

B.E. Biomedical Engineering (BM) Choice Based Credit System (CBCS) Semester - V			
Management and Entrepreneurship Development (Common to EC/TC/EI/BM/ML)			
Subject Code	: 15ES51		IA Marks : 20
Number of Lecture Hours /Week	: 04		Exam Marks : 80
Total Number of Lecture Hours	: 50		Exam Hours : 03
Credits – 4 (Each module – 10 Hours)			
Module -1			
<p>Management: Nature and Functions of Management – Importance, Definition, Management Functions, Levels of Management, Roles of Manager, Managerial Skills, Management & Administration, Management as a Science, Art & Profession (Selected topics of Chapter 1, Text 1).</p> <p>Planning: Planning-Nature, Importance, Types, Steps and Limitations of Planning; Decision Making – Meaning, Types and Steps in Decision Making (Selected topics from Chapters 4 & 5, Text 1).</p>			
Module -2			
<p>Organizing and Staffing: Organization-Meaning, Characteristics, Process of Organizing, Principles of Organizing, Span of Management (meaning and importance only), Departmentalisation, Committees– Meaning, Types of Committees; Centralization Vs Decentralization of Authority and Responsibility; Staffing-Need and Importance, Recruitment and Selection Process (Selected topics from Chapters 7, 8 & 11, Text 1).</p> <p>Directing and Controlling: Meaning and Requirements of Effective Direction, Giving Orders; Motivation-Nature of Motivation, Motivation Theories (Maslow’s Need-Hierarchy Theory and Herzberg’s Two Factor Theory); Communication – Meaning, Importance and Purposes of Communication; Leadership-Meaning, Characteristics, Behavioural Approach of Leadership; Coordination-Meaning, Types, Techniques of Coordination; Controlling – Meaning, Need for Control System, Benefits of Control, Essentials of Effective Control System, Steps in Control Process (Selected topics from Chapters 15 to 18 and 9, Text 1).</p>			
Module -3			
<p>Social Responsibilities of Business: Meaning of Social Responsibility, Social Responsibilities of Business towards Different Groups, Social Audit, Business Ethics and Corporate Governance (Selected topics from Chapter 3, Text 1).</p> <p>Entrepreneurship: Definition of Entrepreneur, Importance of Entrepreneurship, concepts of Entrepreneurship, Characteristics of successful Entrepreneur, Classification of Entrepreneurs, Myths of Entrepreneurship, Entrepreneurial Development models, Entrepreneurial development cycle, Problems faced by Entrepreneurs and capacity building for Entrepreneurship (Selected topics from Chapter 2, Text 2).</p>			
Module -4			
<p>Modern Small Business Enterprises: Role of Small Scale Industries, Impact of Globalization and WTO on SSIs, Concepts and definitions of SSI Enterprises, Government policy and development of the Small Scale sector in India, Growth and Performance of Small Scale Industries in India, Sickness in SSI sector, Problems for Small Scale Industries, Ancillary Industry and Tiny Industry (Definition only) (Selected topics from Chapter1, Text 2).</p> <p>Institutional Support for Business Enterprises: Introduction, Policies & Schemes of Central Level</p>			

Institutions, State Level Institutions (Selected topics from Chapter 4, Text 2).
Module -5 Projects Management: A Project. Search for a Business idea: Introduction, Choosing an Idea, Selection of product, The Adoption process, Product Innovation, Product Planning and Development Strategy, Product Planning and Development Process. Concepts of Projects and Classification: Introduction, Meaning of Projects, Characteristics of a Project, Project Levels, Project Classification, Aspects of a Project, The project Cycle, Features and Phases of Project management, Project Management Processes. Project Identification: Feasibility Report, Project Feasibility Analysis. Project Formulation: Meaning, Steps in Project formulation, Sequential Stages of Project Formulation, Project Evaluation. Project Design and Network Analysis: Introduction, Importance of Network Analysis, Origin of PERT and CPM, Network, Network Techniques, Need for Network Techniques, Steps in PERT, CPM, Advantages, Limitations and Differences. (Selected topics from Chapters 16 to 20 of Unit 3, Text 3).
Question paper pattern <ul style="list-style-type: none"> • The question paper will have TEN questions. • Each full question carries 16 marks. • There will be two full questions (with a maximum of THREE sub questions) from each module. • Each full question will have sub questions covering all topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module.
Text Books: <ol style="list-style-type: none"> 1. Principles of Management – P.C Tripathi, P.N Reddy, McGraw Hill Education, 6th Edition, 2017. ISBN-13:978-93-5260-535-4. 2. Entrepreneurship Development Small Business Enterprises- Poornima M Charantimath, Pearson Education 2008, ISBN 978-81-7758-260-4. 3. Dynamics of Entrepreneurial Development and Management by Vasant Desai. HPH 2007, ISBN: 978-81-8488-801-2.
Reference Book: <ol style="list-style-type: none"> 1. Essentials of Management: An International, Innovation and Leadership perspective by Harold Koontz, Heinz Weihrich McGraw Hill Education, 10th Edition 2016. ISBN- 978-93-392-2286-4.

