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 8th 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 9th April, 2018 have been accepted by the Academic Council at its meeting held on 5th 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).

(Dr. Dinesh Kamble)
I/c REGISTRAR

MUMBAI – 400 032
25th June, 2018

To

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

A.C/4.57/05/05/2018

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No. UG/ 46 -A of 2018 MUMBAI-400 032 25th 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

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

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

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

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

Course Code	Course Name	Credits
BMC501	Diagnostic and Therapeutic Instruments	04
Course Objective	• To understand the basic principles and working of diagnostic and therapeutic 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 Outcome	Learner will be able to… • Understand principles of various analytical instruments used in hospital laboratories. • Demonstrate the knowledge about various blood cell counting systems and blood gas analyzers. • Demonstarte the knowledge about various automated drug delivery systems. • Understand the basic mechanism of ventilation and analysis of pulmonary functions and demonstarte the use of ventilation therapy. • Unserstand the bsic principle and applications of physiotherapy and eletrotherapy techniques. • Understand the basic principle and working of hemodialysis machine.	

Module	Contents	Hours
1	**Analytical Instruments** 1. Colorimeter 2. Spectrophotometer 3. Auto Analyzer 4. Electrophoresis apparatus 5. Chromatography 6. Chromatography 7. ELISA concepts (direct and indirect), reader & washer.	**12**
2	**Blood cell counter and Blood Gas Analyzer** Blood cell counter (Coulter and Pico-scale) Blood gas analyzer principle, pH. pO2 and pCO2 Electrodes and complete block diagram of Blood gas analyzer.	**6**
3	**Automated drug delivery systems** Infusion pumps, components of drug infusion systems, syringe and peristaltic pumps, Implantable infusion system and insulin pumps.	**4**
4	**Pulmonary Function Analyzer** Respiration measurement technique: Lung volume and capacities, Spirometry, pneumotachometers, Pulmonary function measurement, measurement of volume **Ventilators** Artificial ventilation, ventilator terms and its types, modes of ventilators, classification of ventilators, pressure volume flow and time diagrams. Microprocessor controlled ventilator	**16**
5	**Physiotherapy equipments** **Basic principle, working and technical specifications of** 1. **Shortwave Diathermy** 2. **Ultrasonic therapy unit** 3. **Microwave therapy unit** 4. **Nerve** and Muscle Stimulator.	**6**
6	**Hemodialysis machine** 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 : 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
BMC502	Analog and Digital Circuit Design (Abbreviated as ADCD)	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme									
		Theory									
		Internal Assessment			End sem	Duration (hrs)	Term work	Pract.	Oral	Pract. / Oral	Total
		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
Course objective	Students will be able to: • To understand and provide knowledge of various Analog And Digital Circuits Such as Timer IC 555, PLL IC, VCO, 723 voltage regulator . • To understand different types of filters and design them for the given specifications. • To understand, learn and analyze fundamentals of Electronics and Digital circuits. • To develop analytical aptitude and to understand basic electronic concepts related to engineering profession. • To develop competency in terms of logical thinking and application skills. • To design and develop various circuits for biomedical applications and to develop logical thinking of students.	
Course Outcome	Learner will be able to: • Understand various waveform generation IC's and their applications and use it in projects. • Apply the knowledge of various special function IC's and special purpose diodes for designing. • Design active filters and their application in biomedical field and electronic circuit design • Understanding power devices like power diode, SCR, DIAC and TRIAC, UJT and power MOSFET's and their applications in industry • Applying the knowledge of voltage regulators, power supplies, and switches. • Understand different types of ac and dc motors and how to select them for project design.	

Module	Contents	Hours
1.	**Waveform Generation IC's:** • IC 555 Functional Block diagram, Circuit diagram. • IC 555 in Astable Multivibrator(AMV) functional diagram, circuit diagram with application • IC 555 in Monostable Multivibrator (MMV) functional diagram, circuit diagram with application • PLL (IC 565 or equivalent) circuit diagram and applications • VCO(IC 566) Circuit diagram and applications Function Generator (IC 8038 or equivalent) Circuit diagram and its applications	**12**
2.	**Special Function IC's and Special function diodes:** • F-V convertors and V-F convertors: Circuit diagram and its applications • Instrumentation Amplifier (AD 624 /AD 620) Circuit diagram and its applications, • Monolithic Isolation Amplifier module • Opto-couplers and Opto-isolators • Diodes (LED, photodiode,varactor, schottky) PWM (SG 3525 or equivalent) Circuit diagram and its applications	**06**
3.	**Active Filters:** • Frequency response, design of first order (Notch, LP, HP, BP) filter and applications. • Frequency response, design of 2^{nd} order (Chebyshev, Butterworth, Elliptical filters) LP, HP, BP, All pass, Notch, band reject • Capacitor filter, switched capacitor filter. Generalized Impedance Convertor (GIC)	**08**
4.	**Power Devices and Circuits:** • SCR's: Basic structure, characteristics, Two transistor and Operations. series and parallel connections of SCRs. • DIAC and TRIAC: Basic Structure and characteristics, applications • Power diode • UJT: Operation, characteristics, parameters and UJT as a relaxation oscillator Power MOSFET : Device structure, equivalent circuit and characteristics	**06**
5.	**Voltage Controllers and Regulators :** • Analog switches, Relays : Basic Types • Functional block diagram of Voltage Regulators • 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. Switching Mode Power Supply (SMPS)	**10**
6.	**Motors And Drivers :** Stepper, Servo, DC/AC Motors drivers and geared motors (Basic operation and application)	**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. 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	• To provide concepts, principles and techniques used in analog and digital communications. • To cover a range of digital modulation techniques which are frequently used in modern communication systems.	
Course Outcome	Learner will be able to: • Demonstrate concept of electronic communication system with effect of noise and modeling of noise • Have in depth knowledge of amplitude modulation and be able to compare different types of AM transmitters with analysis • Analyze efficiently different types of AM receivers with characteristics, merits and demerits • Exhibit basic operation of FM transmitter and receiver with types, analysis, advantages and disadvantages • Apply sampling theorem and quantization process in digitizing analog signal with different types of analog and digital pulse modulation • Understand and compare different types of digital transmission techniques and multiplexing techniques	

Module	Contents	Time
1	**Introduction to communication system and noise:** • Elements of communication system, types of communication system • Noise definition, types, Signal to Noise ratio, Noise factor, Noise figure, Noise Temperature	04
2	**Amplitude Modulation Transmission:** • Definition, Mathematical analysis of AM wave, Different types of AM, Spectrum, Bandwidth, • AM transmitter: High and low level AM transmitter • 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) • Introduction to ISB and VSB transmitter	10
3	**Amplitude Modulation Receiver:** • Receiver characteristics: sensitivity, selectivity, fidelity, double spotting, Image frequency and its rejection, dynamic range • Types: TRF receiver, superetrodyne receiver, double conversion receiver • AM detectors –Simple and Practical Diode detector, Principles and types of tracking and AGC, SSB detector	08
4	**Frequency Modulation Transmission and Receivers :** • Principles of FM waveform, spectrum, Bandwidth • FM generation: Direct and Indirect FM transmitter • Principles of AFC, Effect of noise in FM, Noise Triangle, Pre-emphasis and De-emphasis • FM Receivers: Block diagram • Types: Simple Slope detector, Balanced slope detector, Foster Seeley discriminator, Ratio detector, Quadrature detector • Capture effect in FM receivers, Difference between AM and FM system	10
5	**Analog and Digital Pulse Modulation Techniques :** • Sampling Theorem for low pass signals and band pass signals, Proof of Sampling theorem, Concept of Aliasing, Quantization, Companding, • Analog modulation techniques: PAM, PWM,PPM – Generation, Detection, Advantages, disadvantages • Digital pulse modulation techniques: PCM, DPCM, DM and ADM– Generation, Detection, Advantages, disadvantages	08
6	**Digital Transmission Techniques and Multiplexing :** • Digital transmission types: ASK, FSK, PSK - Generation, Detection, Advantages Disadvantages • Multiplexing techniques: Concept of multiplexing, FDM, TDM, Hierarchy, Applications, Advantages Disadvantages	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. 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
BMC504	Biomedical Digital Signal Processing (Abbreviated as BDSP)	04	--	--	04	--	--	04

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

Course Code	Course Name	Credits
BMC504	Biomedical Digital Signal Processing	04
Course Objective	• To build a strong base for developing algorithms for signal processing systems and Imaging systems. • To develop competency in terms of logical thinking, programming and application skills. • To train and motivate students for pursuing higher education and research for developing cutting edge technologies.	
Course Outcome	Learner will be able to, • Understand the fundamental techniques and applications of digital signal • Processing with emphasis on biomedical signals. • 2. Implement algorithms based on discrete time signals. • 3. Understand Circular and linear convolution and their implementation using DFT • 4. Understand efficient computation techniques such as DIT and DIF FFT algorithms • 5. Design FIR filters using window method, digital IIR filters by designing prototype analog filters and then applying analog to digital conversion.	

Module	Contents	Hours
1.	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	**08**
2.	Introduction to DFT-Properties of DFT	**08**
3.	Introduction DIT and DIF FFT algorithms. Use of FFT in linear filtering,	**07**
4.	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	**11**
5.	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	**10**
6.	Introduction to Digital signal Processors–Architecture –Features-addressing formats –functional mode-introduction to commercial Processors. Application of DSP in Biomedical 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. 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
Course Objective	• Learn and practice data modelling using the entity-relationship and developing database designs. • Understand the use of Structured Query Language (SQL) and learn SQL syntax. • To create, display, validate and search XML files • To create windows applications using standard .NET controls. • To acquire knowledge of client side scripting language thereby to reduce the load on server and minimize the response time. • To create, validate and display web data.	
Course Outcome	Learner will be able to, • Design data models and schemas in DBMS and apply the features of database management systems and Relational database. • Construct tables and retrieve data from the database by using SQL- the standard language of relational databases. • Implement client side scripting and validation. • Create XML documents using XML schema and XSL elements.	

	• Using operators, variables, and control structures in JavaScript • Designing of windows applications using VB.NET

Module	Contents	Hours
1	**Introduction Database Concepts and Entity Relationship Data Model:** 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	**Structured Query Language (SQL) :** 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	**Transactions Management and Concurrency:** Transaction concept, Transaction states, ACID properties	**06**
4	**JavaScript** 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	**Web Extensions:** XML Documents, XML Elements, Attributes XML Schema, Namespaces , Style Sheets, XPath, Introduction to X-Query	**08**
6	**Programming with VB.Net :** 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, Slberchatz,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									
		Internal Assessment			End sem	Duration (hrs)	Term work	Pract.	Oral	Pract. / Oral	Total
		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	• To cover basic concepts and theory related to statistics. • To focus on various statistical abilities such as analysis of variance, hypothesis testing, estimation, etc.	
Course Outcome	A learner will be able to • Apply statistical methods to sample data and analyse it. • Develop a strong foundation for designing algorithms for computation.	

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									
		Internal Assessment			End sem	Duration (hrs)	Term work	Pract.	Oral	Pract. / Oral	Total
		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
Course Objectives	To introduce learners to basics of Kinetics and Kinematics, Flow properties of blood and give overview of Rehabilitation Engineering.	
Course Outcomes	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.	**Introduction and socio-legal aspects of Rehabilitation Engineering:** Medical Rehabilitation, Epidemiology of Rehabilitation, preventive Rehabilitation, Impairment Disability and Handicap. Delivery of Rehabilitation Care: The team-Medical, Paramedical , Socio-vocational	06
2.	**Orthotics, Amputation, and Prosthetics, Activities of Daily Living (ADL):** 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.	**Mechanical principles of Kinematics and Kinetics:** 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.	**Flow properties of blood:** 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.	**Common deformities and role of surgery in rehabilitation engineering.** Types of deformities, Management of 1st and 2nd degree deformities. Common deformities of lower limb. Treatment for partial foot deformities. Deformities of the foot. Arm deformities. Torticollis	**05**
6.	**An overview of rehabilitation of muscular dystrophy, paraplegia, and quadriplegia:** 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
Course Objective	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.	
Course Outcome	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.	

