Dimond, Peactical Experiment Designs for Engineers and Scintists, John Wiley and Sons Inc. ISBN: 0-471-39054-2
5. Design and Analysis of Experiments (Springer text in Statistics), Springer by A.M. Dean, and D. T.Voss
6. Philip J Ross, "Taguchi Technique for Quality Engineering," McGraw Hill.
7. Madhav S Phadake, "Quality Engineering using Robust Design," Prentice Hall.

Theory Examination:

Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

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4. Only Four question need to be solved.

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ILO1015	Institute Level Optional Course - I: Operations Research	03	--	--	03	--	--	03

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.							
ILO1015	Institute Level Optional Course -I: Operations Research	20	20	20	80	03	--	--	--	--	100

Course Code	Course Name	Credits
ILO1015	Operations Research	03
Course Objectives	<ul style="list-style-type: none"> Formulate a real-world problem as a mathematical programming model. Understand the mathematical tools that are needed to solve optimization problems. Use mathematical software to solve the proposed models. 	
Course Outcomes	<p>Learner will be able to...</p> <ul style="list-style-type: none"> Understand the theoretical workings of the simplex method for linear programming and perform iterations of it by hand. Understand the relationship between a linear program and its dual, including strong duality and complementary slackness. Perform sensitivity analysis to determine the direction and magnitude of change of a model's optimal solution as the data change. Solve specialized linear programming problems like the transportation and assignment problems. 	

	<ul style="list-style-type: none"> • Solve network models like the shortest path, minimum spanning tree, and maximum flow problems. • Understand the applications of, basic methods for, and challenges in integer programming • Model a dynamic system as a queuing model and compute important performance measures
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Module	Detailed Contents	Hours
01	Introduction to Operations Research: Introduction, Historical Background, Scope of Operations Research , Features of Operations Research, Phases of Operations Research, Types of Operations Research Models, Operations Research Methodology, Operations Research Techniques and Tools , Structure of the Mathematical Model, Limitations of Operations Research	02
02	Linear Programming: Introduction, Linear Programming Problem, Requirements of LPP, Mathematical Formulation of LPP, Graphical method, <i>Simplex Method</i> Penalty Cost Method or Big M-method, Two Phase Method, Revised simplex method, Duality , Primal – Dual construction, Symmetric and Asymmetric Dual, Weak Duality Theorem, Complimentary Slackness Theorem, Main Duality Theorem, Dual Simplex Method, Sensitivity Analysis	06
03	Transportation Problem: Formulation, solution, unbalanced Transportation problem. Finding basic feasible solutions – Northwest corner rule, least cost method and Vogel’s approximation method. Optimality test: the stepping stone method and MODI method. Assignment Problem: Introduction, Mathematical Formulation of the Problem, Hungarian Method Algorithm, Processing of n Jobs Through Two Machines and m Machines, Graphical Method of Two Jobs m Machines Problem Routing Problem, Travelling Salesman Problem	06
04	Integer Programming Problem: Introduction, Types of Integer Programming Problems, Gomory’s cutting plane Algorithm, Branch and Bound Technique. Introduction to Decomposition algorithms.	06
05	Queuing models: queuing systems and structures, single server and multi-server models, Poisson input, exponential service, constant rate service, finite and infinite population	06

06	Simulation: Introduction, Methodology of Simulation, Basic Concepts, Simulation Procedure, Application of Simulation <i>Monte-Carlo Method:</i> Introduction, Monte-Carlo Simulation, Applications of Simulation, Advantages of Simulation, Limitations of Simulation	04
07	Dynamic programming. Characteristics of dynamic programming. Dynamic programming approach for Priority Management employment smoothening, capital budgeting, Stage Coach/Shortest Path, cargo loading and Reliability problems.	04
08	Games Theory. Competitive games, rectangular game, saddle point, minimax (maximin) method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy for 2 X 2 games.	04
09	Inventory Models: Classical EOQ Models, EOQ Model with Price Breaks, EOQ with Shortage, Probabilistic EOQ Model,	04

Assessment:

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.