B.E. Biomedical Engineering (BM) Choice Based Credit System (CBCS) Semester - V				
Fundamentals of Signals and DSP (Common to EI & BM)				
Subject Code	: 15EI/BM52		IA Marks	: 20
Number of Lecture Hours /Week	: 04		Exam Marks	: 80
Total Number of Lecture Hours	: 50		Exam Hours	: 03
Credits – 4 (Each module – 10 Hours)				
Module -1				
Introduction to Signals and Systems:				
Basic elements of a DSP System, Classification of Signals, Sampling Theorem (statement and problems on Nyquist rate), Discrete Time Signals (Representation, Standard Signals, Classification, and Operations), Discrete Time Systems, Convolution Sum, Cross correlation and Auto correlation of sequences.				
Text 1: 1.1.1, 1.2, 1.4.2, 2.1, 2.2, 2.3.3, 2.3.7, 2.6.1.				
Module -2				
Z- Transform and its Application to analysis of LTI Systems:				
Direct Z-Transform, Properties of the Z-Transform, Examples, Inverse Z- Transform by Partial- Fraction Expansion method only, System Function of a LTI System, Causality and Stability (from H(z)).				
Realization of Digital System: Direct Form I, Direct form II, cascade form and parallel form				
Text 1: 3.1.1, 3.2, 3.4.3, 3.3.3, 3.5.3.				
Text 2: 9.2,9.3				
Module -3				
DFT: Properties and Applications:				
Definition and Problems on DFT & IDFT, DFT Properties – Periodicity, Linearity, Time Reversal, Circular Time Shift, Circular Frequency Shift, Circular Convolution, Multiplication of two DFTs & Circular Convolution, Parseval's Theorem, DFT in linear filtering. Introduction to FFT, 8-point DFT Computation using Radix-2 DIT-FFT & DIF-FFT methods only, relevant examples.				
Text 1: 7.1.3, 7.2, 7.3.1, 8.1.3.				
Module -4				
IIR & FIR Filters:				
IIR Filters: Low-pass filter specifications, IIR filter Design by Impulse Invariance & Bilinear Techniques, Design of Digital IIR filter by Butterworth approach, Examples. Magnitude response of lowpass Chebyshev Type I, II filter (Theoretical concept only)				
FIR Filters: Design of FIR filters – Symmetric and Antisymmetric FIR filters, Design of Linear phase FIR filters by Rectangular Hamming & Hanning windows. Summary of window function characteristics (window shape, transition bandwidth, stop band attenuation, etc.). Implementation of FIR filters by direct form and Single-stage lattice structure only.				
Text 1: 10.3.2, 10.3.3, 10.3.4, 9.3.1, 9.3.3, 9.3.4, 10.2.1,10.2.2, 10.2.7, 9.2.1, 9.2.4				
Module -5				
Multirate Digital Signal Processing & Adaptive Filters:				
Introduction, Decimation Process, Interpolation Process, Digital Filter Bank, Adaptive Filters, LMS				

adaptive algorithm, Applications, Features & Architectural of TMS320C54XX processor.
Text 2: 15.1,15.2,15.3,15.4,16.2,16.3,16.5,19.2,19.3.

Question Paper Pattern:

- The question paper will have TEN questions.
- Each full question carry 16 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

Text Books:

1. Dimitris G Manolakis, John G. Proakis, “Digital Signal Processing: Principles, Algorithms, and Applications”, 4th Edition, Pearson India, 2007.
2. V.Udayashankara, “Modern Digital Signal Processing”, Third Edition, PHI 2016

Reference Books:

1. Simon Haykin and Barry Van Veen “Signals and Systems”, John Wiley & Sons, 2nd edition
2. S K Mitra, “Digital Signal Processing”, 4th Edition, McGraw-Hill, Year
3. Avtar Singh, “Digital Signal Processing Implementation”, Brooks Cole

B.E. Biomedical Engineering (BM) Choice Based Credit System (CBCS) Semester - V				
Clinical Instrumentation-I				
Subject Code	: 15BM53		IA Marks	: 20
Number of Lecture Hours /Week	: 04		Exam Marks	: 80
Total Number of Lecture Hours	: 50		Exam Hours	: 03
Credits – 4 (Each module – 10 Hours)				
Module 1:				
<p>Electrocardiogram: Action potentials in cardiac muscle, Characteristics of the normal ECG, Cardiac arrhythmias and their electrocardiographic interpretation- Abnormal sinus rhythms, Abnormal Rhythms by impulse conduction blocks, Premature contractions, Paroxysmal Tachycardia, Ventricular & Atrial Fibrillation, Atrial Flutter, Cardiac arrest. Heart sounds, Phonocardiogram, Valvular lesions (Abnormal heart sounds) (Text1: Chapter 9, Chapter 11, Chapter 13, Chapter 23)</p>				
Module 2:				
<p>Catheterization Laboratory Instrumentation, Arrhythmia monitor, Exercise stress testing, Ambulatory monitoring instruments (Text2: 6.10, 7.2, 7.4, 7.5) Foetal Monitoring Instruments: Cardiotocograph, Abdominal Foetal Electrocardiogram, Foetal Phonocardiogram (Text2: 8.1, 8.2.1, 8.2.2) Oximeters: Oximetry, Ear Oximeter, Pulse Oximeter, Skin reflectance Oximeters, Intravascular Oximeter (Text2: 10.1, 10.2, 10.3, 10.4, 10.5)</p>				
Module 3:				
<p>Anatomy of human eye, Physiology of vision, Errors of refraction and their optical correction, Aqueous humor production and drainage, Strabismus. Clinical methods: Spectacles and contact lenses, Refractive surgery, Snellen's Chart, Cover – uncover test, Maddox rod test, Maddox wing test. (Text 3: Chapter 1, Chapter 2, Chapter 3, Chapter 9, Chapter 13, Chapter 21, Chapter 23)</p>				
Module 4:				
<p>Tonometry and its types, Perimetry - Peripheral Field Charting, Central Field Charting, Fundus Fluorescein Angiography, Electroretinography, Electro-oculography, Loupe & Lens Examination, Slit-Lamp Examination, Gonioscopy, Retinoscope- Principle, Procedure & Types, Refractometry, Keratometry- principle and types, subjective refraction, Ophthalmoscopy-Direct & Indirect (Text 3: Chapter 21, Chapter 23)</p>				
Module 5:				
<p>Cataract – list of classification only, Surgical techniques for cataract extraction – Intracapsular cataract extraction & Extracapsular cataract extraction for adulthood cataract, Phacoemulsification, Intraocular lens implantation. General considerations of Glaucoma, surgical procedures for Glaucoma, Vitreous Liquefaction, Vitreous Opacities, Vitreous Haemorrhage, Vitrectomy-types and techniques, Lasers in Ophthalmology, Cryotherapy in Ophthalmology, (Text 3: Chapter 8, Chapter 9, Chapter 10, Chapter 18)</p>				