Module	Detailed Contents	Hrs.
01	**Report Writing**	**05**
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)	
02	**Technical Writing**	**03**

2.1	Technical Paper Writing (IEEE Format)	
2.2	Proposal Writing	
03	**Introduction to Interpersonal Skills**	**09**
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	
04	**Meetings and Documentation**	**02**
4.1	Strategies for conducting effective meetings	
4.2	Notice, Agenda and Minutes of a meeting	
4.3	Business meeting etiquettes	
05	**Introduction to Corporate Ethics**	**02**
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)	
06	**Employment Skills**	**07**
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
TOTAL: ……(50) Marks

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, 2nd edition
9. Bell, Smith, "Management Communication" Wiley India Edition, 3rd edition.
10. Dr. Alex, K., "Soft Skills", S Chand and Company
11Subramaniam, 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				Term work	Pract.	Oral	Pract. / Oral	Total
		Internal Assessment			End sem					
		Test 1	Test 2	Avg.						
BML502	Diagnostic and Therapeutic Instruments (DTI)	--	--	--	--	25	--	25	--	50

Course Code	Course Name	Credits
BML502	Diagnostic & Therapeutic Instrumentation	01
Course Objective	• To demonstrate the application technique of diagnostic and therapeutic equipment. • To implement the basic circuits used in diagnostic and therapeutic equipment.	
Course Outcome	**Learner will be able to…** • Appreciate the importance of wavelength selection for measurement of various ions present in the sample. • Understand principles of various analytical instruments used in hospital laboratories. • Design and Implement power supply of egulated v • Understand the basic principle and applications of physiotherapy and electrotherapy techniques. • Compare the applications of various types of physiotherapy equipments. • Understand the basic principle and working of hemodialysis machine.	

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 : 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

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	• To understand, analyze and design integrated circuits. • To analyze various analog modulation techniques.	
Course Outcome	Learner will be able to, • Apply the knowledge of various special function IC's, filters, power devices, voltage regulators and motors for designing. • Implement and design various analog modulator and demodulator circuits.	

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 filer / 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
Course Objective	• To build a strong base for developing algorithms for signal processing systems and Imaging systems. • To develop competency in terms of logical thinking, programming and application skills. • To train and motivate students for pursuing higher education and research for developing cutting edge technologies.	
Course Outcome	Learner will be able to, • Understand the fundamental techniques and applications of digital signal processing with emphasis on biomedical signals. • Implement algorithms based on discrete time signals. • Understand Circular and linear convolution and their implementation using DFT • Understand efficient computation techniques such as DIT and DIF FFT algorithms • Design FIR filters using window method, digital IIR filters by designing prototype analog filters and then applying analog to digital conversion.	

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
Course Objective	• Learn and practice data modelling using the entity-relationship and developing database designs. • Understand the use of Structured Query Language (SQL) and learn SQL syntax. • To create, display, validate and search XML files • To create windows applications using standard .NET controls. • To acquire knowledge of client side scripting language thereby to reduce the load on server and minimize the response time. • To create, validate and display web data.	
Course Outcome	Learner will be able to, • Design data models and schemas in DBMS and apply the features of database management systems and Relational database. • Construct tables and retrieve data from the database by using SQL- the standard language of relational databases. • Implement client side scripting and validation. • Create XML documents using XML schema and XSL elements. • Using operators, variables, and control structures in JavaScript • Designing of windows applications using VB.NET	

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, Slberchatz,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

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
Course Objective	• To conduct statistical analysis using Statistical tools.	
Course Outcome	Learner will be able to • Apply statistical methods to sample data and analyse it using statistical tools.	

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
BMDLL 5013	Department Level Optional Course – I Rehabilitation Engineering (RE)	--	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 5013	Department Level Optional Course – I Rehabilitation Engineering (RE)	--	--	--	--	25	--	25	--	50

Course Code	Course Name	Credits
BMDLL5013	Rehabilitation Engineering	01
Course Objective	To introduce learners to basics of Kinetics and Kinematics, Flow properties of blood and give overview of Rehabilitation Engineering.	
Course Outcome	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
BMC601	Biomedical Monitoring Equipment (Abbreviated as BME)	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.							
BMC601	Biomedical Monitoring Equipment (BME)	20	20	20	80	03	--	--	--	--	100

Course Code	Course Name	Credits
BMC601	Biomedical Monitoring Equipment	04
Course Objective	• To understand the basic principles and working of patient monitoring system. • 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 Outcome	Learner will be able to: • Provide a better understanding about various bioelectrical signal recorders and patient safety • Demonstrate the principles of electronics used in designing various biomedical monitoring equipment. • Understand the basic princples and working of audiometry equipments and hearing aids • Provide a better understanding about foetal and neonatal monitoring systems. • Acquire the ability to explain the various blood flow and cardiac output meauremnet devices. • 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.	

Module	Contents	Hours
1	**Bioelectrical signals and recorders** ECG, EMG and EEG signals, LEAD configurations, 10-20 electrode system Measuring techniques for EOG, ERG and Phonocardiography, **Patient Safety:** Electric Shock Hazards, Leakage currents, safety codes for electro-medical equipment.	**10**
2	**Arrhythmia and Patient monitoring:** 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. **Point of care devices and their design considerations for homecare devices:** glucometer, lung function test.	**16**
3	**Audiometers and hearing aid** Basic audiometer, Pure tone and Speech audiometer, evoked response Audiometry, Conventional and Digital Hearing Aids, Cochlear Implants.	**04**
4	**Foetal and Neonatal Monitoring System:** Cardiotocograph, Methods of monitoring of Foetal Heart rate, Monitoring of labour activity, Incubator and Infant warmer, Non-stress test monitoring.	**05**
5	**Blood flow and Cardiac output** Electromagnetic, Ultrasonic, NMR and Laser Doppler flowmetry, Indicator Dilution, Dye Dilution and Thermal Dilution Techniques.	**05**
6	**Bio-Telemetry and Telemedicine** 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 : Leislie 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									
		Internal Assessment			End sem	Duration (hrs)	Term work	Pract.	Oral	Pract. / Oral	Total
		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
Course Objective	• 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.	
Course Outcome	Learner will be able to: • Understand the basic of Microprocessor and Microcontroller based systems and their architecture. • Understand 8086 microprocessor along with its architecture and memory organization. • Understand peripheral controller ICs used in interfacing. • Understand 8051 Microcontroller architecture, memory organization, Interrupt structure, Port structure, Timers/Counters • Understand assembly language and C compilers used to program 8051 • Design simple interfaces for keyboard LCD, ADC/DAC and Stepper motors	

Module	Contents	Hours
1.	**Introduction to Microprocessor** 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.	**Architecture of Intel 8086 Microprocessor** Major features of 8086 processor, 8086/88, CPU Architecture and the pipelined operation, Programmer's Model and Memory Segmentation	**04**
3.	**Peripheral Controllers for 8086 family and System Design:** 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.	**MCS-51 Microcontroller** 8051 architecture ; its variants and comparision, comparision of microprocessor and microcontrollers, CPU timing and machine cycle, memory organisation, SFR's, integrated prepherials such as timers/counters, serial ports, parallel I/O ports, interrupt structure, memory interfacing power saving and power down modes.	**10**
5.	**8051programming** Assembly language programming process, programming tools, addressing modes, instruction set and Programming practice using assembly and C compilers	**12**
6.	**Microcontroller design and interfacing case studies** 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, 2nd 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., 2nd 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., 2nd 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
Course Objective	• To introduce the learners the basic theory of digital image processing. • To expose learners to various available techniques and possibilities of this field. • To understand the basic image enhancement, transforms, segmentation, compression, morphology, representation, description techniques & algorithms. • To prepare learners to formulate solutions to general image processing problems. • To develop hands-on experience in using computers to process images. • To familiarize with MATLAB / C/ Labview / similar software for processing digital images.	
Course Outcome	Learner will be able to: • Acquire the fundamental concepts of a digital image processing system such as image acquisition, enhancement, segmentation, transforms, compression, morphology, representation and description. • Analyze images in the spatial domain. • Analyze images in the frequency domain through the Fourier transform. • 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.	

Module	Detailed Contents	Hours
1.	**Basics of Image Processing**: 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.	**05**
2.	**Image Enhancement**: 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,	**12**
3.	**Image Segmentation**: 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.	**08**
4.	**Image Transforms**: DFT, FFT, DCT, DST, Hadamard, Walsh, Haar, Slant, K-L Transforms, Basis functions and basis images	**08**
5.	**Image Compression**: Fundamentals of image compression models, Lossless compression - RLE, Huffman, LZW, Arithmetic coding techniques. Lossy compression - IGS coding, Predictive coding, Transform coding, JPEG, JPEG 2000.	**08**
6.	**Morphology, Representation and Description**: Dilation, Erosion, Open, Close, Hit-or-miss, Boundary extraction, Region filling, Thinning and thickening; Chain Codes, Polygonal approximations, Signatures; Fourier descriptors, Moments.	**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. 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
Course Objective	• 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: • Understand X ray imaging along with X ray tube construction, X ray generators and the total radiographic system. • Understand Fluoroscopic Imaging and Digital Subtraction Angiography. • Distinguish between CR and DR. Understand Mammography. • Understand the technique of Computed tomography, the CT scanner configuration, reconstruction techniques and clinical applications. • Apply the knowledge of CT and learn advancements in CT. • Understand the applications of X-rays in the field of Radiotherapy.	

Module	Detailed Contents	Hours
1.	**X- ray Imaging**: 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.	**Fluoroscopic Imaging** and X ray Image Intensifier, Digital subtraction Angiography	05
3.	**Computed Radiography and Digital Radiography** **Mammography**	04

4.	**Principle of Computed tomography** 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	**14**
5.	**Advancements in CT** Multi-detector computed tomography (MDCT), Flat panel detectors CT-Angiography, Contrast agents in CT	**05**
6.	**Linear Accelerators:** Production and transport of the RF wave, Major components of linear accelerator, Clinical Applications.	**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. 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									
		Internal Assessment			End sem	Duration (hrs)	Term work	Pract.	Oral	Pract. / Oral	Total
		Test 1	Test 2	Avg.							
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
Course Objective	• To setup programming environment for ASP.NET programs • To develop modular applications using object oriented methodologies • To configure ASP.NET application and creating applications using standard .NET controls • To develop data driven web application • To connect different data sources and manage them • To maintain session and controls related information in multi-user web applications	
Course Outcome	Learner will be able to: • Understanding of Microsoft .NET Framework and ASP.NET page structure • Designing of windows applications using C#.NET • Designing of web applications using ASP.NET controls • Creating database driven ASP.NET web applications using SQL Server • Debugging and deploying ASP.NET web applications.	

Module	Contents	Hours
1	**Introduction to .NET Programming:** • .Net Concepts: Framework, Common Language Runtime, Base Class Library, Common Type System (CTS), Assemblies, Namespaces. • Programming with C#: Variables, Comments, Constants, Keywords, Data Types, Control Statements, Conditional Statements, Switch Statement, Loops, Jump, Statements, Goto, break, Continue, Return, Arrays. • Exception handling in C# • Object Oriented Programming (OOP): Class, Object, Encapsulation, Inheritance, Polymorphism, Constructors.	12
2	**Developing Windows Forms Applications:** • 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 • Event Handlers: Creating Event Handlers, Default Event Handlers, Associating Event Handlers at Run Time.	06
3	**Developing Web Applications using ASP.NET and C#** • Introduction to ASP.Net: From ASP to ASP.NET, ASP.NET Features, Web Forms Life Cycle, Request/Response Programming. • Web Applications Using Visual Studio: Using Visual Web Developer, Using Components, Using the Global.asax file. • State Management: Session State, Application State, Cookies. • Server Control: HTML Server Controls, Web Forms Server Controls, Rich Controls, Validation Controls. • Themes • Configuration: Using the machine. config file, Using the web. config file, Globalization and Localization.	12
4	• **Data access and manipulation with ADO.NET using SQL Server** 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	**Security, Deployment, & Introduction to advanced concepts** • Security: Authentication, Authorization, Impersonation, Code Access Security • Deployment.	04
6	**Introduction to advanced concepts of .Net framework:** 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	• To understand the fundamentals in Laser and Fiber Optics. • To understand the applications of Laser and Fiber optics in health sector.	
Course Outcome	Learner will be able to: • Understand the fundamentals and clinical applications of Laser and Fiber Optics. • Correlate the knowledge of medicine and engineering for the wellness of human being. • Understand the safety aspects while dealing with Laser and Fiber Optic Units.	

