**B.E. Medical Electronics (ML)**
**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**

**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).

**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).

**Module -2**

**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).

**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).

**Module -3**

**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).

**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).

**Module -4**

**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).

**Institutional Support for Business Enterprises:** Introduction, Policies & Schemes of Central Level

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**

- 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:**

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:**

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.

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**B.E. Medical Electronics (ML)**
**Choice Based Credit System (CBCS)**
**Semester - V**

# Control Systems

| | | | | |
|---|---|---|---|---|
| Subject Code | : 15ML52 | | 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**

**Modeling of Systems and Block diagram**: Introduction to Control Systems, Types of Control Systems, with examples. Concept of mathematical modeling of physical systems- Mechanical, Translational (Mechanical accelerometer, systems excluded), and Rotational systems, Analogous systems based on force voltage analogy and force current analogy. Introduction to Block diagram algebra. Numerical problems on all topics.

**Module -2**

**Signal Flow graph**: Introduction to Signal flow graph (SFG), Mason's gain formula. Obtaining Transfer functions for the given SFG using Mason's gain formula.

**Time response analysis**: Introduction. Standard test signals, response of first order & second order systems for unit step input. Steady state errors & Error constants. Numerical problems on all topics.

**Module -3**

**Concepts of stability**: The Concept of stability. Necessary conditions for stability. Hurwitz stability criterion. Routh stability criterion. Relative stability analysis using RH Criterion.

**The Root Locus Technique**: Introduction. Root locus concepts. Construction of root loci. Stability analysis using Root locus Technique Numerical problems on all topics.

**Module -4**

**Frequency domain Analysis**: Introduction to frequency domain analysis, Correlation between time & frequency response, Bode plots.

**Polar Plot**: Introduction to Polar plot and Nyquist plots, Nyquist stability criterion. Stability analysis using Polar plot. Numerical problems on all topics

**Module -5**

**State space Analysis:** Concept of state, state variables and state model. State diagrams and State models for Linear continuous-time systems (Electrical systems): State space representation using Physical and Phase variables. Derivation of transfer functions from the state model. Numerical problems on all topics.

**Solution of state equations**: Solutions of homogeneous and Non-homogeneous state equations. Properties of state transition matrix, computation of state transition matrix by matrix exponential and Laplace transform method. Numerical problems

**Question Paper Pattern:**

- The question paper will have TEN questions.
- Each full question consists of 16 marks.
- There will be 2 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 5 full questions, selecting one full question from each module.

**Text Books:**

1. "Control Systems Engineering", I.J. Nagarath and M. Gopal ,New Age International (P) Limited, Publishers, Fifth edition – 2012.
2. "Modern Control Engineering ", K. Ogata, Pearson Education Asia/ PHI, 4th Edition, 2002.

**Reference Books:**

1. "Automatic Control Systems", Benjamin C. Kuo, John Wiley India Pvt. Ltd., 8th Edition, 2008.
2. "Feedback and Control System", Joseph J Distefano III et al., Schaum's Outlines, TMH, 2nd Edition 2007.

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**B.E. Medical Electronics (ML)**
**Choice Based Credit System (CBCS)**
**Semester - V**

# Digital Signal Processing

| | | | | |
|---|---|---|---|---|
| Subject Code | : 15ML53 | | 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**

Review of discrete signal and systems, DFT, IDFT, and Properties of DFT.

**Computation of FFT:** Radix-2 Decimation in Time FFT, Radix-2 Decimation in Frequency FFT Examples

**Module -2**

**Computation of FFT** (Contd.): 4-point Inverse DFT only using DIT/DIF FFT Algorithm.

**Digital Filter Structures:** Basic IIR Filter Structures: Direct forms (I & II), cascade and parallel realizations, Basic FIR filter structures- Direct & cascade form structure. Examples

**Module -3**

**FIR Filters**: Properties, Filter Design using Windows (Rectangular, Hamming, Hanning and Kaiser Window), Filter design using Frequency sampling technique. Realization single stage Lattice structure only.

**Module -4**

**IIR Filters:** Specification and design techniques, Impulse Invariant and Bilinear Transformation techniques. Design of digital Butterworth and Chebyshev low pass filters using Analog filter design techniques, Transform of Low pass to High pass, Band pass and Band rejection filters, Comparison of IIR and FIR filters

**Module -5**

**Multirate Digital Signal Processing:** Introduction, Decimation and Interpolation process, Applications of multirate signal processing: Interfacing of digital systems with different sampling rate, Implementation of Digital filter banks, DFT filter banks, Quadrature Mirror filter banks.

**Adaptive Filters:** Adaptive filters, LMS adaptive algorithms, Recursive least square algorithms, Applications of Adaptive filters.