Question Paper Pattern:

- The question paper will have TEN questions.
- Each full question carry 16 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

Text books:

1. "Textbook of Medical Physiology", Guyton & Hall, 11th Edition, Reed Elsevier Pvt. Ltd., 2007.
2. "Handbook of Biomedical Instrumentation", R S Khandpur, 2nd edition, McGrawHill Education, 2013.
3. "Comprehensive Ophthalmology", A. K. Khurana, 4th Edition, New Age International Ltd., 2010

B.E. Biomedical Engineering (BM) Choice Based Credit System (CBCS) Semester - V				
Biomedical Equipment's				
Subject Code	: 15BM54		IA Marks	: 20
Number of Lecture Hours /Week	: 04		Exam Marks	: 80
Total Number of Lecture Hours	: 50		Exam Hours	: 03
Credits – 4 (Each module – 10 Hours)				
Module 1:				
Electrocardiograph, Block Diagram Description of an Electrocardiograph, The ECG leads, Effects of Artefacts on ECG Recordings.(Text 1: 5.1, 5.1.1, 5.1.2, 5.1.3)				
Electroencephalograph, Block Diagram Description of an Electroencephalograph. Other Biomedical recorders. (Text 1: 5.4, 5.4.1, 5.6)				
Bedside patient monitoring Systems, Measurement of Heart rate (Instantaneous heart rate meters). Measurement of Pulse rate. Blood Pressure measurement(Direct and Indirect-Korotkoff's method ,Rheographic method and Oscillometric Measurement method)				
Text 1: (6.3, 6.5, 6.5.2, 6.6, 6.7, 6.7.1, 6.7.2.1, 6.7.2.2, 6.7.2.4)				
Module 2:				
Pulmonary Function Measurements:-Respiratory Volumes, Respiratory Capacities, Compliance and Related pressures, Dynamic Respiratory Parameters. Spirometry: - Basic Spirometer, Wedge Spirometer, Ultra Sonic Spirometer.				
Text 1: (13.1, 13.1.1, 13.1.2, 13.1.3, 13.1.4, ,13.2, 13.2.1,13.2.2, 13.2.3)				
Basic Audiometer: - General requirements of Audiometers. Masking in audiometer, Pure Tone and Speech Audiometer. Audiometer System (Bekesy). Evoked response Audiometry System. Calibration of audiometers. Hearing aids-Conventional and Digital hearing aid, Cochlear Implants				
Text 1: (17.3, 17.3.1, 17.3.2, 17.4, 17.5, 17.6,17.6.1, 17.6.2, 17.7, 17.8, 17.9, 17.9.1, 17.9.2, 17.9.3)				
Module 3:				
Cardiac pace makers: Need for Cardiac pace maker. Types of pace makers:-external and Implantable pacemakers. Classification codes for Pacemakers. Ventricular synchronous demand pacemaker, Programmable pacemaker. Power sources for Implantable pacemakers.				
Text 1: (25.1, 25.1.1, 25.2, 25.3, 25.3.2, 25.3.3, 25.3.4, 25.3.7)				
Cardiac defibrillators: Need for defibrillator. DC defibrillator. Pacer-Cardioverter-defibrillator. Text 1:(26.1, 26.2, 26.4)				
Principle of surgical diathermy. Solid state electrosurgical machine. Safety aspects in electrosurgical units. Text 1:(27.1, 27.2, 27.3)				
Module 4:				
Hemodialysis Machine: Function of the Kidneys. Changes in body fluids in renal disease. Artificial Kidney. Dialyzers: Parallel flow, coil, Hallow fibre type dialyzers. Performance analysis of dialyzers. Hemodialysis machine. (Text 1:30.1, 30.1.1, 30.2, 30.3.1, 30.3.2, 30.3.3, 30.3.4, 30.5)				
Heart lung machine (Cardiac assist device), Lithotripsy, Ventilator, Infant incubator. (Text 2: 13.3, 13.5, 13.6, 13.7)				
Module 5:				
Introduction to man-Instrument system. Components of Man-Instrument system. Problems encountered in measuring a living system. Physiological effects of Electrical current. Shock Hazards from Electrical equipment's. Methods of accident prevention.				

(Text 3: 1.4, 1.5, 1.7, 16.1, 16.2, 16.3)

Precautions to minimize Electric shock hazards. Safety codes for Electromedical equipment. (Text 1: 18.2.2, 18.3)

Medical equipment maintenance: Types of maintenance repair organization, Levels of capability, types of organization. (Text 4: 26.4, 26.5, 26.6)

Question Paper Pattern:

- The question paper will have TEN questions.
- Each full question carry 16 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

Text Books:

1. "Handbook of Biomedical Instrumentation", R S Khandpur, 2nd edition, McGrawHill Education, 2013
2. "Medical Instrumentation, Application and Design", John G. Webster, 3rd Edition, John Wiley & Sons
3. "Biomedical Instrumentation and Measurements", Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, 2nd Edition, Prentice Hall of India Private Limited, 2001
4. "Introduction to Biomedical Equipment Technology", Joseph J Carr, John M. Brown, 4th Edition, Pearson Education, 2004.