Module	Contents	Hours
1.	**Laser Fundamentals** 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.	**Laser Types, construction and working** 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.	**Laser safety:** 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.	**Optic Fibers Fundamentals** 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.	**Laser and Fiber Optics in surgery** 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.	**Endoscopy** 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 – AbrahimCatzir 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
Course Objective	• To provide in-depth knowledge of modelling of physiological systems. • To understand basic concepts of modeling for designing biological model.	
Course Outcome	Learner will be able to: • Explain the concepts, usage and process of physiological modelling • Apply basic biophysical laws for calculation of membrane potential under different equilibrium conditions and develop simulation programs for understanding neuronal functions • Understand the function of complex closed loop systems like temperature control using modelling. • Understand the function of neuromuscular system with the help of various models. • Understand the function of open loop system like eye movement system and differentiate open loop and closed loop system • Understand the usage of, and the assumptions behind biological models (immune response, drug delivery and insulin glucose feedback) in the working life.	

Module	Detailed Contents	Hours
1.	**Physiological Modelling**: Steps in Modelling, Purpose of Modelling, lumped parameter models, distributed parameter models, compartmental modelling, modelling of circulatory system and respiratory system.	**07**
2.	**Model of Neurons:** 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).	**14**
3.	**Neuromuscular System:** modelling of skeletal muscle, mono and polysynaptic reflexes, stretch reflex, reciprocal innervations, two control mechanism, Golgi tendon, experimental validation, Parkinson's syndrome.	**06**
4.	**Eye Movement Model:** Eye movements, quantitative eye movement models, techniques for validating models, validation of other physiological systems	**12**
5.	**Thermoregulatory systems:** Thermoregulatory mechanisms, model of thermoregulatory system, controller model, validation and application.	**03**
6.	**Modelling of other physiological systems.** **Modelling the Immune response:** Behavior of the immune system, linearized model of the immune response. **Modelling of Drug delivery systems.** **Modelling of Insulin Glucose feedback system** and Pulsatile Insulin secretion.	**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. 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
Course Objective	• To understand the basic principles and working of patient monitoring system. • 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 Outcome	Learner will be able to: • Design and Implement filters for filtering of noise from signals. • Design and Implement Instrumentation amplifier to amplify low amplitude signals. • Design and Implment a regulated power supply. • Design and Implement Pulse Width Modulator. • Undesrtand the working of ECG machine by recording ECG. • Provide a better understanding about foetal monitoring systems. • Test the hearing ability by use of an audiometry.	

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 : 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

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
Course Objective	• To apply the theoretical concepts of Microcontroller to design practical circuits. • To learn circuit simulation and software simulations and then convert into a working model.	
Course Outcome	Learner will be able to: • Execute the program using microprocessor and microcontroller kits. • Execute assembly and C language programs using simulator. • Apply the knowledge of programming to implement a mini project.	

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, 2nd 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., 2nd 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., 2nd 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
Course Objective	• To introduce the learners the basic theory of digital image processing. • To expose learners to various available techniques and possibilities of this field. • To understand the basic image enhancement, transforms, segmentation, compression, morphology, representation, description techniques & algorithms. • To prepare learners to formulate solutions to general image processing problems. • To develop hands-on experience in using computers to process images. • To familiarize with MATLAB / C/ Labview/ similar software for processing digital images.	
Course Outcome	Learner will be able to: • Acquire the fundamental concepts of a digital image processing system such as image acquisition, enhancement, segmentation, transforms, compression, morphology, representation and description. • Analyze images in the spatial domain. • Analyze images in the frequency domain through the Fourier transform. • 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**.**	

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
Course Objective	• 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: • Understand X ray imaging along with X ray tube construction, X ray generators and the total radiographic system. • Understand Fluoroscopic Imaging and Digital Subtraction Angiography • Distinguish between CR and DR. Understand Mammography. • Understand the technique of Computed tomography, the CT scanner configuration, reconstruction techniques and clinical applications. • Apply the knowledge of CT and learn advancements in CT.	

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
Course Objective	• To setup programming environment for ASP.NET programs • To develop modular applications using object oriented methodologies • To configure ASP.NET application and creating applications using standard .NET controls • To develop data driven web application • To connect different data sources and manage them • To maintain session and controls related information in multi-user web applications	
Course Outcome	Learner will be able to: • Understanding of Microsoft .NET Framework and ASP.NET page structure • Designing of windows applications using C#.NET • Designing of web applications using ASP.NET controls • Creating database driven ASP.NET web applications using SQL Server • Debugging and deploying ASP.NET web applications	

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
BMDLL 6022	Department Level Optional Course – II Lasers and Fiber optics (LFO)	--	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 6022	Department Level Optional Course – II Lasers and Fiber optics (LFO)	--	--	--	--	25	--	25	--	50

Course Code	Course Name	Credits
BMDLL6022	Lasers and Fiber Optics	01
Course Objective	• To understand the fundamentals in Laser and Fiber Optics. • To understand the applications of Laser and Fiber optics in health sector.	
Course Outcome	Learner will be able to: • Understand the fundamentals and clinical applications of Laser and Fiber Optics. • Correlate the knowledge of medicine and engineering for the wellness of human being. • Understand the safety aspects while dealing with Laser and Fiber Optic Units.	

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 ppresentations 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 – AbrahimCatzir 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

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
Course Objective	• To understand basic approach of modeling for designing biological model. • To simulate physiological processes for better understanding. • To develop competency in terms of logical thinking, programming and application skills • To train and motivate students for pursuing higher education and research for developing cutting edge technologies.	
Course Outcome	Learner will be able to: • Apply concept of physiological modelling to model thermometer system. • Virtually understand biophysical laws for calculation of membrane potential under different equilibrium conditions and develop simulation programs for understanding neuronal functions. • Simulate mathematical model for the eye movement • Electrically simulate model of thermoregulatory system • Understand the usage of, and the assumptions behind biological models	

	(immune response, drug delivery and insulin glucose feedback) in the working life.

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

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 (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	
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 (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	
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	• 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…** • 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 lithotriptor machine, modern lithotriptor 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	• 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	A Learner will be able to • 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 : 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

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	• 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	**Learner will be able to…** • 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	• 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:** • 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	

	• Understand HIS, RIS integration of HIS/RIS/PACS, PACS archive and servers • Understand IHE and IHE domains

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 McGrow 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	• 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	**Learner will be able to …** • 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 Eduction
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	• To provide an introduction to modern embedded systems • To understand the design, implementation and programming of modern real time embedded systems.	
Course Outcomes	Learner will be able to • 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 Manag-ement	20	20	20	80	03	--	--	--	--	100

Course Code	Course Name	Credits
ILO1011	Product Life Cycle Management	03
Course Objectives	• 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	**Learner will be able to…** • 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	**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 **PLM Strategies:** Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy , Change management for PLM	12
02	**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	09
03	**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	06
04	**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	06
05	**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	06
06	**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	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, AntoninoRisitano, "Product Design for the environment-A life cycle approach", Taylor & Francis 2006, ISBN: 0849327229
3. SaaksvuoriAntti, ImmonenAnselmie, "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	• 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	**Learner will be able to** • 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	**Probability theory:** Probability: Standard definitions and concepts; Conditional Probability, Baye's Theorem. **Probability Distributions:** Central tendency and Dispersion; Binomial, Normal, Poisson, Weibull, Exponential, relations between them and their significance. **Measures of Dispersion:** Mean, Median, Mode, Range, Mean Deviation, Standard Deviation, Variance, Skewness and Kurtosis.	**10**
02	**Reliability Concepts:** Reliability definitions, Importance of Reliability, Quality Assurance and Reliability, Bath Tub Curve. **Failure Data Analysis:** Hazard rate, failure density, Failure Rate, Mean Time To Failure (MTTF), MTBF, Reliability Functions. **Reliability Hazard Models:** Constant Failure Rate, Linearly increasing, Time Dependent Failure Rate, Weibull Model. Distribution functions and reliability analysis.	**10**
03	**System Reliability** System Configurations: Series, parallel, mixed configuration, k out of n structure, Complex systems.	**05**
04	**Reliability Improvement** Redundancy Techniques: Element redundancy, Unit redundancy, Standby redundancies. Markov analysis. System Reliability Analysis – Enumeration method, Cut-set method, Success Path method, Decomposition method.	**10**
05	**Maintainability and Availability** System downtime, Design for Maintainability: Maintenance requirements, Design methods: Fault Isolation and self-diagnostics, Parts standardization and Interchangeability, Modularization and Accessibility, Repair Vs Replacement. Availability – qualitative aspects.	**05**
06	**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, Fau1t tree analysis and Event tree Analysis	**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. Dhillion, C. Singh, "Engineering Reliability", John Wiley & Sons, 1980.
4. P.D.T. Conor, "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.**

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
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	• 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	**Learner will be able to** • 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

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:

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
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	Avg.							
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	• 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	**Learner will be able to** • 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 2^2Design, The 2^3 Design, The General 2^k Design, A Single Replicate of the 2^kDesign, The Addition of Center Points to the 2^kDesign, Blocking in the 2^kFactorial 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. Mayers, 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.**

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
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	• 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	**Learner will be able to…** • 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.	

	• 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

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, *Simplex Method* 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 *Monte-Carlo Method:* 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:

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
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	• 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	**Learner will be able to** • 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. Kennetch 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

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
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	• 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** • Understand natural as well as manmade disaster and their extent and possible effects on the economy.	

	• 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

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 Elseveir 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	• 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	**Learner will be able to** • 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.**

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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
ILO1019	Institute Level Optional Course - I: Development Engineering	03	--	--	03	--	--	03

Course Code	Course Name	Credits
ILO1019	Development Engineering	03
Course Objectives	• 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	**Learner will be able to** • 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.**

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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
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	• 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…** • 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 : 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.