REFERENCES:

1. Taha, H.A. "Operations Research - An Introduction", Prentice Hall, (7th Edition), 2002.
2. Ravindran, A, Phillips, D. T and Solberg, J. J. "Operations Research: Principles and Practice", John Willey and Sons, 2nd Edition, 2009.
3. Hiller, F. S. and Liebermann, G. J. "Introduction to Operations Research", Tata McGraw Hill, 2002.
4. Operations Research, S. D. Sharma, KedarNath Ram Nath-Meerut.
5. Operations Research, KantiSwarup, P. K. Gupta and Man Mohan, Sultan Chand & Sons.

Theory Examination:

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Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ILO1016	Institute Level Optional Course - I: Cyber Security and Laws	03	--	--	03	--	--	03

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.							
ILO1016	Institute Level Optional Course -I: Cyber Security and laws	20	20	20	80	03	--	--	--	--	100

Course Code	Course Name	Credits
ILO1016	Cyber Security and Laws	03
Course Objectives	<ul style="list-style-type: none"> • To understand and identify different types cyber crime and cyber law • To recognized Indian IT Act 2008 and its latest amendments • To learn various types of security standards compliances 	
Course Outcomes	<p>Learner will be able to</p> <ul style="list-style-type: none"> • Understand the concept of cyber crime and its effect on outside world • Interpret and apply IT law in various legal issues • Distinguish different aspects of cyber law • Apply Information Security Standards compliance during software design and development 	

Module	Detailed Contents	Hours
01	Introduction to Cybercrime: Cybercrime definition and origins of the world, Cybercrime and information security, Classifications of cybercrime, Cybercrime and the Indian ITA 2000, A global Perspective on cybercrimes.	04
02	Cyber offenses & Cybercrime: How criminal plan the attacks, Social Engg, Cyber stalking, Cybercafé and Cybercrimes, Botnets, Attack vector, Cloud computing, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Devices-Related Security Issues, Organizational Security Policies and Measures in Mobile Computing Era, Laptops	10
03	Tools and Methods Used in Cyberline: Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Over Flow, Attacks on Wireless Networks, Phishing, Identity Theft (ID Theft)	06
04	The Concept of Cyberspace: E-Commerce , The Contract Aspects in Cyber Law ,The Security Aspect of Cyber Law ,The Intellectual Property Aspect in Cyber Law, The Evidence Aspect in Cyber Law , The Criminal Aspect in Cyber Law, Global Trends in Cyber Law , Legal Framework for Electronic Data Interchange Law Relating to Electronic Banking , The Need for an Indian Cyber Law	08
05	Indian IT Act.: Cyber Crime and Criminal Justice : Penalties, Adjudication and Appeals Under the IT Act, 2000,IT Act. 2008 and its Amendments	08
06	Information Security Standard compliances SOX, GLBA, HIPAA, ISO, FISMA, NERC, PCI.	06

Assessment:

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.

REFERENCES:

1. Nina Godbole, Sunit Belapure, *Cyber Security*, Wiley India, New Delhi
2. The Indian Cyber Law by Suresh T. Vishwanathan; Bharat Law House New Delhi
3. The Information technology Act, 2000; Bare Act- Professional Book Publishers, New Delhi.
4. Cyber Law & Cyber Crimes By Advocate Prashant Mali; Snow White Publications, Mumbai
5. Nina Godbole, *Information Systems Security*, Wiley India, New Delhi
6. Kenneth J. Knapp, *Cyber Security & Global Information Assurance* Information Science Publishing.
7. William Stallings, *Cryptography and Network Security*, Pearson Publication
8. Websites for more information is available on : The Information Technology ACT, 2008- TIFR : <https://www.tifrh.res.in>
9. Website for more information , A Compliance Primer for IT professional : <https://www.sans.org/reading-room/whitepapers/compliance/compliance-primer-professionals-33538>

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2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ILO1017	Institute Level Optional Course - I: Disaster Management and Mitigation Measures	03	--	--	03	--	--	03

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.							
ILO1017	Institute Level Optional Course -I: Disaster Management and Mitigation Measures	20	20	20	80	03	--	--	--	--	100