B.E. Biomedical Engineering (BM) Choice Based Credit System (CBCS) Semester - V				
VLSI Design (Common to EI, BM & ML)				
Subject Code	: 15EI/BM/ML551		IA Marks	: 20
Number of Lecture Hours/Week	: 03		Exam Marks	: 80
Total Number of Lecture Hours	: 40		Exam Hours	: 03
Credits – 3 (Each module – 8 Hours)				
Module -1				
Moore's law, speed power performance, nMOS fabrication, CMOS fabrication: n-well, p-well processes, BiCMOS, Comparison of bipolar and CMOS.				
Basic Electrical Properties of MOS And BiCMOS Circuits: Drain to source current versus voltage characteristics, threshold voltage, transconductance.				
Module -2				
Basic Electrical Properties of MOS And BiCMOS Circuits: nMOS inverter, Determination of pull up to pull down ratio, nMOS inverter driven through one or more pass transistors, alternative forms of pull up, CMOS inverter, BiCMOS inverters, latch up.				
Basic Circuit Concepts: Sheet resistance, area capacitance calculation, Delay unit, inverter delay, estimation of CMOS inverter delay, driving of large capacitance loads, super buffers, BiCMOS drivers.				
Module -3				
MOS and BiCMOS Circuit Design Processes: MOS layers, stick diagrams, nMOS design style, CMOS design style, design rules and layout, λ - based design.				
Scaling of MOS Circuits: scaling factors for device parameters, limitations of scaling.				
Module -4				
Subsystem Design and Layout-1 : Switch logic pass transistor, Gate logic inverter, NAND gates, NOR gates, pseudo nMOS, Dynamic CMOS, example of structured design, Parity generator, Bus arbitration, multiplexers, logic function block, code converter.				
Subsystem Design and Layout-2 : Clocked sequential circuits, dynamic shift registers, bus lines, subsystem design processes, General considerations, 4-bit arithmetic processes, 4-bit shifter.				
Module -5				
Design Process-Computational Elements: Regularity, design of ALU subsystem, ALU using adders, carry look ahead adders, Multipliers, serial parallel multipliers, Braun array, Bough – Wooley multiplier.				
Memory, Register and Aspects of Timing: Three Transistor Dynamic RAM cell, Dynamic memory cell, Pseudo- Static RAM, JK Flip-flop, D Flip-flop circuits, RAM arrays, practical aspects and testability: Some thoughts of performance, optimization and CAD tools for design and simulation.				
Question Paper Pattern:				
<ul style="list-style-type: none"> • The question paper will have TEN questions. • Each full question carry 16marks 				

- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

Text Books:

1. Basic VLSI Design -3rd Edition Douglas A Pucknell, Kamaran Eshraghian, Prentice Hall of India publication, 2005.

Reference Books:

1. CMOS Digital Integrated Circuits, Analysis And Design, 3rd Edition, Sung – Mo (Steve) Kang, Yusuf Leblbici, Tata McGraw Hill, 2002.
2. VLSI Technology - S.M. Sze, 2nd edition Tata McGraw Hill, 2003.

B.E. Biomedical Engineering (BM) Choice Based Credit System (CBCS) Semester - V				
Rehabilitation Engineering (Common to BM & ML)				
Subject Code	: 15BM/ML552		IA Marks	: 20
Number of Lecture Hours /Week	: 03		Exam Marks	: 80
Total Number of Lecture Hours	: 40		Exam Hours	: 03
Credits – 3 (Each module – 8 Hours)				
Module 1:				
Introduction to Rehabilitation:				
What is Rehabilitation, Medical Rehabilitation, Preventive Rehabilitation, Impairment, Disability and Handicap, Sociovocational Rehabilitation				
Rehabilitation Team: Classification of members, Medical, The Rehabilitation team – The medical team, Physical therapist, Occupational therapist, Prosthetist-Orthotist, Rehabilitation nurse, Speech pathologist, Psychologist and child development Specialist, Horticultural Therapist, Music therapist, Creative Movement Therapist, Dance and play Therapist, Recreational therapist, Biomedical engineer. (Text 1: Chapter 1, Chapter 2)				
Module 2:				
Therapeutic Exercise Technique: Coordination Exercises, Balance Training, Gait, Pathological Gaits, Gait Training – Crutch Walking: Patterns of Gait, Relaxation exercises, Methods for training Relaxation, Strengthening exercises, Mobilization exercises				
Principles in Management of Communication: Communication, Speech, Language, Aphasia, Dysarthria, Speech therapy, Dysphagia, Communication for Visually impaired, Types of visual aids, Writing aids, (Text 1: Chapter 3, Chapter 5)				
Module 3:				
Orthotic Devices in Rehabilitation Engineering: Definition, General Principles of Orthosis, Biomechanics of Orthosis, Classification, Material and fabrication for lower limb Orthosis, Calipers – Foot Orthoses, Ankle-Foot Orthosis, Knee-Ankle-Foot Orthosis, Hip-Knee-Ankle-Foot Orthoses, Functional Electrical Stimulation, Spinal Orthosis- Cervical, Head cervical Orthosis, Head cervical thoracic orthosis, Thoraco lumbar sacral orthosis, Lumbosacro-orthosis, Splints-its functions & types. (Text 1: Chapter 7)				
Module 4:				
Amputation: General Principles of Amputation Surgery, Levels of Amputation in Upper limb and Lower limb, Rehabilitation of Lower limb amputations				
Prosthetics: Classification, Components of Prosthesis, Upper limb Prosthetics – Terminal Devices, Myoelectric Prosthesis, Lower extremity Prosthesis – Transfemoral prosthesis, Prosthesis for hip disarticulation. (Text 1: Chapter 8)				
Module 5:				
Mobility Aids: Functions, Parallel bars, Walking frames - types, Walking stick, Tripods, Quadripods, Crutches - types, Wheel chairs – parts and maintenance (Text 1: Chapter 9)				
Question Paper Pattern:				
<ul style="list-style-type: none"> The question paper will have TEN questions. 				