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	• To expose to hardware description language which will help them to understand and design various tools for the devices.	
Course Outcome	A Learner will be able to • 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	• 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 • 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	• 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 • 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 Communcation 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 McGrow 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	• 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	**Learner will be able to** • 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 Eduction
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	• Design, implementation and programming of a basic modern embedded system.	
Course Outcome	Learner will be able to • 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	• 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	**Learner will be able to** • 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:

1. Learner is allotted 6 hrs per week for the project work
2. Learners should carry out literature survey /visit industry / analyze current trends and identify the problem for Project and finalize in consultation with Guide/Supervisor.
3. Group of maximum four students will be completing a comprehensive project work.
4. Learners should use multiple literatures and understand the problem.
5. Learners should attempt solution to the problem by experimental/simulation methods.
6. 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

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
BMC801	Biomedical Microsystems (Abbreviated as BM)	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.							
BMC801	Biomedical Micro-systems (BM)	20	20	20	80	03	--	--	--	--	100

Course Code	Course Name	Credits
BMC801	Biomedical Microsystems	04
Course Objectives	• To understand various fabrication techniques for MEMS devices. • To apply the knowledge of MEMS in Biomedical field. • To understand recent advancements in Biomedical Engineering for a successful career in the area of nanotechnology.	
Course Outcomes	**Learner will be able to…** • Understand basic property and select appropriate material for MEMS application • Develop or modify the MEMS processes for a simple MEMS device in order to reduce the fabrication time. • Understand different microfabrication techniques and choose appropriate technique • Analyze Micro total analysis system with designing of its components • Demonstrate working principles of Bio Nano-sensors and drug delivery devices with types and fabrication • Understand packaging techniques used in MEMS	

Module	Contents	Hours
1	**Introduction to miniaturization and materials** • Block diagram of MEMS and BIOMEMS, comparison, examples • Clean room: definition, classification, air flow system • Safety in handling hazardous materials in clean room • Scaling Laws in Miniaturization • Substrates and Wafers: CZ process, wafer types • Materials: Properties and applications of single crystal silicon, SiO2, Si3N4, SiC, Polysilicon, GaAs, Glass, Al, Gold, PMMA, PDMS, SU8, Conducting polymers	**08**
2	**MEMS FABRICATION PROCESSES** • Wafer cleaning processes: RCA, Piranha • PVD: definition, Types: Evaporation (Thermal and E-beam) and Sputtering (DC and RF), applicable materials, advantages, disadvantages • CVD: definition, reaction steps, types: APCVD, LPCVD, PECVD, and HWCVD, applicable materials, advantages, disadvantages • Oxidation: Thermal • Polymers coating techniques: spinning, spraying and electrodeposition • Doping: definition, Types: Ion implantation and Diffusion, advantages, disadvantages • Etching: Types: Dry etching (RIE, DRIE) and wet etching (isotropic and anisotropic), advantages, disadvantages, specific etchants • Photolithography: Definition, steps, light sources (UV, DUV, and EUV), positive and negative photoresist, mask, different projection systems • X-ray lithography: Synchrotron radiation, X-ray mask • Nanolithography: EBL • Surface characterization techniques: AFM, SEM, TEM, Ellipsometer, Profilometer	**12**
3	**Microfabrication Techniques** • Bulk micromachining: definition, advantages and disadvantages Examples: pressure sensor, dissolved wafer process, CO_2 sensor • Surface micromachining: definition, advantages and disadvantages Examples: pressure sensor, cantilever Non polysilicon surface micromachining: SOI fabrication • LIGA: definition, process steps, examples, advantages and disadvantages, Molding techniques: Injection, compression, hot embossing • Soft lithography: Definition, SAMs, Types: Micro contact Printing, • Micro molding techniques: replica molding, microtransfer molding, micromolding in capillaries and solvent-assisted micromolding	**04**
4	**MICRO TOTAL ANALYSIS SYSTEMS (μTAS)** • Basic block diagram	**08**

	• Flow techniques in µ-fluidics: pressure driven force, electro-osmosis, electrophoresis • Micropump, microvalves: types and fabrication • Microchannels: Types and fabrication (SU8, glass, silicon) • Separation techniques: capillary electropherosis, electrochromatography, isoelectric focusing Detection techniques: fluorescence, chemiluminiscence	
5	**MICRO/ NANO BIOSENSORS AND DRUG DELIVERY DEVICES** • Biosensor: definition, block diagram • Classification based on the basis of detection techniques: Electric, Magnetic, Optical, Thermal, Mechanical, and Chemical • Basic steps involved in the development of biosensors: surface modification, immobilization, integration with transducer • Design, fabrication of cantilever for antibody detection • Hypodermic needles, transdermal patches : disadvantages • Micro needles: solid, hollow, polymer, silicon (fabrication) Nano particles for drug delivery	**10**
6	**MICROSYSTEM PACKAGING** • Packaging materials • Levels of packaging • Comparison between IC and MEMS packaging • Packaging technologies: Die preparation, surface bonding, wire bonding, sealing • Pressure sensor packaging	**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. "MEMS & MICROSYSTEMS Design and Manufacture", Tai-Ran Hsu, TATA Mcgraw-HILL.
2. "Fundamentals of Microfabrication" Marc Madou, CRC Press.

Reference Books:

1. "Fundamentals of BioMEMS and Medical Microdevices", Steven S. Saliterman, (SPIE Press Monograph Vol. PM153 by Wiley Interscience
2. "Microsystem Technology", W. Menz, J. Mohr, 0. Paul, WILEY-VCH, ISBN 3-527-29634-4
3. "Electro Mechanical System Design", James J. Allen, Taylor & Francis Group, LLC, ISBN-0-8247-5824-2, 2005
4. "MICROSYSTEM DESIGN",Stephen D. Senturia, KLUWER ACADEMIC PUBLISHERS, eBook ISBN: 0-306-47601-0

5. “Introduction to Microfabrication”, Sami FranssilaJohn Wiley & Sons Ltd, ISBN 0-470-85106-6
6. “Microelectromechanical Systems”, Nicolae Lobontiu, Ephrahim Garcia, KLUWER ACADEMIC PUBLISHERS, eBook ISBN: 0-387-23037-8
7. “BIOMEDICAL NANOTECHNOLOGY”, Neelina H. MalschCRC PRESS, Taylor and Francis Group, ISBN 10: 0-8247-2579-4

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
BMC802	Hospital Management (Abbreviated as HM)	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.							
BMC802	Hospital Manage-ment (HM)	20	20	20	80	03	--	--	--	--	100

Course Code	Course Name	Credits
BMC802	Hospital Management	04
Course Objectives	• To understand the basic principles used for designing of various departments in the hospital. • To understand the role of Biomedical Engineer in hospital and basic develop skills enabling to serve Hospitals. • Apply modern engineering and management principles to provide high quality of hospital care tin the community.	
Course Outcomes	**Learner will be able to** • Understand and apply resource management concepts (personnel, finance, and material resources) and the processes and strategies needed in specific hospital sectors. • Understand the management structure and functions in hospital. Communicate effectively and develop their leadership and team building abilities. • Understand the principles of designing, implementing and commissioning of clinical services and supportive departments in the hospital. • Understand the roles and responsibilities of Biomedical Engineer in hospital. • Understand the functions of other Engineering services and axillary services • Understand and apply materials management concept in industry	

Module	Contents	Hours
1	**Process of management:** Principles of management, Leadership, Motivation, Time management, , H.R. management (Recruitment, Performance appraisal, Training and development,), effective communication, Accounting - Types of Budget	08
2	**Organization of the hospital & Hospital Planning:** Management structure, Types of hospitals, Governing body, Hospital committee and hospital functionaries, Duties and responsibilities of various positions. Guiding principles in planning hospital facilities and services and planning the hospital building	06
3	**Clinical and Supportive Services :** Clinical Services: **(Location, Layout , equipment** And personnel): Emergency, IN patient, OUT patient, Intensive care unit, Operation Theatre, Laboratory, Blood Bank, Radiology **Supportive services:** Registration Medical record department, Central Sterile Service Dept, Pharmacy, Laundry and Linen Medical social service Dept. Hospital security, Housekeeping, Dietary (Food services)	14
4	**Biomedical Engineering Department: (Location, Layout, equipment and personnel and functions)** Roles and responsibilities of Biomedical Engineer in hospitals, Maintenance types: Routine(preventive) and breakdown Maintenance contracts (CMC and AMC)	05
5	**Other Engineering and Auxiliary Services :** A) Engineering Services (Electrical, Mechanical and Civil) : Responsibilities and functions, Hospital Ventilation and Air Conditioning, Medical Gas systems, Communication, Hospital information systems B) Auxiliary Services: Waste management, Hospital Infection control, Disaster management	08
6	**Material Management & Inventory Control** Classification of Materials Purchase Management: Purchase system(Centralized, Decentralized, Local purchase), Purchase Procedures: Selection of Suppliers, Tendering procedures, Analyzing bids, Price negotiations, Issue of purchase orders, Rate Contracts. Store Management: Functions of Store Manager, Materials handling, Flow of goods/FIFO. Inventory Control**:** Lead-time, Buffer stock, Reorder level, Two Bin System, EOQ	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. Hospital Management by Dr. Pradyna Pai
2. Hospital Planning, Designing and Management: Kunders G D, Gopinath, A katakam (Private Pub Bangalore)

Reference Books:

1. Computers in Medicine: R. D. Lele (TMH Pub)
2. Hospital Care and Hospital Management AICTE Journal Vol. 1,2,3 by Dr. Kalanidhi. (AICTE Pub Bangalore
3. Careers in Biomedical : Shantanu Thatte.

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 8041	Department Level Optional Course –IV: Healthcare Informatics (Abbreviated as HCI)	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 8041	Healthcare Informatics (HCI)	20	20	20	80	03	--	--	--	--	100

Course Code	Course Name	Credits
BMDLO8041	Healthcare Informatics	04
Course Objectives	• To understand the healthcare interoperability semantic and syntactic. • To understand the standards of healthcare interoperability standards for Medical Images and Medical Messages	
Course Outcomes	**Learner will be able to** • Understand Healthcare interoperability standards • Fabricate HL7 Messages • Understand and Design UML Diagrams • Understand semantic interoperability through DICOM • Edit and Compare DICOM file	

Module	Contents	Hours
1.	**Healthcare Interoperability** Standards In Healthcare System, Categorizing Standards, Standard Development, Various Healthcare Informatics Standards, Need for a Lingua Franca, Electronic Health Records, Interoperability Modelling Basics	04

2.	**HL7 Version 2** Message Syntax, Delimiters, Segment Definition, Message Header MSH, Patient Identification Details (PID) , Patent Visit (PV1), Request and Specimen Details (OBR) , Result Details (OBX), Z-Segments, Data, Simple Data Types, Complex Data Types, Codes and Identifiers, Names and Addresses, Other Complex Data Types	**08**
3.	**Unified Modelling Language (UML):** Use Case Diagrams, Activity Diagrams, Class Diagrams, Sequence Diagrams **HL7 Version 3:** Main goal of V3, V3 Development Methodology, V3 Messaging Components, Artifacts of the V3 Design Methodology, Dynamic Models, Static Models Clinical Document Architecture: Data Types, Codes and Vocabularies, Header , Body	**12**
4.	**DICOM standard:** Introduction, DICOM Grammar: VRs, DICOM Data Dictionary, DICOM Objects, DICOM Information Hierarchy, Modules, IODs and IEs	**06.**
5.	**DICOM Communications:** DICOM SOPs, Unit Identification on n/w, Services and Data, DIMSE Example: C-Echo, Storage, Query: Find, C-Find IOD, C-Find DIMSE, C-Cancel, Modality Worklist, Basic DICOM Retrieval: C-Get, Advanced DICOM Retrieval: C-Move, DICOM: Ping, Push and Pull	**08.**
6.	**DICOM Associations** Association Establishment, Transfer Syntax, Application Context, **DICOM Media: Files, Folders, and DICOMDIRs** DICOM File Format, DICOM File Services, Storing DICOM Data in PACS	**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. Principles of Health Interoperability HL7 and SNOMED (Health Information Technology Standards), Springer Publication by Tim Benson
2. Digital Imaging and Communication in Medicine by Oleg S. Pianykh, Springer Publication
   CDA™ Book, By Keith Boone, Springer Publication

Reference Books:

1. Informatics in Medical Imaging, George C. Kagadis, Steve G. Langer CRC Press

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 8042	Department Level Optional Course –IV: Robotics in Medicine (Abbreviated as RIM)	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 8042	Robotics in Medicine (RIM)	20	20	20	80	03	--	--	--	--	100

Course Code	Course Name	Credits
BMDLO8042	Robotics in Medicine	04
Course Objectives	• To introduce to basics of Robotics, Kinematics, Inverse Kinematics, vision and motion planning. • To introduce to various applications of Robots in Medicine.	
Course Outcomes	**A Learner will be able to** • Design basic Robotics system and formulate Kinematic, Inverse Kinematic motion planning solutions for various Robotic configurations. • Design Robotic systems for Medical application.	