Course Code	Course Name	Credits
ILO1017	Disaster Management and Mitigation Measures	03
Course Objectives	<ul style="list-style-type: none"> To understand the various types of disaster occurring around the world To identify extent and damaging capacity of a disaster To study and understand the means of losses and methods to overcome /minimize it. To understand role of individual and various organization during and after disaster To know warning systems, their implementation and based on this to initiate training to a laymen To understand application of GIS in the field of disaster management To understand the emergency government response structures before, during and after disaster 	
Course Outcomes	Learner will be able to <ul style="list-style-type: none"> Understand natural as well as manmade disaster and their extent and possible effects on the economy. 	

	<ul style="list-style-type: none"> • Planning of national importance structures based upon the previous history. • Understand government policies, acts and various organizational structure associated with an emergency. • Know the simple do's and don'ts in such extreme events and act accordingly
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Module	Detailed Contents	Hours
01	Introduction: Definition of Disaster, hazard, global and Indian scenario, general perspective, importance of study in human life, Direct and indirect effects of disasters, long term effects of disasters. Introduction to global warming and climate change.	03
02	Natural Disaster and Manmade disasters: Natural Disaster: Meaning and nature of natural disaster, Flood, Flash flood, drought, cloud burst, Earthquake, Landslides, Avalanches, Volcanic eruptions, Mudflow, Cyclone, Storm, Storm Surge, climate change, global warming, sea level rise, ozone depletion . Manmade Disasters: Chemical, Industrial, Nuclear and Fire Hazards. Role of growing population and subsequent industrialization, urbanization and changing lifestyle of human beings in frequent occurrences of manmade disasters.	06
03	Disaster Management, Policy and Administration: Disaster management: meaning, concept, importance, objective of disaster management policy, disaster risks in India, Paradigm shift in disaster management. Policy and administration: Importance and principles of disaster management policies, command and co-ordination of in disaster management, rescue operations-how to start with and how to proceed in due course of time, study of flowchart showing the entire process.	06
04	Institutional Framework for Disaster Management in India: Importance of public awareness, Preparation and execution of emergency management programme. Scope and responsibilities of National Institute of Disaster Management (NIDM) and National disaster management authority (NDMA) in India. Methods and measures to avoid disasters, Management of casualties, set up of emergency facilities, importance of effective communication amongst different agencies in such situations. Use of Internet and softwares for effective disaster management. Applications of GIS, Remote sensing and GPS in this regard.	06
05	Financing Relief Measures: Ways to raise finance for relief expenditure, role of government agencies and NGO's in this process, Legal aspects	09

	related to finance raising as well as overall management of disasters. Various NGO's and the works they have carried out in the past on the occurrence of various disasters, Ways to approach these teams. International relief aid agencies and their role in extreme events.	
06	Preventive and Mitigation Measures: Pre-disaster, during disaster and post-disaster measures in some events in general, Structural mapping: Risk mapping, assessment and analysis, sea walls and embankments, Bio shield, shelters, early warning and communication. Non Structural Mitigation: Community based disaster preparedness, risk transfer and risk financing, capacity development and training, awareness and education, contingency plans. Do's and don'ts in case of disasters and effective implementation of relief aids.	06

Assessment:

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.

REFERENCES:

1. 'Disaster Management' by Harsh K.Gupta, Universities Press Publications.
2. 'Disaster Management: An Appraisal of Institutional Mechanisms in India' by O.S.Dagur, published by Centre for land warfare studies, New Delhi, 2011.
3. 'Introduction to International Disaster Management' by Damon Copolla, Butterworth Heinemann Elsevier Publications.
4. 'Disaster Management Handbook' by Jack Pinkowski, CRC Press Taylor and Francis group.
5. 'Disaster management & rehabilitation' by Rajdeep Dasgupta, Mittal Publications, New Delhi.
6. 'Natural Hazards and Disaster Management, Vulnerability and Mitigation – R B Singh, Rawat Publications
7. Concepts and Techniques of GIS –C.P. Lo Albert, K.W. Yonng – Prentice Hall (India) Publications.