**Question Paper Pattern:**

- The question paper will have TEN questions.
- Each full question consists of 16 marks.
- There will be 2 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 5 full questions, selecting one full question from each module.

**Text Books:**

1. Digital Signal Processing- PROAKIS and MANOLAKIS, 3rd Edition, Prentice Hall of India / Pearson.

2. Real Time Digital Signal Processing: Fundamentals, Algorithms and implementation using TMS Processor- V.Udayashankara, Prentice Hall of India, New Delhi, 2010.

**Reference Books:**

1. Digital Signal Processing- S K MITRA, 4th Edition, McGraw-Hill. Theory and Application of DSP- RABINAR L R and GOLD B, Prentice Hall of India, 1999.
2. Introduction to digital signal processing- JOHNSON, Prentice Hall of India 1999.
3. Digital Signal Processing-ALAN V OPPENHEIM, Prentice Hall of India.
4. DSP using Matlab- Prokis & Ingle 1st edition, Cengage Learning

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**B.E. Medical Electronics (ML)**
**Choice Based Credit System (CBCS)**
**Semester - V**

# Diagnostic and Therapeutic Equipment's

| | | | | |
|---|---|---|---|---|
| Subject Code | : 15ML54 | | 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**

**Patient monitoring systems: S**ystem concepts, cardiac monitors, bedside monitors, central monitors

**Arrhythmia & ambulatory monitoring equipment's**: Cardiac arrhythmia, arrhythmia monitors, QRS detection, exercise-stress testing, ambulatory monitoring equipment's.

**Module-2**

**Oximeters**: Oximetry, ear oximeters, pulse oximeters, skin reflectance oximeters, intravascular oximeters,

**Audiometer**: Mechanism of hearing, measurement of sound, basic audiometers, pure tone audiometer, speech audiometer, Bekesy system audiometers, evoked response audiometry, calibration of audiometers, hearing aids.

**Module-3**

**Cardiac pacemakers: E**xternal pacemakers, implantable pacemakers, pacing systems.

**Cardiac defibrillators**: Need, DC defibrillator, implantable defibrillator, pacer-cardioverter-defibrillator.

**Neurological equipment's:** Clinical significance of EEG, EEG recording systems and associated pathology.

**EMG:** Recording system and analysis of EMG. Nerve conduction study.

**Module-4**

**Ventilators:** mechanics of respiration, artificial ventilation, ventilators, types of ventilators, classification of ventilators, pressure-volume-flow graphs, modern ventilators, high frequency ventilators, humidifiers, nebulizers, aspirators

**Module-5**

**Physiotherapy & Electrotherapy equipment's:** high frequency heat therapy, shortwave and microwave diathermy, ultrasonic therapy, electro-diagnosis, electrical stimulation, bladder stimulators, cerebellar stimulators

**Question Paper Pattern:**

- The question paper will have TEN questions.
- Each full question consists of 16 marks.
- There will be 2 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 5 full questions, selecting one full question from each module.

**Text Books**

1. R S Khandpur, "Handbook of biomedical Instrumentation", 2nd edition, Tata McGraw Hill publications.

**Reference Books**

1. John G Webster, "Medical Instrumentation-Application and design", 3rd edition, John Wiley Publications
2. Joseph D. Bronzino, "Medical Devices and Systems - The Biomedical Engineering Handbook", Third Edition –CRC Press, 2006.
3. Leslie Cromwell, "Biomedical Instrumentation and Measurement", Pearson Education, New Delhi, 2007.

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**B.E. Medical Electronics (ML)**
**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:**

- The question paper will have TEN questions.
- Each full question carry16marks

- 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.

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**B.E. Medical Electronics (ML)**
**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:**

- 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.

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**B.E. Medical Electronics (ML)**
**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:**

- 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. 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.

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**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.

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**B.E. Medical Electronics (ML)**
**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:**

- 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

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**B.E. Medical Electronics (ML)**
**Choice Based Credit System (CBCS)**
**Semester - V**

# Computer Organization

**(Common to EI, 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:**

- The question paper will have TEN questions.
- Each full question carry16marks
- 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.

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**B.E. Medical Electronics (ML)**
**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**

**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.

**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 resourses, Keyword shortcuts.

**Module-2**

**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.

**Data Acquisition:** DAQ software architecture, DAQ assistant, Channels and task configurations, Selecting and configuring a data acquisition device, Components of computer based measurement system.

**Module-3**

**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.

**Neuromuscular Electrophysiology (Electromyography):** Physiological basis, Experiment set up, Experiment descriptions, Trouble shooting the nerve –Muscle Preparation.