Module	Contents	Hours
1.	Introduction Automation and Robots, Classification, Application, Specification, Notations	06
2.	Direct Kinematics Dot and cross products, Coordinate frames, Rotations, Homogeneous coordinates Link coordination arm equation, (Five- axis robot, Four-axis robot, Six-axis robot)	08

3.	Inverse Kinematics General properties of solutions tool configuration Five axis robots, Three-Four axis, Six axis robot(Inverse Kinematics). Workspace analysis and trajectory planning work envelope and examples, workspace fixtures, Pick and place operations, Continuous path motion, Interpolated motion, Straight-line motion.	**10**
4.	Robot Vision Image representation, Template matching, Polyhedral objects, Shane analysis, Segmentation (Thresholding, region labeling, Shrink operators, Swell operators, Euler numbers, Perspective transformation, Structured illumination, Camera calibration).	**10**
5.	Task Planning Task level programming, Uncertainty, Configuration, Space, Gross motion, Planning, Grasp Planning, Fine-motion planning, Simulation of planar motion, Source and Goal scenes, Task Planner simulation.	**08**
6.	Applications in Biomedical Engineering Application in rehabilitation, Clinical and Surgery	**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. Fundamentals of Robotics-Analysis and control, Robert Schilling, Prentice Hall of India.
2. Robotics, Fu,Gonzales and Lee, McGraw Hill
3. Introduction to Robotics, J.J,Craig,Pearson Education

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

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 8043	Department Level Optional Course –IV: Nuclear Medicine (Abbreviated as NM)	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 8043	Nuclear Medicine (NM)	20	20	20	80	03	--	--	--	--	100

Course Code	Course Name	Credits
BMDLO8043	Nuclear Medicine	04
Course Objectives	• To enable the students to understand the basic science of nuclear medicine, operating principles and quality control aspects of various nuclear medicine equipment. • To keep the students abreast with the technological developments in the field of nuclear medicine.	
Course Outcomes	**Learners will be able to** • Understand essential physics of nuclear medicine such as basic concepts of radioactivity, its measurement, interaction with matter and radionuclide production. • Understand concepts of radiopharmaceuticals and various aspects of radiation safety. • Apply the principles of physics to understand working of various detectors and counting systems. • Study principle of operation of different scanning system and their quality control function. • Understand various Emission Tomography Techniques along with their Clinical Applications. • Understand concept of radionuclide therapy and the function of	

	radiotherapy equipment.

Module	Content	Hours
1.	**Basics of Nuclear Physics**: Radioactivity, Radioactive Decay Law, Radioactive Decay Processes, Decay scheme of Mo-99. Units of Radioactivity Measurement, Successive Decay Equations. Statistics of Counting, Interaction of Radiation with Matter **Production of Radionuclide:** Methods of radionuclide production: Nuclear Reactor, Medical Cyclotron & Radionuclide Generators Spectra of commonly used radio nuclides e.g Tc-99m, Cs-137. Problems in radiation measurements.	**10**
2.	**Radiopharmaceuticals:** Ideal Radiopharmaceutical, Methods of Radiolabeling **Internal Radiation Dosimetry:** Absorbed Dose Calculations to Target & Non-Target Tissues, MIRD Methodology **Radiation Safety:** Natural & Artificial Radiation Exposure, External & Internal Radiation Hazard, Methods of Minimizing External Exposure, Methods of Preventing Internal Exposure, Evaluation of External & Internal Hazard, Biological Effects of Radiation, Radioactive Waste Management.	**08**
3.	**Detectors in Nuclear Medicine & Counting and Measuring System:** Gas filled Detectors, Scintillation Detectors and Solid State Detectors, Scintillation Counting System, Gamma Ray Spectrometry, Radionuclide Dose Calibrator, Properties of Detectors. **In Vitro techniques(Brief Description):** Introduction, Single and Double Isotope method, Radioimmunoassay, RIA Counting System, Liquid scintillation Counting system, RIA Applications.	**10**
4.	**In Vivo Techniques:** General Principle, Uptake Monitoring System, Rectilinear Scanner, Gamma Camera Fundamentals, Position Circuitry and working, Computer Interface, Performance Parameters, Quality Control Functions	**07**
5.	**Emission Tomography Techniques and Clinical Applications**: Introduction, Principles and applications of SPECT, Principles and applications of PET, System performance parameters and Quality Control Functions. **Introduction to Hybrid Modalities:** PET/CT, SPECT/CT **Clinical Applications** Clinical Applications of PET, SPECT and Hybrid Modalities in Cardiology, Neurology and Oncology.	**08**
6.	**Radionuclide Therapy** Choice of a Radionuclide in Therapeutic Nuclear Medicine Treatment of Benign & Malignant Diseases Palliative & Curative Procedures Radiotherapy Equipment: Cobalt unit, Gamma knife	**05**

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. J. Harbert and A.F.G. Rocha, *Textbook of Nuclear medicine*, Second Edition, Lea& Febiger.
2. B.R. Bairi, Balvinder Singh, N.C. Rathod and P.V. Narurkar, *Handbook of Nuclear medicine Instruments*, Tata McGraw – Hill.
3. Gopal B. Saha, *Fundamentals of Nuclear Pharmacy*, Springer Science+Business Media
4. Ramesh Chandra, *Introductory Physics of Nuclear Medicine*, Lea& Febiger.

References Books:

1. William R. Hendee, *Medical Radiation Physics*, Year Book Medical Publishers
2. G. Hine, *Instrumentation of Nuclear medicine*, Academic Press
3. Glenn F. Knoll, *Radiation Detection & Measurement*, John Wiley & Sons.

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
ILO2021	Institute Level Optional Course –II: Project Management	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme									
		Theory									
		Internal Assessment			End sem	Duration (hrs)	Term work	Pract.	Oral	Pract. / Oral	Total
		Test 1	Test 2	Avg.							
ILO2021	Institute Level Optional Course – II Project Management	20	20	20	80	03	--	--	--	--	100

Course Code	Course Name	Credits
ILO2021	Project Management	03
Course Objectives	• To familiarize the students with the use of a structured methodology/approach for each and every unique project undertaken, including utilizing project management concepts, tools and techniques. • To appraise the students with the project management life cycle and make them knowledgeable about the various phases from project initiation through closure.	
Course Outcomes	**Learner will be able to** • Apply selection criteria and select an appropriate project from different options. • Write work break down structure for a project and develop a schedule based on it. • Identify opportunities and threats to the project and decide an approach to deal with them strategically. • Use Earned value technique and determine & predict status of the project. • Capture lessons learned during project phases and document them for future reference	

Module	Detailed Contents	Hours
01	**Project Management Foundation:** Definition of a project, Project Vs Operations, Necessity of project management, Triple constraints, Project life cycles (typical & atypical) Project phases and stage gate process. Role of project manager. Negotiations and resolving conflicts. Project management in various organization structures. PM knowledge areas as per Project Management Institute (PMI).	05
02	**Initiating Projects:** How to get a project started, Selecting project strategically, Project selection models (Numeric /Scoring Models and Non-numeric models), Project portfolio process, Project sponsor and creating charter; Project proposal. Effective project team, Stages of team development & growth (forming, storming, norming & performing), team dynamics.	06
03	**Project Planning and Scheduling:** Work Breakdown structure (WBS) and linear responsibility chart, Interface Co-ordination and concurrent engineering, Project cost estimation and budgeting, Top down and bottoms up budgeting, Networking and Scheduling techniques. PERT, CPM, GANTT chart. Introduction to Project Management Information System (PMIS).	08
04	**Planning Projects:** Crashing project time, Resource loading and leveling, Goldratt's critical chain, Project Stakeholders and Communication plan. Risk Management in projects: Risk management planning, Risk identification and risk register. Qualitative and quantitative risk assessment, Probability and impact matrix. Risk response strategies for positive and negative risks	06
05	**Executing Projects:** Planning monitoring and controlling cycle. Information needs and reporting, engaging with all stakeholders of the projects. Team management, communication and project meetings. **Monitoring and Controlling Projects:** Earned Value Management techniques for measuring value of work completed; Using milestones for measurement; change requests and scope creep. Project audit. **Project Contracting** Project procurement management, contracting and outsourcing,	08
06	**Project Leadership and Ethics:** Introduction to project leadership, ethics in projects. Multicultural and virtual projects. **Closing the Project:** Customer acceptance; Reasons of project termination, Various types of project terminations (Extinction, Addition, Integration,	06

	Starvation), Process of project termination, completing a final report; doing a lessons learned analysis; acknowledging successes and failures; Project management templates and other resources; Managing without authority; Areas of further study.	

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.

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.

REFERENCES:

1. Jack Meredith & Samuel Mantel, Project Management: A managerial approach, Wiley India, 7thEd.
2. A Guide to the Project Management Body of Knowledge (PMBOK® Guide), 5th Ed, Project Management Institute PA, USA
3. Gido Clements, Project Management, Cengage Learning.
4. Gopalan, Project Management, , Wiley India
5. Dennis Lock, Project Management, Gower Publishing England, 9 th Ed.

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ILO2022	Institute Level Optional Course –II: Finance Management	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme									
		Theory									
		Internal Assessment			End sem	Duration (hrs)	Term work	Pract.	Oral	Pract. / Oral	Total
		Test 1	Test 2	Avg.							
ILO2022	Institute Level Optional Course – II Finance Management	20	20	20	80	03	--	--	--	--	100

Course Code	Course Name	Credits
ILO2022	Finance Management	03
Course Objectives	• Overview of Indian financial system, instruments and market • Basic concepts of value of money, returns and risks, corporate finance, working capital and its management • Knowledge about sources of finance, capital structure, dividend policy	
Course Outcomes	**Learner will be able to** • Understand Indian finance system and corporate finance • Take investment, finance as well as dividend decisions	

Module	Detailed Contents	Hours
01	**Overview of Indian Financial System:** Characteristics, Components and Functions of Financial System. **Financial Instruments:** Meaning, Characteristics and Classification of Basic Financial Instruments — Equity	06

	Shares, Preference Shares, Bonds-Debentures, Certificates of Deposit, and Treasury Bills. **Financial Markets:** Meaning, Characteristics and Classification of Financial Markets — Capital Market, Money Market and Foreign Currency Market. **Financial Institutions:** Meaning, Characteristics and Classification of Financial Institutions — Commercial Banks, Investment-Merchant Banks and Stock Exchanges	
02	**Concepts of Returns and Risks:** Measurement of Historical Returns and Expected Returns of a Single Security and a Two-security Portfolio; Measurement of Historical Risk and Expected Risk of a Single Security and a Two-security Portfolio. **Time Value of Money:** Future Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Present Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Continuous Compounding and Continuous Discounting.	**06**
03	**Overview of Corporate Finance:** Objectives of Corporate Finance; Functions of Corporate Finance—Investment Decision, Financing Decision, and Dividend Decision. **Financial Ratio Analysis:** Overview of Financial Statements—Balance Sheet, Profit and Loss Account, and Cash Flow Statement; Purpose of Financial Ratio Analysis; Liquidity Ratios; Efficiency or Activity Ratios; Profitability Ratios; Capital Structure Ratios; Stock Market Ratios; Limitations of Ratio Analysis.	**09**
04	**Capital Budgeting:** Meaning and Importance of Capital Budgeting; Inputs for Capital Budgeting Decisions; Investment Appraisal Criterion—Accounting Rate of Return, Payback Period, Discounted Payback Period, Net Present Value(NPV), Profitability Index, Internal Rate of Return (IRR), and Modified Internal Rate of Return (MIRR) **Working Capital Management:** Concepts of Meaning Working Capital; Importance of Working Capital Management; Factors Affecting an Entity's Working Capital Needs; Estimation of Working Capital Requirements; Management of Inventories; Management of Receivables; and Management of Cash and Marketable Securities.	**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.

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.

REFERENCES:

1. Fundamentals of Financial Management, 13th Edition (2015) by Eugene F. Brigham and Joel F. Houston; Publisher: Cengage Publications, New Delhi.
2. Analysis for Financial Management, 10th Edition (2013) by Robert C. Higgins; Publishers: McGraw Hill Education, New Delhi.
3. Indian Financial System, 9th Edition (2015) by M. Y. Khan; Publisher: McGraw Hill Education, New Delhi.
4. Financial Management, 11th Edition (2015) by I. M. Pandey; Publisher: S. Chand (G/L) & Company Limited, New Delhi.