(Learners are expected to refer reports published at national and International level and updated information available on authentic web sites)

End Semester Examination:

Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ILO1018	Institute Level Optional Course - I: Energy Audit and Management	03	--	--	03	--	--	03

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.							
ILO1018	Institute Level Optional Course -I: Energy Audit and Management	20	20	20	80	03	--	--	--	--	100

Course Code	Course Name	Credits
ILO1018	Energy Audit and Management	03
Course Objectives	<ul style="list-style-type: none"> To understand the importance energy security for sustainable development and the fundamentals of energy conservation. To introduce performance evaluation criteria of various electrical and thermal installations to facilitate the energy management To relate the data collected during performance evaluation of systems for identification of energy saving opportunities 	
Course Outcomes	<p>Learner will be able to</p> <ul style="list-style-type: none"> To identify and describe present state of energy security and its importance. To identify and describe the basic principles and methodologies adopted in energy audit of an utility. To describe the energy performance evaluation of some common electrical installations and identify the energy saving opportunities. To describe the energy performance evaluation of some common thermal installations and identify the energy saving opportunities To analyze the data collected during performance evaluation and recommend energy saving measures 	

Module	Detailed Contents	Hours
01	Energy Scenario: Present Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy Security, Energy Conservation and its Importance, Energy Conservation Act-2001 and its Features. Basics of Energy and its various forms, Material and Energy balance	04
02	Energy Audit Principles: Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution. Elements of monitoring& targeting; Energy audit Instruments; Data and information-analysis. Financial analysis techniques: Simple payback period, NPV, Return on investment (ROI), Internal rate of return (IRR)	08
03	Energy Management and Energy Conservation in Electrical System: Electricity billing, Electrical load management and maximum demand Control; Power factor improvement, Energy efficient equipments and appliances, star ratings. Energy efficiency measures in lighting system, Lighting control: Occupancy sensors, daylight integration, and use of intelligent controllers. Energy conservation opportunities in: water pumps, industrial drives, induction motors, motor retrofitting, soft starters, variable speed drives.	10
04	Energy Management and Energy Conservation in Thermal Systems: Review of different thermal loads; Energy conservation opportunities in: Steam distribution system, Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system. General fuel economy measures in Boilers and furnaces, Waste heat recovery, use of insulation- types and application. HVAC system: Coefficient of performance, Capacity, factors affecting Refrigeration and Air Conditioning system performance and savings opportunities.	10
05	Energy Performance Assessment: On site Performance evaluation techniques, Case studies based on: Motors and variable speed drive, pumps, HVAC system calculations; Lighting System: Installed Load Efficacy Ratio (ILER) method, Financial Analysis.	04
06	Energy conservation in Buildings: Energy Conservation Building Codes (ECBC): Green Building, LEED rating, Application of Non-Conventional and Renewable Energy Sources	03

Assessment:

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.

REFERENCES:

1. Handbook of Electrical Installation Practice, Geofry Stokes, Blackwell Science
2. Designing with light: Lighting Handbook, By Anil Valia, Lighting System
3. Energy Management Handbook, By W.C. Turner, John Wiley and Sons
4. Handbook on Energy Audits and Management, edited by A. K. Tyagi, Tata Energy Research Institute (TERI).
5. Energy Management Principles, C.B.Smith, Pergamon Press
6. Energy Conservation Guidebook, Dale R. Patrick, S. Fardo, Ray E. Richardson, Fairmont Press
7. Handbook of Energy Audits, Albert Thumann, W. J. Younger, T. Niehus, CRC Press
8. www.energymanagertraining.com
9. www.bee-india.nic.in

Theory Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ILO1019	Institute Level Optional Course - I: Development Engineering	03	--	--	03	--	--	03

Course Code	Course Name	Credits
ILO1019	Development Engineering	03
Course Objectives	<ul style="list-style-type: none"> To understand the characteristics of rural Society and the Scope, Nature and Constraints of rural To study Implications of 73rd CAA on Planning, Development and Governance of Rural Areas An exploration of human values, which go into making a 'good' human being, a 'good' professional, a 'good' society and a 'good life' in the context of work life and the personal life of modern Indian professionals To understand the Nature and Type of Human Values relevant to Planning Institutions 	
Course Outcomes	<p>Learner will be able to</p> <ul style="list-style-type: none"> Apply knowledge for Rural Development Apply knowledge for Management Issues. Apply knowledge for Initiatives and Strategies. Develop acumen for higher education and research. Master the art of working in group of different nature. Develop confidence to take up rural project activities independently. 	