- Each full question carry 16 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

Text Books:

1. Rehabilitation Medicine - By Dr. S. Sunder, 3rd Edition, Jaypee Medical Publications, Reprint 2004.

B.E. Biomedical Engineering (BM) Choice Based Credit System (CBCS) Semester - V				
Hospital Design, Planning & Management (Common to BM & ML)				
Subject Code	: 15BM/ML553		IA Marks	: 20
Number of Lecture Hours /Week	: 03		Exam Marks	: 80
Total Number of Lecture Hours	: 40		Exam Hours	: 03
Credits – 3 (Each module – 8 Hours)				
Module-1				
Planning & Building a New Hospital: Role of Hospital in Health Care, Hospital Planning & Design, Guiding principle in Hospital facilities & services, Functional Plans for Hospital construction, Design items, Functional program & design stage, Planning the Hospital building.				
Module-2				
Effective Hospital Management: Planning, Organization, Directing & Leading, Controlling, Financial Management Administrative Service: Medical Record, Hospital Infection, Hospital Utilization Statistics, Material Management, Evaluation of Hospital services.				
Module-3				
Planning & Designing Medical Services: Out Patient service, Emergency service, Clinical laboratories, Radiology services, Radiation Therapy Department, Surgical Department, Nursing Department, Operation Theater, CSSD Nursing services.				
Module-4				
Planning & Designing Engineering Services: Engineering Department, Maintenance management, Clinical [Bio-medical] Engineering, Electrical System, Air Condition System, Water supply & sanitary system, Centralized Medical Gas System, Telecommunication System, Environmental Control, Safety & Security System, Disposal of Hospital Wastes.				
Module-5				
Planning & Design of Supportive Services: Admitting Department, Medical Record Department, Centralized Sterilization & Supply department, Pharmacy Material Management, Food service Department, Laundry & Linen Services, House Keeping & Val entry Department.				
Question Paper Pattern:				
<ul style="list-style-type: none"> • The question paper will have TEN questions. • Each full question carry 16 marks • There will be TWO full questions (with maximum of THREE sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer FIVE full questions, selecting ONE full question from each module. 				
Textbook				
<ol style="list-style-type: none"> 1. Principles of Hospital Administration & Planning - by B. M.Sakharkar, Jaypee Publications, 1998. 2. Hospital Facilities, Planning & Management - by G. D. Kunders, Tata McGraw Hill, 2004. 				

REFERENCE BOOKS:

1. Hospital Administration & Management - by S. L. Goel & R. Kumar Deep & Deep Publications
2. Applied Clinical Engineering - by Barry N. Feinberg, Prentice Hall, 1984.
3. Clinical Engineering Principle & Practices - By John G. Webster & Albert M. Cook, Prentice Hall.

B.E. Biomedical Engineering (BM) Choice Based Credit System (CBCS) Semester - V				
Biomedical Nanotechnology (Common to BM & ML)				
Subject Code	: 15BM/ML554		IA Marks	: 20
Number of Lecture Hours /Week	: 03		Exam Marks	: 80
Total Number of Lecture Hours	: 40		Exam Hours	: 03
Credits – 3 (Each module – 8 Hours)				
Module-1				
Introduction: Converging Technologies: Nanotechnology and Biomedicine, Nanotechnology and Nanobiomedicine, Toward Biomolecular Medicine, Drug Synthesis and Delivery, Implants and Prosthesis, Diagnostics and Screening, Nanotechnology Platforms for Biomedicine.				
Module-2				
Nanotechnology and Trends in Drug Delivery Systems with Self-Assembled Carriers: Introduction, Drug Delivery Systems since the 1980s, Chemical System Engineering and Nanotechnology, Toward Development of Drug Delivery Systems with Bionanotechnology, Self-Assembly and Self-Organization, Nanoparticles and Nano-Sized Spaces, Quantum Dot (Semiconductor Nanoparticle), Safety of the Human Body and the Environment.				
Module-3				
Implants and Prostheses: Introduction, Biomaterials, Biological Processes, Wound Healing Processes, Macrophages, Biomaterial Interface Processes, Foreign Body Reaction, Nanotechnology in Implantology, Current Nanofabrication Methods, Lithography, Colloidal Resists, Self-Assembly Systems, Soft Lithography, Biomimetic Approaches.				
Module-4				
Nano-Enabled Components and Systems for Biodefense: Introduction, Sensor Component of Nano-Enabled Biodefense, Nano-Enabled Sensors for Monitoring Exposures, Nano-Enabled Sensors for Monitoring Airborne Exposures, Nano-Enabled Sensors for Monitoring Contact Exposures, Nanoscale Components of Sensing Systems, Nanolithography of Biological Molecules and Sensing Materials, Nanoparticle Arrays on Surfaces, Functional Three-Dimensional Nanostructures.				
Module-5				
Nanobiology in Cardiology and Cardiac Surgery: Diagnostic Applications of Nanobiology and Nanotechnology: Molecular Imaging of Angiogenesis, Cellular Imaging, Artificial Molecular Receptors, Fluid Acceleration Sensors, Therapeutic Applications, Targeted Anti-proliferative Drug Delivery/Prevention of Restenosis after Percutaneous Revascularization, Smart Drugs, Nanorobotics. Applications of Nanobiology/Nanotechnology in Cardiological and Cardiosurgical Practice: Applications in the Therapy of Myocardial Ischemia, Nanotechnological Applications in Trauma / Bleeding / Wound Healing in Cardiac Surgery, Nanotechnology and Aortic Surgery.				
Question Paper Pattern:				
<ul style="list-style-type: none"> • The question paper will have TEN questions. • Each full question carry 16 marks • There will be TWO full questions (with maximum of THREE sub questions) from each module. 				

- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

Text Books:

1. Biomedical Nanotechnology by edited Neelina H. Malsch; CRC Press, Taylor & Francis Group
2. Nanoscale Technology in Biological Systems edited by Ralph S. Greco, Fritz B. Prinz, R. Lane Smith; CRC Press

B.E. Biomedical Engineering (BM) Choice Based Credit System (CBCS) Semester - V				
Computer Organization (Common to EL, BM & ML)				
Subject Code	: 15EI/BM/ML561		IA Marks	: 20
Number of Lecture Hours/Week	: 03		Exam Marks	: 80
Total Number of Lecture Hours	: 40		Exam Hours	: 03
Credits – 3 (Each module – 8 Hours)				
Module -1				
Basic Structure of Computers: Basic Operational Concepts, Bus Structures, Performance – Processor Clock, Basic Performance Equation, Clock Rate, Performance Measurement. Machine Instructions and Programs: Memory Location and Addresses, Memory Operations, Instructions and Instruction Sequencing, Addressing Modes, Assembly Language, Basic Input and Output Operations, Stacks and Queues, Subroutines.				
Module -2				
Input / Output Organization: Accessing I/O Devices, Interrupts – Interrupt Hardware, Enabling and Disabling Interrupts, Handling Multiple Devices, Controlling Device Requests, Exceptions, Direct Memory Access, Buses, Interface Circuits, Standard I/O Interfaces – PCI Bus, SCSI Bus, USB.				
Module -3				
Memory System: Basic Concepts, Semiconductor RAM Memories, Read Only Memories, Speed, Size, and Cost, Cache Memories – Mapping Functions, Replacement Algorithms, Performance Considerations, Virtual Memories, Secondary Storage.				
Module -4				
Arithmetic: Numbers, Arithmetic Operations and Characters, Addition and Subtraction of Signed Numbers, Design of Fast Adders, Multiplication of Positive Numbers, Signed Operand Multiplication, Fast Multiplication, Integer Division, Floating-point Numbers and Operations.				
Module -5				
Basic Processing Unit: Some Fundamental Concepts, Execution of a Complete Instruction, Multiple Bus Organization, Hard-wired Control, Micro programmed Control. Embedded Systems and Large Computer Systems: Examples of Embedded Systems, Processor chips for embedded applications, Simple Microcontroller. The structure of General-Purpose Multiprocessors.				
Question Paper Pattern:				
<ul style="list-style-type: none"> • The question paper will have TEN questions. • Each full question carry 16 marks • There will be TWO full questions (with maximum of THREE sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer FIVE full questions, selecting ONE full question from each module. 				

Text Books:

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky: Computer Organization, 5th Edition, Tata McGraw Hill, 2002.

Reference Books:

1. William Stallings: Computer Organization & Architecture, 9th Edition, Pearson, 2015.

B.E. Biomedical Engineering (BM) Choice Based Credit System (CBCS) Semester - V				
Virtual Bio-Instrumentation (Common to BM & ML)				
Subject Code	: 15BM/ML562		IA Marks	: 20
Number of Lecture Hours/Week	: 03		Exam Marks	: 80
Total Number of Lecture Hours	: 40		Exam Hours	: 03
Credits – 3 (Each module – 8 Hours)				
Module-1				
<p>Graphical System Design (GSD): Introduction, GSD model, Design flow with GSD, Virtual Instrumentation, Virtual Instrumentation and traditional instrumentation, Hardware and software in virtual instrumentation, Virtual Instrumentation for test, control and design, GSD using LabVIEW, Graphical programming and textural programming.</p> <p>Introduction to LabVIEW: Introduction, Advantages of LabVIEW, Advantages of LabVIEW, Software environment, Creating and saving a VI, Front panel toolbar, Block diagram toolbar, Palettes, Shortcut menus, Property dialog boxes, Front panel controls and indicators, Block diagram, Data types, Data flow program, LabVIEW documentation resources, Keyword shortcuts.</p>				
Module-2				
<p>Modular Programming: Introduction, Modular Programming in LabVIEW, Build a VI front panel and block diagram, ICON and connector pane, Creating an icon, Building a connector pane, Displaying subVIs and express Vis as icons or expandable nodes, Creating subVIs from sections of a VI, Opening and editing subVIs, Placing subVIs on block diagrams, Saving subVIs, Creating a stand-alone application.</p> <p>Data Acquisition: DAQ software architecture, DAQ assistant, Channels and task configurations, Selecting and configuring a data acquisition device, Components of computer based measurement system.</p>				
Module-3				
<p>General Goals of Virtual Bio-Instrumentation (VBI): Definition of VBI and importance, General Goals of VBI applications. Basic Concepts: DAQ basics, LabVIEW basics, BioBench basics.</p> <p>Neuromuscular Electrophysiology (Electromyography): Physiological basis, Experiment set up, Experiment descriptions, Trouble shooting the nerve –Muscle Preparation.</p> <p>Cardiac Electrophysiology (Electrocardiology): Physiological basis, Experiment descriptions.</p> <p>Cardiopulmonary Applications: Cardiopulmonary measurement system, How the Cardiopulmonary measurement system works, Clinical Significance</p>				
Module-4				
<p>Medical Device Development Applications: The Endotester – A Virtual Instrument –Based Quality control and Technology, Assessment System for surgical video Systems: Introduction, Materials and Methods, Endoscope Tests, Results, Discussion.</p> <p>Fluid Sense Innovative IV Pump Testing: Introduction, The test System, Training Emulator.</p>				
Module-5				
<p>Healthcare Information management Systems:</p> <p>Medical Informatics: Defining medical informatics, Computers in medicine, Electronic Medical record,</p>				

Computerized physician order entry, Decision support.
Information Retrieval, Medical Imaging, Patient Monitoring, Medical Education, Medical Simulation.
Managing Disparate Information: ActiveX, ActiveX Data Objects (ADO), Dynamic Link Libraries,
Database Connectivity, Integrated Dashboards.

Note: Wherever possible students should be given appropriate hands on training with Virtual Instrumentation LabVIEW software.

Question Paper Pattern:

- The question paper will have TEN questions.
- Each full question carry 16 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

Textbook:

1. Virtual Instrumentation using LabVIEW by Jovitha Jerome, PHI Learning Private Limited, 2010. (Module 1 & 2)
2. "Virtual Bio-Instrumentation" Biomedical, Clinical, and Healthcare Applications in Lab VIEW. ,by JON B. OLANSEN and ERIC ROSOW, Prentice Hall Publication, 2002.