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ILO2023	Institute Level Optional Course –II: Entrepreneurship development 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.							
ILO2023	Institute Level Optional Course – II Entrepreneurship Development and Management	20	20	20	80	03	--	--	--	--	100

Course Code	Course Name	Credits
ILO2023	Enterpreneurship Development and Management	03
Course Objectives	• To acquaint with entrepreneurship and management of business • Understand Indian environment for entrepreneurship • Idea of EDP, MSME	
Course Outcomes	**Learner will be able to** • Understand the concept of business plan and ownerships • Interpret key regulations and legal aspects of entrepreneurship in India • Understand government policies for entrepreneurs	

Module	Detailed Contents	Hours
01	**Overview Of Entrepreneurship:** Definitions, Roles and Functions/Values of Entrepreneurship, History of Entrepreneurship Development, Role of	04

	Entrepreneurship in the National Economy, Functions of an Entrepreneur, Entrepreneurship and Forms of Business Ownership Role of Money and Capital Markets in Entrepreneurial Development: Contribution of Government Agencies in Sourcing information for Entrepreneurship	
02	**Business Plans And Importance Of Capital To Entrepreneurship:** Preliminary and Marketing Plans, Management and Personnel, Start-up Costs and Financing as well as Projected Financial Statements, Legal Section, Insurance, Suppliers and Risks, Assumptions and Conclusion, Capital and its Importance to the Entrepreneur **Entrepreneurship And Business Development:** Starting a New Business, Buying an Existing Business, New Product Development, Business Growth and the Entrepreneur Law and its Relevance to Business Operations	**09**
03	Women's Entrepreneurship Development, Social entrepreneurship-role and need, EDP cell, role of sustainability and sustainable development for SMEs, case studies, exercises	**05**
04	**Indian Environment for Entrepreneurship:** key regulations and legal aspects , MSMED Act 2006 and its implications, schemes and policies of the Ministry of MSME, role and responsibilities of various government organisations, departments, banks etc., Role of State governments in terms of infrastructure developments and support etc., Public private partnerships, National Skill development Mission, Credit Guarantee Fund, PMEGP, discussions, group exercises etc	**08**
05	**Effective Management of Business:** Issues and problems faced by micro and small enterprises and effective management of M and S enterprises (risk management, credit availability, technology innovation, supply chain management, linkage with large industries), exercises, e-Marketing	**08**
06	**Achieving Success In The Small Business:** Stages of the small business life cycle, four types of firm-level growth strategies, Options – harvesting or closing small business Critical Success factors of small business	**05**

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.

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.

REFERENCES:

1. Poornima Charantimath, Entrepreneurship development- Small Business Enterprise, Pearson
2. Education Robert D Hisrich, Michael P Peters, Dean A Shapherd, Entrepreneurship, latest edition, The McGrawHill Company
3. Dr TN Chhabra, Entrepreneurship Development, Sun India Publications, New Delhi
4. Dr CN Prasad, Small and Medium Enterprises in Global Perspective, New century Publications, New Delhi
5. Vasant Desai, Entrepreneurial development and management, Himalaya Publishing House
6. Maddhurima Lall, Shikah Sahai, Entrepreneurship, Excel Books
7. Rashmi Bansal, STAY hungry STAY foolish, CIIE, IIM Ahmedabad
8. Law and Practice relating to Micro, Small and Medium enterprises, Taxmann Publication Ltd.
9. Kurakto, Entrepreneurship- Principles and Practices, Thomson Publication
10. Laghu Udyog Samachar
11. www.msme.gov.in
12. www.dcmesme.gov.in
13. www.msmetraining.gov.in

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ILO2024	Institute Level Optional Course –II: Human Resource Management	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme									
		Theory									
		Internal Assessment			End sem	Duration (hrs)	Term work	Pract.	Oral	Pract. / Oral	Total
		Test 1	Test 2	Avg.							
ILO2024	Institute Level Optional Course – II Human Resource Management	20	20	20	80	03	--	--	--	--	100

Course Code	Course Name	Credits
ILO2024	Human Resource Management	03
Course Objectives	• To introduce the students with basic concepts, techniques and practices of the human resource management. • To provide opportunity of learning Human resource Management (HRM) processes, related with the functions, and challenges in the emerging perspective. • To familiarize the students about the latest developments, trends & different aspects of HRM. • To acquaint the student with the importance of behavioral skills, Inter-personal, inter- group in an organizational setting. • To prepare the students as future organizational change facilitators, stable leaders and managers, using the knowledge and techniques of human resource management.	
Course Outcomes	**Learner will be able to** • Gain knowledge and understand the concepts about the different aspects of the human resource management.	

	• Understand and tackle the changes and challenges in today's diverse, dynamic organizational setting and culture. • Utilize the behavioral skill sets learnt, in working with different people, teams & groups within the national and global environment. • Apply the acquired techniques, knowledge and integrate it within the engineering/ non engineering working environment emerging as future engineers and managers.

Module	Detailed Contents	Hours
01	**Introduction to HR:** Human Resource Management- Concept, Scope and Importance, Interdisciplinary Approach Relationship with other Sciences, Competencies of HR Manager, HRM functions. Human resource development (HRD): changing role of HRM – Human resource Planning, Technological change, Restructuring and rightsizing, Empowerment, TQM, Managing ethical issues.	**05**
02	**Organizational Behavior (OB) :** Introduction to OB Origin, Nature and Scope of Organizational Behavior, Relevance to Organizational Effectiveness and Contemporary issues, Personality: Meaning and Determinants of Personality, Personality development, Personality Types, Assessment of Personality Traits for Increasing Self Awareness, Perception: Attitude and Value, Effect of perception on Individual Decision-making, Attitude and Behavior. Motivation: Theories of Motivation and their Applications for Behavioral Change (Maslow, Herzberg, McGregor); Group Behavior and Group Dynamics: Work groups formal and informal groups and stages of group development. Team Effectiveness: High performing teams, Team Roles, cross functional and self-directed team. Case study	**07**
03	**Organizational Structure & Design:** Structure, size, technology, Environment of organization; Organizational Roles & conflicts: Concept of roles; role dynamics; role conflicts and stress. Leadership: Concepts and skills of leadership, Leadership and managerial roles, Leadership styles and contemporary issues in leadership. Power and Politics: Sources and uses of power; Politics at workplace, Tactics and strategies.	**06**
04	**Human resource Planning:** Recruitment and Selection process, Job-enrichment, Empowerment - Job-Satisfaction, employee morale. Performance Appraisal Systems: Traditional & modern methods, Performance Counseling, Career Planning. Training & Development: Identification of Training Needs, Training	**05**

	Methods	
05	**Emerging Trends in HR :** Organizational development; Business Process Re-engineering (BPR), BPR as a tool for organizational development , managing processes & transformation in HR. Organizational Change, Culture, Environment, Cross Cultural Leadership and Decision Making**:** Cross Cultural Communication and diversity at work**,** Causes of diversity, managing diversity with special reference to handicapped, women and ageing people, intra company cultural difference in employee motivation.	**06**
06	**HR & MIS:** Need, purpose, objective and role of information system in HR, Applications in HRD in various industries (e.g. manufacturing R&D, Public Transport, Hospitals, Hotels and service industries **Strategic HRM** Role of Strategic HRM in the modern business world, Concept of Strategy, Strategic Management Process, Approaches to Strategic Decision Making; Strategic Intent – Corporate Mission, Vision, Objectives and Goals **Labor Laws & Industrial Relations** Evolution of IR, IR issues in organizations, Overview of Labor Laws in India; Industrial Disputes Act, Trade Unions Act, Shops and Establishments Act	**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.

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.

REFERENCES:

1. Stephen Robbins, Organizational Behavior, 16th Ed, 2013
2. V S P Rao, Human Resource Management, 3rd Ed, 2010, Excel publishing
3. Aswathapa, Human resource management: Text & cases, 6th edition, 2011
4. C. B. Mamoria and S V Gankar, Dynamics of Industrial Relations in India, 15th Ed, 2015, Himalaya Publishing, 15thedition, 2015
5. P. Subba Rao, Essentials of Human Resource management and Industrial relations, 5th Ed, 2013, Himalaya Publishing
6. Laurie Mullins, Management & Organizational Behavior, Latest Ed, 2016, Pearson Publications

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ILO2025	Institute Level Optional Course –II: Professional Ethics and Corporate Social Responsibility	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme									
		Theory									
		Internal Assessment			End sem	Duration (hrs)	Term work	Pract.	Oral	Pract. / Oral	Total
		Test 1	Test 2	Avg.							
ILO2025	Institute Level Optional Course – II Professional ethics and Corporate Social Responsibility	20	20	20	80	03	--	--	--	--	100

Course Code	Course Name	Credits
ILO2025	Professional Ethics and Corporate Social Resonsibility (CSR)	03
Course Objectives	• To understand professional ethics in business • To recognized corporate social responsibility	
Course Outcomes	Learner will be able to • Understand rights and duties of business • Distinguish different aspects of corporate social responsibility • Demonstrate professional ethics • Understand legal aspects of corporate social responsibility	

Module	Detailed Contents	Hours
01	**Professional Ethics and Business:** The Nature of Business Ethics; Ethical Issues in Business; Moral Responsibility and Blame; Utilitarianism: Weighing Social Costs and Benefits; Rights and Duties of Business	**04**
02	**Professional Ethics in the Marketplace:** Perfect Competition; Monopoly Competition; Oligopolistic Competition; Oligopolies and Public Policy **Professional Ethics and the Environment:** Dimensions of Pollution and Resource Depletion; Ethics of Pollution Control; Ethics of Conserving Depletable Resources	**08**
03	**Professional Ethics of Consumer Protection:** Markets and Consumer Protection; Contract View of Business Firm's Duties to Consumers; Due Care Theory; Advertising Ethics; Consumer Privacy **Professional Ethics of Job Discrimination:** Nature of Job Discrimination; Extent of Discrimination; Reservation of Jobs.	**06**
04	**Introduction to Corporate Social Responsibility:** Potential Business Benefits—Triple bottom line, Human resources, Risk management, Supplier relations; Criticisms and concerns—Nature of business; Motives; Misdirection. Trajectory of Corporate Social Responsibility in India	**05**
05	**Corporate Social Responsibility:** Articulation of Gandhian Trusteeship Corporate Social Responsibility and Small and Medium Enterprises (SMEs) in India, Corporate Social Responsibility and Public-Private Partnership (PPP) in India	**08**
06	**Corporate Social Responsibility in Globalizing India:** Corporate Social Responsibility Voluntary Guidelines, 2009 issued by the Ministry of Corporate Affairs, Government of India, Legal Aspects of Corporate Social Responsibility—Companies Act, 2013.	**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.

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.

REFERENCES:

1. Business Ethics: Texts and Cases from the Indian Perspective (2013) by Ananda Das Gupta; Publisher: Springer.
2. Corporate Social Responsibility: Readings and Cases in a Global Context (2007) by Andrew Crane, Dirk Matten, Laura Spence; Publisher: Routledge.
3. Business Ethics: Concepts and Cases, 7th Edition (2011) by Manuel G. Velasquez; Publisher: Pearson, New Delhi.
4. Corporate Social Responsibility in India (2015) by Bidyut Chakrabarty, Routledge, New Delhi.