Module	Detailed Contents	Hours
01	Introduction to Rural Development Meaning, nature and scope of development; Nature of rural society in India; Hierarchy of settlements; Social, economic and ecological constraints for rural development. Roots of Rural Development in India Rural reconstruction and Sarvodaya programme before independence; Impact of voluntary effort and Sarvodaya Movement on rural development; Constitutional direction, directive principles; Panchayati Raj - beginning of planning and community development; National extension services.	08
02	Post-Independence rural Development Balwant Rai Mehta Committee - three tier system of rural local. Government; Need and scope for people's participation and Panchayati Raj; Ashok Mehta Committee - linkage between Panchayati Raj, participation and rural development.	04

03	Rural Development Initiatives in Five Year Plans Five Year Plans and Rural Development; Planning process at National, State, Regional and District levels; Planning, development, implementing and monitoring organizations and agencies; Urban and rural interface - integrated approach and local plans; Development initiatives and their convergence; Special component plan and sub-plan for the weaker section; Micro-eco zones; Data base for local planning; Need for decentralized planning; Sustainable rural development.	06
04	Post 73rd Amendment Scenario 73rd Constitution Amendment Act, including - XI schedule, devolution of powers, functions and finance; Panchayati Raj institutions - organizational linkages; Recent changes in rural local planning; Gram Sabha - revitalized Panchayati Raj; Institutionalization; resource mapping, resource mobilization including social mobilization; Information Technology and rural planning; Need for further amendments.	04
05	Values and Science and Technology Material development and its values; the challenge of science and technology; Values in planning profession, research and education. Types of Values Psychological values — integrated personality; mental health; Societal values — the modern search for a good society; justice, democracy, rule of law, values in the Indian constitution; Aesthetic values — perception and enjoyment of beauty; Moral and ethical values; nature of moral judgment; Spiritual values; different concepts; secular spirituality; Relative and absolute values; Human values— humanism and human values; human rights; human values as freedom, creativity, love and wisdom.	10
06	Ethics Canons of ethics; ethics of virtue; ethics of duty; ethics of responsibility; Work ethics; Professional ethics; Ethics in planning profession, research and education	04

Assessment:

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.

REFERENCES:

1. ITPI, Village Planning and Rural Development, ITPI, New Delhi
2. Thooyavan, K.R. Human Settlements: A 2005 MA Publication, Chennai
3. GoI, Constitution (73rd GoI, New Delhi Amendment) Act, GoI, New Delhi
4. Planning Commission, Five Year Plans, Planning Commission
5. Planning Commission, Manual of Integrated District Planning, 2006, Planning Commission New Delhi
6. Planning Guide to Beginners
7. Weaver, R.C., The Urban Complex, Doubleday.
8. Farmer, W.P. et al, Ethics in Planning, American Planning Association, Washington.

9. How, E., Normative Ethics in Planning, Journal of Planning Literature, Vol.5, No.2, pp. 123-150.

10. Watson, V. , Conflicting Rationalities: -- Implications for Planning Theory and Ethics, Planning Theory and Practice, Vol. 4, No.4, pp.395 – 407

Theory Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
BML701	Life Saving and Surgical Equipment (LSSE)	--	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.						
BML701	Life Saving and Surgical Equipment (LSSE)	--	--	--	--	25	--	25	--	50

Course Code	Course Name	Credits
BML701	Life Saving and Surgical Equipment	01
Course Objectives	<ul style="list-style-type: none"> To understand the basic principles and working of life Saving Equipment. To develop skills enabling Biomedical Engineers to serve the health care industry To develop core competency and skill in the field of Biomedical Engineering, to design and develop new health care systems. 	
Course Outcomes	Learner will be able to... <ul style="list-style-type: none"> Design and implement basic Pacemaker circuits. Design and implement basic oscillator circuits for Surgical Diathermy. Demonstration the knowledge of application techniques of physiotherapy machines. Demonstrate the knowledge of application technique of oximeter 	

Syllabus: Same as that of BMC701 Life Saving and Surgical Equipment (LSSE).