B.E. Biomedical Engineering (BM) Choice Based Credit System (CBCS) Semester - V			
Operating Systems (Common to EI & BM)			
Subject Code	: 15EI/BM563		IA Marks : 20
Number of Lecture Hours/Week	: 03		Exam Marks : 80
Total Number of Lecture Hours	: 40		Exam Hours : 03
Credits – 3 (Each module – 8 Hours)			
Module -1			
Introduction to Operating Systems: What operating systems do, Computer System Organization, Architecture and Operations, Process Management, memory management, Storage Management, Protection and Security, Computing Environments. Operating system structures: OS Services, User-OS Interface, System calls, System programs, OS structure, System Boot. Text: 1.1, 1.2, 1.3, 1.5, 1.6, 1.7, 1.8, 1.9, 1.11, 2.1, 2.2, 2.3, 2.5, 2.7, 2.10.			
Module -2			
Process Management Processes: Process concept, Process scheduling, Operation on processes, Inter process communication. Threads – Overview, Multithreading models, Threading issues. CPU scheduling – Basic concepts, Scheduling criteria, Scheduling algorithms, real time scheduling. Text: 3.1, 3.2, 3.3, 3.4, 4.1, 4.3, 4.6, 6.1, 6.2, 6.3, 6.6			
Module -3			
Process Synchronization: Background, The critical section problem, Peterson’s Solution, Synchronization hardware, Mutex Locks, Semaphores, Classical problems of synchronization, Monitors. Deadlock – System model, Deadlock characterization, Methods for handling deadlocks, deadlock prevention, deadlock avoidance, deadlock detection and recovery from deadlock. Text: 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 5.8, 7.1, 7.2, 7.3, 7.4, 7.5, 7.5, 7.6, 7.7.			
Module -4			
Memory management: Main Memory: Background, Swapping, Contiguous, allocation, Paging. Virtual memory: Background, Demand paging, Copy-on-write, Page replacement. Text: 8.1, 8.2, 8.3, 8.5, 9.1, 9.2, 9.3, 9.4.			
Module -5			
Storage Management: Mass storage structure: Overview of mass storage structure, Disk structure, Disk scheduling, Disk management, Swap space management. File System Interface: File concept, Access methods, Directory and Disk structure, File system mounting, Protection. File System Structure: File system structure, File system implementation, Directory implementation, Allocation methods, and free space management. Text: 10.1, 10.2, 10.4, 10.5, 10.6, 11.1, 11.2, 11.3, 11.4, 11.6, 12.1, 12.2, 12.3, 12.4, 12.5			

Question Paper Pattern:

- The question paper will have TEN questions.
- Each full question carry 16 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

Text Books:

1. Operating System Concepts-by Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, **9th Edition**, John Wiley & Sons 2016 (India Edition).

Reference Books:

1. Operating system concepts and design- Milan Milankovic, 2nd Edition, McGraw Hill 1992.
2. Operating systems- Harvey M Deital Addison Wesley 1990.
3. Operating Systems concepts based approach, D.MDhamdhere, Tata McGraw Hill 2002.

B.E. Biomedical Engineering (BM) Choice Based Credit System (CBCS) Semester - V				
Medical Physics				
Subject Code	: 15BM564		IA Marks	: 20
Number of Lecture Hours/Week	: 03		Exam Marks	: 80
Total Number of Lecture Hours	: 40		Exam Hours	: 03
Credits – 3 (Each module – 8 Hours)				
Module 1:				
Biomechanics: Properties of materials, the principles of equilibrium, Stress analysis, Structural instability, Mechanical work and energy, Kinematics and Kinetics, Dimensional analysis: the scaling process in biomechanics. (Text 1: Chapter 1)				
Module 2:				
Biofluid Mechanics: Pressure in the body, Properties of fluids in motion: the constitutive equations, Fundamentals of fluid dynamics, flow of viscous fluids in tubes, flow through an orifice, influence of elastic walls, numerical methods in biofluid mechanics. (Text 1: Chapter 2)				
Module 3:				
Physics of the Senses: Cutaneous sensation, the Chemical senses, Audition, Vision, Psychophysics. (Text 1: Chapter 3)				
Module 4:				
Radioisotopes and Nuclear Medicine: Atomic structure, Production of isotopes, Principles of measurement, Non-imaging investigation: Principles, Non-imaging examples, Radionuclide imaging, Table of applications. (Text 1: Chapter 6)				
Module 5:				
Non-Ionizing Electromagnetic radiation – Tissue absorption and safety issues: Tissue as a Leaky Dielectric, Relaxation process, Overview of non-ionizing radiation effect, Low-frequency effects: 0.1Hz – 100KHz, Higher frequencies: >100KHz, Ultraviolet (Text 1: 8.2, 8.3, 8.4, 8.5, 8.6, 8.7)				
Biomechanical Measurements: Static measurements, Dynamic measurements (Text 1: Chapter 20)				
Question Paper Pattern:				
<ul style="list-style-type: none"> • The question paper will have TEN questions. • Each full question carry 16 marks • There will be TWO full questions (with maximum of THREE sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer FIVE full questions, selecting ONE full question from each module. 				
Text Book(s) :				
1. “Medical Physics and Biomedical Engineering”- B H Brown, R H Smallwood, D C Barber, P V Lawford, D R Hose, Taylor & Francis Group, 1999				

Reference(s):

1. J. R. Cameron & J. G. Skofronick, Medical Physics , John Wiley and Sons, 1978.
2. Paul Davidovits “Physics in Biology and Medicine “ , Academic Press, 3rd Edition, 2007.