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ILO2026	Institute Level Optional Course –II: Research Methodology	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme									
		Theory									
		Internal Assessment			End sem	Duration (hrs)	Term work	Pract.	Oral	Pract. / Oral	Total
		Test 1	Test 2	Avg.							
ILO2026	Institute Level Optional Course – II Research Methodology	20	20	20	80	03	--	--	--	--	100

Course Code	Course Name	Credits
ILO2026	Research Methodology	03
Course Objectives	• To understand Research and Research Process • To acquaint students with identifying problems for research and develop research strategies • To familiarize students with the techniques of data collection, analysis of data and interpretation	
Course Outcomes	**Learner will be able to** • Prepare a preliminary research design for projects in their Course matter areas • Accurately collect, analyze and report data • Present complex data or situations clearly • Review and analyze research findings	

Module	Detailed Contents	Hrs
01	**Introduction and Basic Research Concepts:** Research – Definition; Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, Principle. Research methods vs Methodology, Need of Research in Business and Social Sciences , Objectives of Research, **Issues** and Problems in Research, Characteristics of Research: Systematic, Valid, Verifiable, Empirical and Critical	**10**
02	**Types of Research:** Basic Research, Applied Research, Descriptive Research, Analytical Research, Empirical Research, Qualitative and Quantitative Approaches	**08**
03	**Research Design and Sample Design :** Research Design – Meaning, Types and Significance, Sample Design – Meaning and Significance Essentials of a good sampling Stages in Sample Design Sampling methods/techniques Sampling Errors	**08**
04	**Research Methodology :** Meaning of Research Methodology, Stages in Scientific Research Process **a.** Identification and Selection of Research Problem **b.** Formulation of Research Problem **c.** Review of Literature **d.** Formulation of Hypothesis **e.** Formulation of research Design **f**. Sample Design **g.** Data Collection **h.** Data Analysis **i.** Hypothesis testing and Interpretation of Data **j.** Preparation of Research Report	**08**
05	**Formulating Research Problem:** Considerations: Relevance, Interest, Data Availability, Choice of data, Analysis of data, Generalization and Interpretation of analysis	**04**
06	**Outcome of Research:** Preparation of the report on conclusion reached,	**04**

	Validity Testing & Ethical Issues, Suggestions and Recommendation	

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.

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.

REFERENCES:

1. Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS Publishers Distributors.
2. Kothari, C.R., 1985, Research Methodology-Methods and Techniques, New Delhi, Wiley Eastern Limited.
3. Kumar, Ranjit, 2005, Research Methodology-A Step-by-Step Guide for Beginners, (2^{nd}ed), Singapore, Pearson Education

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ILO2027	Institute Level Optional Course –II: IPR and Patenting	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.							
ILO2027	Institute Level Optional Course – II IPR and Patenting	20	20	20	80	03	--	--	--	--	100

Course Code	Course Name	Credits
ILO2027	IPR and Patenting	03
Course Objectives	• To understand intellectual property rights protection system • To promote the knowledge of Intellectual Property Laws of India as well as International treaty procedures • To get acquaintance with Patent search and patent filing procedure and applications	
Course Outcomes	**Learner will be able to** • understand Intellectual Property assets • assist individuals and organizations in capacity building • work for development, promotion, protection, compliance, and enforcement of Intellectual Property and Patenting	

Module	Detailed Contents	Hours
01	**Introduction to Intellectual Property Rights (IPR)**: Meaning of IPR, Different category of IPR instruments - Patents, Trademarks, Copyrights, Industrial Designs, Plant variety protection, Geographical indications, Transfer of technology etc. **Importance of IPR in Modern Global Economic Environment:** Theories of IPR, Philosophical aspects of IPR laws, Need for IPR, IPR as an instrument of development	05
02	**Enforcement of Intellectual Property Rights:** Introduction, Magnitude of problem, Factors that create and sustain counterfeiting/piracy, International agreements, International organizations (e.g. WIPO, WTO) activein IPR enforcement **Indian Scenario of IPR:** Introduction, History of IPR in India, Overview of IP laws in India, Indian IPR, Administrative Machinery, Major international treaties signed by India, Procedure for submitting patent and Enforcement of IPR at national level etc.	07
03	**Emerging Issues in IPR:** Challenges for IP in digital economy, e-commerce, human genome, biodiversity and traditional knowledge etc.	06
04	**Basics of Patents:** Definition of Patents, Conditions of patentability, Patentable and non-patentable inventions, Types of patent applications (e.g. Patent of addition etc), Process Patent and Product Patent, Precautions while patenting, Patent specification Patent claims, Disclosures and non-disclosures, Patent rights and infringement, Method of getting a patent	07
05	**Patent Rules:** Indian patent act, European scenario, US scenario, Australia scenario, Japan scenario, Chinese scenario, Multilateral treaties where India is a member (TRIPS agreement, Paris convention etc.)	08
06	**Procedure for Filing a Patent (National and International):** Legislation and Salient Features, Patent Search, Drafting and Filing Patent Applications, Processing of patent, Patent Litigation, Patent Publicationetc, Time frame and cost, Patent Licensing, Patent Infringement **Patent databases:** Important websites, Searching international databases	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.

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.

REFERENCE BOOKS:

1. Rajkumar S. Adukia, 2007, A Handbook on Laws Relating to Intellectual Property Rights in India, The Institute of Chartered Accountants of India
2. Keayla B K, Patent system and related issues at a glance, Published by National Working Group on Patent Laws
3. T Sengupta, 2011, Intellectual Property Law in India, Kluwer Law International
4. Tzen Wong and Graham Dutfield,2010, Intellectual Property and Human Development: Current Trends and Future Scenario, Cambridge University Press
5. Cornish, William Rodolph&Llewelyn, David. 2010, Intellectual Property: Patents, Copyrights, Trade Marks and Allied Right, 7th Edition, Sweet & Maxwell
6. LousHarns, 2012, The enforcement of Intellactual Property Rights: A Case Book, 3rd Edition, WIPO
7. PrabhuddhaGanguli, 2012, Intellectual Property Rights, 1st Edition, TMH
8. R Radha Krishnan & S Balasubramanian, 2012, Intellectual Property Rights, 1st Edition, Excel Books
9. M Ashok Kumar andmohdIqbal Ali, 2-11, Intellectual Property Rights, 2nd Edition, Serial Publications
10. KompalBansal and PraishitBansal, 2012, Fundamentals of IPR for Engineers, 1st Edition, BS Publications
11. Entrepreneurship Development and IPR Unit, BITS Pilani, 2007, A Manual on Intellectual Property Rights,

12. Mathew Y Maa, 2009, Fundamentals of Patenting and Licensing for Scientists and Engineers, World Scientific Publishing Company
13. N S Rathore, S M Mathur, PritiMathur, AnshulRathi**,** IPR: Drafting,Interpretation of Patent Specifications and Claims**,** New India Publishing Agency
14. Vivien Irish, 2005,Intellectual Property Rights for Engineers,IET
15. Howard B Rockman, 2004, Intellectual Property Law for Engineers and scientists, Wiley-IEEE Press

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ILO2028	Institute Level Optional Course –II: Digital Business 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.							
ILO2028	Institute Level Optional Course – II Digital Business Management	20	20	20	80	03	--	--	--	--	100

Course Code	Course Name	Credits
ILO2028	Digital Business Management	03
Course Objectives	• To familiarize with digital business concept • To acquaint with E-commerce • To give insights into E-business and its strategies	
Course Outcomes	**The learner will be able to** • Identify drivers of digital business • Illustrate various approaches and techniques for E-business and management • Prepare E-business plan	

Module	Detailed content	Hours
1	**Introduction to Digital Business:** Introduction, Background and current status, E-market places, structures, mechanisms, economics and impacts Difference between physical economy and digital economy, **Drivers of digital business**- Big Data & Analytics, Mobile, Cloud Computing, Social media, BYOD, and Internet of Things(digitally intelligent machines/services) Opportunities and Challenges in Digital Business,	09

2	**Overview of E-Commerce: E-Commerce-** Meaning, Retailing in e-commerce-products and services, consumer behavior, market research and advertisement B2B-E-commerce-selling and buying in private e-markets, public B2B exchanges and support services, e-supply chains, Collaborative Commerce, Intra business EC and Corporate portals Other E-C models and applications, innovative EC System-From E-government and learning to C2C, mobile commerce and pervasive computing EC Strategy and Implementation-EC strategy and global EC, Economics and Justification of EC, Using Affiliate marketing to promote your e-commerce business, Launching a successful online business and EC project, Legal, Ethics and Societal impacts of EC	**06**
3	**Digital Business Support services**: ERP as e –business backbone, knowledge Tope Apps, Information and referral system, **Application Development:** Building Digital business Applications and Infrastructure	**06**
4	**Managing E-Business**-Managing Knowledge, Management skills for e-business, Managing Risks in e –business, Security Threats to e-business - Security Overview, Electronic Commerce Threats, Encryption, ryptography, Public Key and Private Key Cryptography, Digital Signatures, Digital Certificates, Security Protocols over Public Networks: HTTP, SSL, Firewall as Security Control, Public Key Infrastructure (PKI) for Security, Prominent Cryptographic Applications	**06**
5	**E-Business Strategy**-E-business Strategic formulation- Analysis of Company's Internal and external environment, Selection of strategy, E-business strategy into Action, challenges and E-Transition (Process of Digital Transformation)	**04**
6	**M Materializing e-business: From Idea to Realization**-Business plan preparation **Case Studies and presentations**	**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.

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.

REFERENCES:

1. A textbook on E-commerce**,** Er Arunrajan Mishra, Dr W K Sarwade,Neha Publishers & Distributors, 2011
2. E-commerce from vision to fulfilment, Elias M. Awad, PHI-Restricted, 2002
3. Digital Business and E-Commerce Management, 6th Ed, Dave Chaffey, Pearson, August 2014
4. Introduction to E-business-Management and Strategy, Colin Combe, ELSVIER, 2006
5. Digital Business Concepts and Strategy, Eloise Coupey, 2nd Edition, Pearson
6. Trend and Challenges in Digital Business Innovation, Vinocenzo Morabito, Springer
7. Digital Business Discourse Erika Darics, April 2015, Palgrave Macmillan
8. E-Governance-Challenges and Opportunities in : Proceedings in 2nd International Conference theory and practice of Electronic Governance
9. Perspectives the Digital Enterprise –A framework for Transformation, TCS consulting journal Vol.5
10. Measuring Digital Economy-A new perspective -DOI:10.1787/9789264221796-en OECD Publishing

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ILO2029	Institute Level Optional Course –II: Environmental 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.							
ILO2029	Institute Level Optional Course – II Environmental Management	20	20	20	80	03	--	--	--	--	100

Course Code	Course Name	Credits
ILO2029	Environmental Management	03
Course Objectives	• Understand and identify environmental issues relevant to India and global concerns • Learn concepts of ecology • Familiarise environment related legislations	
Course Outcomes	**Learner will be able to** • Understand the concept of environmental management • Understand ecosystem and interdependence, food chain etc. • Understand and interpret environment related legislations	

Module	Detailed Contents	Hours
01	Introduction and Definition of Environment: Significance of Environment Management for contemporary managers, Career opportunities. Environmental issues relevant to India, Sustainable Development, The Energy	10

	scenario.	
02	Global Environmental concerns : Global Warming, Acid Rain, Ozone Depletion, Hazardous Wastes, Endangered life-species, Loss of Biodiversity, Industrial/Man-made disasters, Atomic/Biomedical hazards, etc.	**06**
03	Concepts of Ecology: Ecosystems and interdependence between living organisms, habitats, limiting factors, carrying capacity, food chain, etc.	**05**
04	Scope of Environment Management, Role & functions of Government as a planning and regulating agency. Environment Quality Management and Corporate Environmental Responsibility	**10**
05	Total Quality Environmental Management, ISO-14000, EMS certification.	**05**
06	General overview of major legislations like Environment Protection Act, Air (P & CP) Act, Water (P & CP) Act, Wildlife Protection Act, Forest Act, Factories Act, etc.	**03**

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.

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.