List of Experiments: (Any Seven)

1. Implementation and testing of basic circuit of pacemaker.
2. Implementation of NAND Gate Oscillator in Surgical Diathermy.
3. Implementation of RLC Over damped system.
4. Implementation of OT lights.
5. Demonstration of Defibrillator.
6. Demonstration of Pacemaker.
7. Demonstration of Surgical Diathermy.
8. Demonstration of Oximeter.
9. Industry / Hospital visits may 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) : 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. 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.

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
BML702	Basics of VLSI (BVLSI)	--	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.						
BML702	Basics of VLSI (BVLSI)	--	--	--	--	25	--	25	--	50

Course Code	Course Name	Credits
BML702	Basics of VLSI	01
Course Objective	<ul style="list-style-type: none"> To expose to hardware description language which will help them to understand and design various tools for the devices. 	
Course Outcome	<p>A Learner will be able to</p> <ul style="list-style-type: none"> Understand hardware description language used to model circuits Implement some basic digital circuits using HDL Understand the physics of MOS devices Understand the implementation of inverter circuits using CMOS devices and noise in these circuits Understand the design rules and layouts for various digital gates 	

Syllabus: Same as that of BMC702 Basics of VLSI (BVLSI).

List of Experiments: (Any Seven)

1. Study of NMOS CW modulation of NMOS channel (Using ORCAD or similar software)
2. Study of CMOS Inverter characteristics (Using ORCAD or similar software)
3. Basic Logic gates (using VHDL)
4. Binary to gray and Gray to Binary code conversion(using VHDL)
5. Binary to Excess-3 code conversion(using VHDL)
6. Implementation of 4:1/8:1 Mux(using VHDL)
7. Implementation of 3:8 Decoder(using VHDL)
8. Implementation of one bit Half Adder a Full adder (using VHDL)
9. Implementation of 4 bit full adder using half adder as component(using VHDL)

10. Implementation of JK flip flop(using VHDL)

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

Reference Books:

1. VHDL Programming by Examples Douglas Perry, , Tata McGraw Hill Publications, 2002
2. Principles of CMOS VLSI Design : ASystems Perspective Neil H.E. Weste, Kamran Eshraghian second edition, Addison Wesley Publications, 1993
3. Digital Integrated Circuits: A Desiqn Perspective, Rabaey Jan M., Chandrakasan Anantha, Nikolic Borivoje, second edition, Prentice Hall of India

Oral examination will be based on entire syllabus.

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
BML703	Medical Imaging - II (MI - II)	--	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.						
BML703	Medical Imaging - II (MI - II)	--	--	--	--	25	--	25	--	50

Course Code	Course Name	Credits
BML703	Medical Imaging - II	01
Course Objective	<ul style="list-style-type: none"> To familiarize the learners with the various Imaging techniques in medicine operating principles and quality control aspects of various imaging modalities. To keep the learners abreast with the technological developments in the field of Medical Imaging 	
Course Outcome	Learner will be able to <ul style="list-style-type: none"> Understand the construction and working of ultrasound transducer Understand the instrumentation and applications of Endoscopy Apply the knowledge of Image processing in reconstructing the medical images Understand the basic principles of MRI Physics and Nuclear imaging Understand the concept of Hybrid Imaging. 	

Syllabus: Same as that of BMC703 Medical Imaging – II (MI – II).

List of Experiments: (Any Seven)

1. Study experiment of Ultrasound Transducer
2. Demonstration on Endoscopy
3. MRI reconstruction using Fourier Transform
4. Image fusion for Hybrid Imaging
5. Calculation of T2 from T2* given ΔB and and plot the equations in graph.