B.E. Biomedical Engineering (BM) Choice Based Credit System (CBCS) Semester - V				
Signal Conditioning Circuits and Data Acquisition Lab (Common to EI, BM & ML)				
Subject Code	: 15 EI/BM/ML L57		IA Marks	: 20
Number of Practical Hours/Week	: 03		Exam Marks	: 80
Total Number of Practical Hours	: 42		Exam Hours	: 03
Credits - 2				
Revised Bloom's Taxonomy Levels: L1 – Remembering, L2 – Understanding, L3 – Applying, L4 –Analyzing, L5 – Evaluating, and L6 - Creating				
Laboratory Experiments: Note: Standard design procedure to be adopted Students should build the circuit using discrete components and ICs (models are not to be used)			Revised Bloom's Taxonomy (RBT)Level	
1. To design and implement <ul style="list-style-type: none"> • Inverting Amplifier and Inverting Attenuator • Non-Inverting Amplifier and Voltage Follower 			L3, L4, L5, L6	
2. To realize <ul style="list-style-type: none"> • Full wave Precision rectifier 			L3, L4	
3. To design and implement <ul style="list-style-type: none"> • Butterworth I order Low-pass filter • Butterworth II order High-pass filter 			L3, L4, L5, L6	
4. To design and implement <ul style="list-style-type: none"> • RC Phase shift oscillator • Wein Bridge oscillator 			L3, L4, L5, L6	
5. To realize <ul style="list-style-type: none"> • ZCD • Positive and Negative Voltage level detectors 			L3, L4	
6. To design and implement <ul style="list-style-type: none"> • Astable Multivibrator using 555 timer • Mono-stable Multivibrator using 555 timer 			L3, L4, L5, L6	
7. To realize <ul style="list-style-type: none"> • Sample and Hold circuit using discrete components 			L3, L4	
8. To realize <ul style="list-style-type: none"> • Programmable Gain Amplifier using Analog Mux 			L3, L4	
9. To design and implement <ul style="list-style-type: none"> • 4 bit R-2R DAC using discrete components 			L3, L4	
10. To design and implement <ul style="list-style-type: none"> • 8-bit DAC using IC (DAC 0800) 			L3, L4, L5, L6	
11. To design and implement <ul style="list-style-type: none"> • 8-bit ADC using IC (ADC 0809) 			L3, L4, L5, L6	
12. To design and implement <ul style="list-style-type: none"> • 3 bit Flash ADC using ICs 			L3, L4, L5, L6	

Conduct of Practical Examination:

1. All laboratory experiments are to be included for practical examination.
2. Students are allowed to pick one experiment from the lot.
3. Strictly follow the instructions as printed on the cover page of answer script for breakup of marks.
4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

Reference Books:

1. "Linear Integrated Circuits", D. Roy Choudhury and Shail B. Jain, 4th edition, Reprint 2010, New Age International.
2. "Op - Amps and Linear Integrated Circuits", Ramakant A. Gayakwad, 4th edition, PHI.
3. "A course in Electrical & Electronic Measurements & Instrumentation", A K Sawhney, Dhanpat Rai Publications, 19th edition, 2011.
4. "Operational Amplifiers and Linear Integrated Circuits", Robert. F. Coughlin & Fred. F. Driscoll, PHI/Pearson, 2006
5. "Op - Amps and Linear Integrated Circuits", James M. Fiore, Thomson Learning, 2001
6. "Design with Operational Amplifiers and Analog Integrated Circuits", Sergio Franco, TMH, 3e, 2005

B.E. Biomedical Engineering (BM) Choice Based Credit System (CBCS) Semester - V Clinical Instrumentation Lab				
Subject Code	: 15BML58		IA Marks	: 20
Number of Practical Hours/Week	: 03		Exam Marks	: 80
Total Number of Practical Hours	: 42		Exam Hours	: 03
Credits - 2				
Revised Bloom's Taxonomy Levels: L1 – Remembering, L2 – Understanding, L3 – Applying, L4 –Analyzing, L5 – Evaluating, and L6 - Creating				
Title of the Experiments			Revised Bloom's Taxonomy (RBT)Level	
1. Measurement of Operational Amplifier parameters: I/P Offset current, I/P bias current, Slew rate, I/P offset Voltage, PSRR, CMRR & offset nulling.			L3, L4	
2. Design and Test the Operational Amplifier as: (i) Adder, (ii) Subtractor, (iii) Integrator, and (iv) Differentiator.			L3, L4, L5, L6	
3. Conduct an experiment to perform Operational Amplifier as: (i) Comparator (ii) Schmitt Trigger.			L3, L4	
4. Design and Test the bio-potential amplifiers for ECG/ or EEG/ or EMG				
5. Design and Test the Notch Filter for 50 Hz and 60 Hz.			L3, L4, L5, L6	
6. Design and Testing of Instrumentation amplifier for different gains.			L3, L4, L5, L6	
7. Testing an IC based Sample and Hold Circuit and plotting its characteristics.			L3, L4	
8. Testing and analysis of the following by hardware circuit/simulation (i) DC Defibrillator (ii) Pacemaker			L3, L4	
9. Acquisition of ECG: (i) Single lead (iii) Three lead, and (iii) 12-Leads. Analysis of the acquired ECG in amplitude, time and frequency domain.			L3, L4	
10. Acquisition and analysis (time & frequency) of EEG.			L3, L4	
11. Acquisition and analysis of Lung Volumes and Lung Capacities using Spirometer.			L3, L4	
12. Quantification and assessment of hearing ability using audiometer				
13. (i) Measurement of corneal curvature using keratometer, and (ii) Measurement of Visual Acuity using Snell's Chart.			L3, L4	
14. Study Experiments: Baby incubator, Ventilator, Heart-lung machine, Dialysis machine, Pacemaker, Ophthalmoscope, Recording of pulse & oxygen saturation using Pulse Oximeter, and Infusion Pump.			L1, L2	
Conduct of Practical Examination:				
<ol style="list-style-type: none"> 1. All laboratory experiments are to be included for practical examination. 2. Students are allowed to pick one experiment from the lot. 3. Strictly follow the instructions as printed on the cover page of answer script for breakup of marks. 4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero. 				