REFERENCES:

1. Environmental Management: Principles and Practice, C J Barrow, Routledge Publishers London, 1999
2. A Handbook of Environmental Management Edited by Jon C. Lovett and David G. Ockwell, Edward Elgar Publishing
3. Environmental Management, **T V Ramachandra and Vijay Kulkarni, TERI Press**
4. Indian Standard Environmental Management Systems — Requirements With Guidance For Use, Bureau Of Indian Standards, February 2005
5. Environmental Management: An Indian Perspective, S N Chary and Vinod Vyasulu, Maclillan India, 2000
6. Introduction to Environmental Management, Mary K Theodore and Louise Theodore, CRC Press
7. Environment and Ecology, Majid Hussain, 3rd Ed. Access Publishing.2015

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
BML803	Project Stage - II	--	12	--	--	06	--	06

Course Code	Course Name	Examination Scheme								
		Theory				Term work	Pract.	Oral	Pract. / Oral	Total
		Internal Assessment			End sem					
		Test 1	Test 2	Avg.						
BML 803	Project Stage - II	--	--	--	--	50	--	--	100	150

Course Code	Course Name	Credits
BML803	Project Stage-II	06
Course objective	• Implement the concept of Project Stage-I • Use advanced tools for Implementation • Rectify/ Debug the design and Submit project report.	
Course Outcome	**Learner will be able to** • Debug/ Rectify the design incurred during implementation • Write Analysis, Results, Design in prescribed format • Learn the behavioral science by working in a group	

Pr**oject Guidelines:**

1. The students have already under gone project assignment in their seventh semester and in this semester the students are expected to continue the project work of stage I and should attempt solution to the problem.
2. Learner is allotted 12 hrs per week for the project work
3. Report should be prepared as per the guidelines issued by the University of Mumbai
4. Learners should be motivated to publish a paper based on the work in Conferences/students competitions
5. Project Groups: Learners can form groups not more than 4 (Four)

Faculty Load:

1. In semester VIII - 1 (One) periods of 1 hour each per week per project group
2. Each faculty is permitted to take (guide) maximum 4 (Four) project groups.

Assessment:

Term Work:

The Term Work should be examined by approved internal faculty appointed by the head of the institute based on 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- II

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

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
BML801	Biomedical Microsystems (BM)	--	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.						
BML801	Biomedical Microsystems (BM)	--	--	--	--	25	--	25	--	50

Course Code	Course Name	Credits
BML801	Biomedical Microsystems	01
Course Objectives	• To understand various fabrication techniques for MEMS devices and applying them for fabricating biomedical devices.	
Course Outcomes	**Learner will be able to…** • Select appropriate material, fabrication technique and packaging technique for given application • Simulate given microsystems to evaluate its performance	

Syllabus: Same as that of BMC801 Biomedical Microsystems(BM).

List of Experiments: (Any Three)

1. Simulation of scaling law
2. Crystal structure
3. Biosensors
4. Simulation of pressure sensors
5. Simulation of cantilever
6. Simulation of Microchannel
7. Simulation of Microvalve

8. Simulation of Micropump

List of Tutorials (Any Four)

1. Scaling Laws
2. Materials for MEMS
3. MEMS deposition techniques
4. MEMS etching techniques
5. Lithography
6. Surface characterization techniques
7. Micromachining
8. Softlithography
9. Micro Total Analysis systems
10. Drug delivery devices
11. MEMS packaging

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

Presentation based on the topics covered in the syllabus.

Assessment:

Term Work:

Term work shall consist of minimum 3 experiments and 4 Tutorials.
The distribution of marks for term work shall be as follows:
Laboratory work (Experiments and Tutorials) : 10 Marks
Presentation : 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. "MEMS & MICROSYSTEMS Design and Manufacture", Tai-Ran Hsu, TATA Mcgraw-HILL.
2. "Fundamentals of Microfabrication" Marc Madou, CRC Press.

Reference Books:

1. "Fundamentals of BioMEMS and Medical Microdevices", Steven S. Saliterman, (SPIE Press Monograph Vol. PM153 by Wiley Interscience
2. "Microsystem Technology", W. Menz, J. Mohr, 0. Paul, WILEY-VCH, ISBN 3-527-29634-4
3. "Electro Mechanical System Design", James J. Allen, Taylor & Francis Group, LLC, ISBN-0-8247-5824-2, 2005
4. "MICROSYSTEM DESIGN",Stephen D. Senturia, KLUWER ACADEMIC PUBLISHERS,

eBook ISBN: 0-306-47601-0
5. "Introduction to Microfabrication", Sami FranssilaJohn Wiley & Sons Ltd, ISBN 0-470-85106-6
6. "Microelectromechanical Systems", Nicolae Lobontiu, Ephrahim Garcia, KLUWER ACADEMIC PUBLISHERS, eBook ISBN: 0-387-23037-8
7. "BIOMEDICAL NANOTECHNOLOGY", Neelina H. MalschCRC PRESS, Taylor and Francis Group, ISBN 10: 0-8247-2579-4

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
BML802	Hospital Management (HM)	--	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.						
BML802	Hospital Management (HM)	--	--	--	--	25	--	25	--	50

Course Code	Course Name	Credits
BML802	Hospital Management	01
Course Objectives	• To understand the basic principles used for designing of various departments in the hospital. • To understand the role of Biomedical Engineer in hospital and basic develop skills enabling to serve Hospitals. • Apply modern engineering and management principles to provide high quality of hospital care tin the community.	
Course Outcomes	**Learner will be able to** • Understand and apply finance management concepts and the processes and strategies needed in specific hospital sectors. • Understand the management structure and functions in hospital. Communicate effectively and develop their leadership and team building abilities. • Design the layout of clinical services and supportive departments in	

	the hospital. • Understand the roles and responsibilities of Biomedical Engineer in hospital. • Understand the functions of other Engineering services and axillary services • Understand and apply materials management and the purchase procedure in industry

Syllabus: Same as that of BMC802 Hospital Management (HM).

List of Experiments and Assignments: (Any Four Experiments and Any Four Assignments)

1. Design of Registration form of hospital.
2. Prepare budget using EXCEL sheet for purchase of hospital equipment.
3. Preparation of Comparative Statement of Equipment for purchase **(Any Two)**
4. Negotiations of the equipment in the comparative statement.
5. Design the layout of Out Patient Department in hospital.
6. Design the layout of In Patient Department in hospital.
7. Design the layout of Surgical Operation Theatre Complex in hospital.
8. Design the layout of Radiology Department in hospital.
9. Design the layout of Pathology Laboratory and Blood Bank Department in hospital.
10. Design the layout of Physiotherapy Department in hospital.
11. Design the layout of Central Sterile Supply Department in hospital.

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

Group Presentation based on the assigned topic by visiting a hospital.

Assessment:

Term Work:

Term work shall consist of minimum 4 experiments, 4 assignments and presentation.
The distribution of marks for term work shall be as follows:
Laboratory work (Experiments) : 10 Marks
Laboratory work (Assignments) : 05 Marks
Presentations : 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. Hospital Management by Dr. Pradyna Pai
2. Hospital Planning, Designing and Management: Kunders G D, Gopinath, A katakam (Private Pub Bangalore)

Reference Books:

1. Computers in Medicine: R. D. Lele (TMH Pub)
2. Hospital Care and Hospital Management AICTE Journal Vol. 1,2,3 by Dr. Kalanidhi. (AICTE Pub Bangalore
3. Careers in Biomedical : Shantanu Thatte.

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
BMDLL 8041	Healthcare Informatics (HCI)	--	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 8041	Healthcare Informatics (HCI)	--	--	--	--	25	--	25	--	50

Course Code	Course Name	Credits
BMDLL8041	Healthcare Informatics	01
Course Objectives	• To understand the healthcare interoperability semantic and syntactic. • To understand the standards of healthcare interoperability standards for Medical Images and Medical Messages	
Course Outcomes	**Learner will be able to** • Fabricate HL7 Messages • Edit and Compare DICOM file	

Syllabus: Same as that of BMDLO8041 Healthcare Informatics (HCI).

List of Experiments: (Any Seven)

1. To find term/ Concept and ID or Vocabulary codes

2. Identifying and Chapters of Health Level 7 for trigger Event and message types and message
3. Structure should be sent to cover each requirement
4. Reading and editing segment
5. Create Health Level 7 Message
6. Create Patient Information Database from Health Level 7 Messages
7. To Study DICOM Validation Tool (DVTK)
8. Edit DICOM File using hex-Editor\
9. Creating Database of a patient
10. Comparing DICOM file

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. Principles of Health Interoperability HL7 and SNOMED (Health Information Technology Standards), Springer Publication by Tim Benson
2. Digital Imaging and Communication in Medicine by Oleg S. Pianykh, Springer Publication
   CDA™ Book, By Keith Boone, Springer Publication

Reference Books:

1. Informatics in Medical Imaging, George C. Kagadis, Steve G. Langer CRC Press

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
BMDLL 8042	Robotics in Medicine (RIM)	--	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 8042	Robotics in Medicine (RIM)	--	--	--	--	25	--	25	--	50

Course Code	Course Name	Credits
BMDLL8042	Robotics in Medicine	01
Course Objectives	• To introduce to basics of Robotics, Kinematics, Inverse Kinematics, vision and motion planning. • To introduce to various applications of Robots in Medicine.	
Course Outcomes	**A Learner will be able to** • Design basic Robotics system and formulate Kinematic, Inverse Kinematic motion planning solutions for various Robotic configurations. • Design Robotic systems for Medical application.	

Syllabus: Same as that of BMDLO8042 Robotics in Medicine (RIM).

List of Tutorials: (Any Seven)

1. Automation and Robots Classification
2. Specification, Notations
3. Direct Kinematics Dot and cross products
4. Five- axis robot, Four-axis robot, Six-axis robot(Direct Kinematics)
5. Five axis robots, Three-Four axis, Six axis robot(Inverse Kinematics)
6. Robot Vision Image representation
7. Segmentation
8. Applications in Biomedical Engineering ,Application in rehabilitation, Clinical and Surgery

9. Task Planning, Task level programming

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. Learners are supposed carryout thorough literature survey, collect data and prepare their presentation.

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

Reference Books:

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

Course Code	Course Name	Teaching scheme			Credit assigned			
BMDLL	**Nuclear**	**Theory**	**Pract.**	**Tut.**	**Theory**	**Pract.**	**Tut.**	**Total**

8043	**Medicine (NM)**	**--**	**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 8043	**Nuclear Medicine (NM)**	**--**	**--**	**--**	**--**	**25**	**--**	**25**	**--**	**50**

Course Code	**Course Name**	**Credits**
BMDLL8043	**Nuclear Medicine**	**01**
Course Objectives	• To enable the students to understand the basic science of nuclear medicine, operating principles and quality control aspects of various nuclear medicine equipment. • To keep the students abreast with the technological developments in the field of nuclear medicine.	
Course Outcomes	**Learners will be able to** • Understand essential physics of nuclear medicine such as basic concepts of radioactivity, its measurement, interaction with matter and radionuclide production. • Understand concepts of radiopharmaceuticals and various aspects of radiation safety. • Apply the principles of physics to understand working of various detectors and counting systems. • Study principle of operation of different scanning system and their quality control function. • Understand various Emission Tomography Techniques along with their Clinical Applications. • Understand concept of radionuclide therapy and the function of radiotherapy equipment.	

Syllabus: Same as that of BMDLL8043 Nuclear Medicine (NM).

List of Experiments and Tutorials: (Any Seven)

1. Interaction of Radiations with Matter

2. Classification of Detectors
3. Gas Filled Detectors
4. Scintillation and Solid State Detectors
5. Gamma Camera
6. Liquid Scintillation Technique
7. Tracers in Uptake Studies
8. Uptake Studies
9. Radiation Safety

Industry / Hospital Visits may be conducted.

Any other experiment and tutorials 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 and Tutorials) : 10 Marks
Presentation : 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. J. Harbert and A.F.G. Rocha, *Textbook of Nuclear medicine*, Second Edition, Lea& Febiger.
2. B.R. Bairi, Balvinder Singh, N.C. Rathod and P.V. Narurkar, *Handbook of Nuclear medicine Instruments*, Tata McGraw – Hill.
3. Gopal B. Saha, *Fundamentals of Nuclear Pharmacy*, Springer Science+Business Media
4. Ramesh Chandra, *Introductory Physics of Nuclear Medicine*, Lea& Febiger.

References Books:

1. William R. Hendee, *Medical Radiation Physics*, Year Book Medical Publishers
2. G. Hine, *Instrumentation of Nuclear medicine*, Academic Press
3. Glenn F. Knoll, *Radiation Detection & Measurement*, John Wiley & Sons.