6. Presentations based on given topics
7. Hospital Visits
8. Seminars by expert speakers
9. Research on advanced topics

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. Christensen's Physics of Diagnostic Radiology
2. Medical Imaging Physics William .R.Hendee
3. The essential physics of Medical Imaging- Jerrold T. Bushberg, J. Anthony Seibert, Edwin L, John Boone

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 entire syllabus.

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
BMDLL 7031	Networking and Information in Medical Systems (NIMS)	--	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 7031	Networking and Information in Medical System (NIMS)	--	--	--	--	25	--	25	--	50

Course Code	Course Name	Credits
BMDLL 7031	Networking and Information in Medical System	01
Course Objective	<ul style="list-style-type: none"> To understand the fundamental component of computer Networking. Configure various networking devices and components. To understand a concept about network security. Understand various Information system used in Healthcare System To understand the healthcare IT infrastructure Understand various IHE domains 	
Course Outcome	Learner will be able to <ul style="list-style-type: none"> Configure various networking devices and components Design Basic Network using IP addressing and devices Design data flow in Hospital Using IHE Domain. 	

Syllabus: Same as that of BMDLO7031 Networking and Information in Medical System (NIMS)

List of Experiments: (Any four and mini project)

1. Study of various networking cables, demonstration of crimping of cables and configuring networking parameters for computer.
2. Tutorial on IP addressing.
3. Introduction and basic commands used in various network simulation software.

4. Internetwork Communication through Router and Switch, See the Mac Table of each switch and Routing table of Router
5. Static routing configuration.
6. Case study of IHE domain

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 (Case study) : 10 Marks

Laboratory work (Mini Project) : 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. PACS and Imaging Informatics by Huang, Second Edition, Wiley and Blackwell
2. PACS Guide to Digital Revolution by Keith J. Dreyer (Springer)
3. Data Communication and Networking by Behrouz A. Forouzan McGraw Hill
4. Computer Networks by A.S. Tanenbaum, Pearson Education

Reference Books:

1. Governance of Picture Archiving and Communications Systems by Carrison K.S. Tong
(Medical Information Science Reference)
2. Practical Imaging Informatics, By Barton F. Branstetter, Springer
3. PACS fundamentals- By Herman Oosterwijk
4. Cryptography and Network Security By William Stalling, Pearsons

Oral examination will be based on the entire syllabus.

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
BMDLL 7032	Advanced Image Processing (AIP)	--	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 7032	Advanced Image Processing (AIP)	--	--	--	--	25	--	25	--	50

Course Code	Course Name	Credits
BMDLL7032	Advanced Image Processing	01
Course Objective	<ul style="list-style-type: none"> To introduce the learners to advanced theory of digital image processing. To understand the various techniques & algorithms such as Colour imaging, Feature extraction, Restoration, Texture and Application To prepare learners to formulate solutions to Complex image processing Algorithms To develop programming skills to solve complex Image Processing Problems. 	
Course Outcome	<p>Learner will be able to</p> <ul style="list-style-type: none"> Acquire the advanced concepts of a digital image processing system such as Colour imaging, Feature extraction, Restoration, Texture and Application Extract feature and classify images. Strategize and implement with MATLAB/C/SCILAB algorithms for advanced digital image processing operations. 	

Syllabus: Same as that of BMDLO7032 Advanced Image Processing (AIP).

List of Experiments: (Any Seven)

1. Transition of Colour Models
2. Pseudo Colouring
3. Filtering of Colour Images

4. Canny Edge Detector
5. Watershed Algorithm
6. Top Hat Transformation
7. Bottom Hat Transformation
8. Wavelet Decomposition
9. Geometric Mean Filter
10. K means clustering

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 (Case study) : 10 Marks

Laboratory work (Mini Project) : 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 for Medical Applications, GEOFF DOUGHERTY, Cambridge University Press.
2. Digital Image Processing, Gonzalez and Woods, Pearson Education
3. Image Processing analysis and Machine Vision, Milind Sonka et.al Cengage

Reference Books:

1. Computer Vision, Linda Shapiro et.al Addison-Wesley
2. Computer Vision a Modern Approach, David A. Forsyth, Jean Ponce, Pearson

Oral examination will be based on the entire syllabus.