**Cardiac Electrophysiology (Electrocardiology):** Physiological basis, Experiment descriptions.

**Cardiopulmonary Applications:** Cardiopulmonary measurement system, Hiw the Cardiopulmonary measurement system works, Clinical Significance

**Module-4**

**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.

**Fluid Sense Innovative IV Pump Testing:** Introduction, The test System, Training Emulator.

**Module-5**

**Healthcare Information management Systems:**

**Medical Informatics:** Defining medical informatics, Computers in medicine, Electronic Medical record,

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| Computerized physician order entry, Decision support.<br>Information Retrieval, Medical Imaging, Patient Monitoring, Medical Education, Medical Simulation.<br>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:**<br>• The question paper will have TEN questions.<br>• Each full question carry16marks<br>• There will be TWO full questions (with maximum of THREE sub questions) from each module.<br>• Each full question will have sub questions covering all the topics under a module.<br>• The students will have to answer FIVE full questions, selecting ONE full question from each module. |
| |
| **Textbook:**<br>1. Virtual Instrumentation using LabVIEW by Jovitha Jerome, PHI Learning Private Limited, 2010. (Module 1 & 2)<br>2. "Virtual Bio-Instrumentation" Biomedical, Clinical, and Healthcare Applications in Lab VIEW, by JON B. OLANSEN and ERIC ROSOW, Prentice Hall Publication, 2002. |

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**B.E. Medical Electronics (ML)**
**Choice Based Credit System (CBCS)**
**Semester - V**

# Medical Electronics Design

| | | | | |
|---|---|---|---|---|
| Subject Code | : 15ML563 | | 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, Definition of Medical Device, Medical Device Life cycle, Medical Device design cycle, Bio-potential Amplifier: Characteristics, Single ended Bio-potential Amplifier, Single ended Bio-potential Amplifier Arrays, Body Potential drivers.

**Module -2**

Differential amplifiers, Simple Differential Bio-potential Amplifier, Op-amp Instrumentation amplifier, Instrumentation Bio-potential Amplifier, Switched capacitor based Bio-potential Instrumentation Bio-potential Amplifier.

**Module -3**

Band pass Selection for Bio-potential amplifier introduction, Wide band Bio-potential amplifier, Bio-potential amplifier with dc rejection, AC-coupled Instrumentation Bio-potential Amplifier front end, , Passive filter, Active filter, 50-60 Hz notch filter, Switched-capacitor filters: fourth, fifth ,eighth -order Butterworth low-pass .

**Module -4**

Radiated Emission: Fields radiated by a loop; straight wire. Differential mode radiation and common mode radiation. Radiation from non-sinusoidal sources and broadband sources.

**Module -5**

Standards and Regulations Background: What are standards? Voluntary and mandatory standards, Standards development process, Conformity assessment with standards, National and international standards systems, Identification of standards, Current trends in the use of standards in medical device regulations.

The ISO 9000 Series of Standards, The ISO 14000 Series of Standards, EN 46001, The ISO 13485 Standards, ISO 9000-3, IEC 601-1-4. The Medical Devices Directives, Choosing the appropriate directive, Identifying the applicable essential requirements, Identification of corresponding harmonized standards, Essential requirements, Classification of the device based on conformity, Medical Devices Directives, Active Implantable Medical Devices Directives, *In-vitro* Diagnostic Medical Devices Directives.

**Question Paper Pattern:**

- The question paper will have TEN questions.
- Each full question carry16marks
- 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. "Design and development of Medical Electronic Instrumentation", David Prutchi, Wiley publishers.(2005)
2. "The Designer's Guide to Electromagnetic Compatibility", Daryl Gerke and Bill Kimmel, Kimmel Gerke Associates Publishers ". (2002)
3. "Medical device regulations: global overview and guiding principles" , Michael Cheng, World Health Organization publishers.(2003)

**Reference Books:**

1. "Handbook of medical device design", Richard C. Fries, 1st edition, CRC Press. (2000)
2. "Execution, and Management of Medical Device Clinical Trials", Salah Abdel-aleem, Wiley Publishers.(2009)
3. "Pharmaceutical and Medical Device Validation by Experimental Design", Lynn D. Torbeck (2007)

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**B.E. Medical Electronics (ML)**
**Choice Based Credit System (CBCS)**
**Semester - V**

# Pharmacology and Drug Delivery

| | | | | |
|---|---|---|---|---|
| Subject Code | : 15ML564 | | 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**

**Pharmacodynamics and Pharmacokinetics:** Drug metabolism, pharmacokinetic action of drugs in human bodies, Dynamics of Drug Absorption, Distribution, Action, and Elimination, toxic, adverse effects.

**Module -2**

**Diseases and Drugs:** Study of the pharmacology of the diseases and drugs used with mode of action especially of diabetes, vasoactive peptides, chemotherapy, hypertension, myocardial ischemia and inflammation.