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
BMDLL 7033	Embedded Systems (ES)	--	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 7033	Embedded Systems (ES)	--	--	--	--	25	--	25	--	50

Course Code	Course Name	Credits
BMDLL7033	Embedded Systems	01
Course Objective	<ul style="list-style-type: none"> Design, implementation and programming of a basic modern embedded system. 	
Course Outcome	Learner will be able to <ul style="list-style-type: none"> To become aware of embedded hardware and software components in an embedded system. To analyze the design and development process of embedded systems. To understand the design, implementation and programming of a real world embedded system (case study). 	

Syllabus: Same as that of BMDLO7033 Embedded Systems (ES).

List of Experiments: (Any four and mini project)

1. Biotelemetry system,
2. Portable patient monitoring system (ECG, heart rate, blood pressure, pulse oximeter)
3. Glucometer,
4. Robotic arm in surgeries
5. Automated wheelchair,
6. Drug delivery system (syringe pump),
7. Fall detection system for elderly,
8. CT/MRI bed.
9. Embedded system course project.

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 (Case study) : 10 Marks

Laboratory work (Mini Project) : 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. Embedded System Architecture, Programming & Design (Third Edition)- Raj Kamal
2. An Embedded Software Primer- David E. Simon

Reference Books:

1. Embedded Real time Systems Programming- Sriram V Iyer, Pankaj Gupta

Oral examination will be based on mini project.

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
BML704	Project Stage - I	--	06	--	--	03	--	03

Course Code	Course Name	Examination Scheme								
		Theory				Term work	Pract.	Oral	Pract. / Oral	Total
		Internal Assessment			End sem					
		Test 1	Test 2	Avg.						
BML 704	Project Stage - I	--	--	--	--	25	--	25	--	50

Course Code	Course Name	Credits
BML704	Project Stage-I	03
Course objective	<ul style="list-style-type: none"> To apply the knowledge gained during Curriculum to develop and design problem statement. Conduct literature survey. Design Circuit/ Flow chart of the statement. Documentation and project report writing. 	
Course Outcome	<p>Learner will be able to</p> <ul style="list-style-type: none"> Review literature to define problem statement Apply knowledge of the engineering fundamentals acquired during the curriculum and beyond Develop and create design using appropriate design methodologies considering the various health, society and environmental needs. Write problem statement, Design concept in prescribed format. Learn the behavioral science by working in a group. 	

Project Guidelines:

- Learner is allotted 6 hrs per week for the project work
- Learners should carry out literature survey /visit industry / analyze current trends and identify the problem for Project and finalize in consultation with Guide/Supervisor.
- Group of maximum four students will be completing a comprehensive project work.
- Learners should use multiple literatures and understand the problem.
- Learners should attempt solution to the problem by experimental/simulation methods.
- The solution to be validated with proper justification and compile the report in standard format

7. Learner may use this opportunity to learn different computational techniques as well as some model development.

Faculty Load:

1. In semester VII – 1/2 (half) period of 1/2 hour per week per project group
2. Each faculty is permitted to take (guide) maximum 4 (Four) project groups

Assessment:**Term Work:**

Term Work should be examined by approved internal faculty appointed by the head of the institute based on the following:

- Scope and objective of the project work.
- Extensive Literature survey.
- Progress of the work (Continuous assessment)
- Report in prescribed University format.

Guidelines for Assessment of Project Stage- I

1. Project I should be assessed through a presentation jointly by Internal and External Examiners approved by the University of Mumbai
2. Project stage I should be assessed based on following points
 - Quality of problem selected
 - Literature Survey
 - Clarity of Problem definition and Feasibility of problem solution
 - Relevance to the specialization / Industrial trends
 - Clarity of objective and scope
 - Quality of Project Design
 - Compilation of Project Report
 - Quality of Written and Oral Presentation