**Module -3**

**Drug disperse systems:** drug emulsions; drug suspensions; applications of disperse systems in delivery of pharmaceuticals; pharmaceutical gels, Diffusional system, Fick's law of diffusion, transdermal delivery, ocular delivery and intra-uterine system.

**Module -4**

**Formulation methods:** principles, technology and manufacture of sustained drug delivery systems and applications to therapeutic delivery systems designed to release a specific quantity of drug at controlled rates; modified-release by coating: enteric and other coated tablets, particles and other systems.

**Module -5**

**Polymers & Release pattern:** types of polymer, pharmaceutical polymers, NDDS models, osmotic pumps, Controlled release, delayed release, Sustained release etc., order of release. Oral controlled DDS, factors affecting controlled release.

**Question Paper Pattern:**

- The question paper will have TEN questions.
- Each full question carry16marks
- 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. Bertram G. Katzung, Susan B. Masters, Anthony J. Trevor (2009). Basic and Clinical Pharmacology, 11th edition, McGraw Hill.
2. H. C. Ansel, N. G. Popovich and L. V. Allen, (1999) Pharmaceutical Dosages Forms and Drug

Delivery Systems, 6th Edn., Williams & Wilkins.
3. K. B. Sloan (Ed), (1992) - Prodrugs, Topical and Ocular Drug Delivery, Marcel Dekker Inc.

**Reference Books**

1. Brunton LL, Lazo JS, Parker KL, Buxton ILO, Blumenthal D: Goodman & Gilman's The Pharmacological Basis of Therapeutics. McGraw Hill Medical. 11th ed. 2008.
2. Vasant V. Ranade, Mannfred. A. Hollinger. Drug Delivery Systems. CRC Press, London. 2nd edition, 2005.

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**B.E. Medical Electronics (ML)**
**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:**<br>**Note:** Standard design procedure to be adopted<br>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<br>• Inverting Amplifier and Inverting Attenuator<br>• Non-Inverting Amplifier and Voltage Follower | L3, L4, L5, L6 |
| 2. To realize<br>• Full wave Precision rectifier | L3, L4 |
| 3. To design and implement<br>• Butterworth I order Low-pass filter<br>• Butterworth II order High-pass filter | L3, L4, L5, L6 |
| 4. To design and implement<br>• RC Phase shift oscillator<br>• Wein Bridge oscillator | L3, L4, L5, L6 |
| 5. To realize<br>• ZCD<br>• Positive and Negative Voltage level detectors | L3, L4 |
| 6. To design and implement<br>• Astable Multivibrator using 555 timer<br>• Mono-stable Multivibrator using 555 timer | L3, L4, L5, L6 |
| 7. To realize<br>• Sample and Hold circuit using discrete components | L3, L4 |
| 8. To realize<br>• Programmable Gain Amplifier using Analog Mux | L3, L4 |
| 9. To design and implement<br>• 4 bit R-2R DAC using discrete components | L3, L4 |
| 10. To design and implement<br>• 8-bit DAC using IC (DAC 0800) | L3, L4, L5, L6 |
| 11. To design and implement<br>• 8-bit ADC using IC (ADC 0809) | L3, L4, L5, L6 |
| 12. To design and implement<br>• 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

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**B.E. Medical Electronics (ML)**
**Choice Based Credit System (CBCS)**
**Semester - V**

# Diagnostic and Therapeutic Equipment's Lab

| | | | | |
|---|---|---|---|---|
| Subject Code | : 15MLL58 | | 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) Substractor, (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 | L3, L4, L5, L6 |
| 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. Recording and analysis of EEG in time and frequency domains. | L3, L4 |
| 8. Recording and analysis of EMG in time and frequency domain. Determination of nerve conduction velocity. | L3, L4 |
| 9. Quantification and assessment of hearing thresholds using audiometers. | L3, L4 |
| 10. Simulation and analysis of Pacemaker & Defibrillator Circuits. | L3, L4 |
| 11. Measurement, analysis and interpretation of physiological parameters using patient monitoring system. | L3, L4 |
| 12. Measurement and analysis of Lung Volumes and Lung Capacities using spirometer. | L3, L4 |
| 13. Measurement and analysis of Oxygen Saturation and Pulse rate from Pulse Oximeter. | L3, L4 |
| 14. Study of stimulator circuits: a) Nerve stimulator b) bladder stimulator | L3, L4 |

**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. John G Webster, "Medical Instrumentation-Application and design", 3rd edition, John Wiley Publications
4. R S Khandpur, "Handbook of biomedical Instrumentation", 2nd edition, Tata McGraw Hill publications
5. Joseph D. Bronzino, "Medical Devices and Systems - The Biomedical Engineering Handbook", Third Edition – CRC Press, 2006.