



MANGALORE UNIVERSITY

MSc Medical Physics

MPS 405: Basic Electronics and Biomedical Instrumentation

Teaching hours: 12 h each unit

Objective:

To familiarize the students about the fundamentals of electronics, electronic circuits, electrical/electronic signals and biomedical instruments used in diagnosis and therapy for measuring, recording, storing, and analyzing the signals and data analysis.

Outcomes:

- ☐ Students will learn the basic electronics and electronic circuits used in various devices.
- ☐ They will be familiar with both analog and digital electronics and electronic circuits used in biomedical devices.
- ☐ They will acquire knowledge on biomedical instrumentation and their applications.
- ☐ They will be learning biomedical signal monitoring, recording, storing and analyzing.
- ☐ They will also learn about equipments used in diagnosis and therapy.

Unit I: Fundamentals of Electronics

Construction and Operation of Diode, Zener Diode, Bipolar Junction Transistor (BJT), Field Effect Transistor (FET), MOSFET, Biasing Circuit. Timer based Multivibrators. Power Supply: Rectifiers, Filters, Zener Voltage Regulator, Voltage Regulator ICs.

Unit II: Analog Electronics

Bipolar Junction Transistors - Amplifier Configurations: CB and CE Configuration Characteristics, CC, Cascode. JFET Amplifier. OPAMP: Op-Amp-Circuit Symbol, ideal Op-Amp-Characteristics-CMRR, Applications: Adder, Subtractor, Analog Integrator, Analog Differentiator, Voltage-to-Current Converter, Current-to-Voltage Converter and Logarithmic Amplifier.

Unit III: Digital Electronics

Logic Gates: Boolean Algebra, Boolean Laws – De-Morgans Theorem, Implementation of

Logic Circuits from Truth Table – Sum-of-Products method and Products-of-Sum method. Combinational Circuits: Multiplexer and de-Multiplexer Circuits, BCD to Decimal Decoders, Seven Segment Decoders, Decimal to BCD Encoder. Arithmetic Building Blocks: Half- Adder and Full-Adder., Digital Comparator. Flip Flops: RS, Clocked RS, D-Flip Flop, Edge- triggered D Flip Flop – J K Flip Flop. Sequential Logic Circuits: Registers - Shift Registers, Applications. Counters: Ripple Counters - Up, Down and Up-Down Ripple Counters, Asynchronous and Synchronous Counters. Analog-to-Digital and Digital-to-Analog Converters. Microprocessor – Principles, Types, Working and Applications.

Unit IV: Bioelectric Signal Monitoring and Recording

Origin and Characteristics of Bioelectric Signals and Recording. Electrodes - Types, Design, Properties and Utility, Skin Contact Impedance of Electrodes, Noise Suppression Techniques. Transducers and Measurement of Physiological Events, Transducers – Properties, Principles and Working. The origin of Biopotentials, Resting and Action Potentials. Amplifiers and Signal Processing - ECG, EEG, EMG.

Unit V: Biomedical Instrumentation

Diagnostic Equipments: pH meters, Audiometer, Endoscopes, Blood Flow Meters, Pulmonary Function Analyzers, Blood Gas Analyzer, Oximeters: Principle and Working.

Therapeutics Equipments: Cardiac Pace Makers, Defibrillators, Hemodialysis Machines, Short-wave and Micro-wave Diathermy, Ultrasonic Therapy, Pain relief through Electrical Stimulation, Surgical Diathermy. Laser: Principle of Operation, Types, Laser Tissue Interaction, Biomedical Applications of Laser in Surgery and Therapy. Lithotripters, Anaesthesia Machine, Ventilators, Radiotherapy Equipment, Automated Drug Delivery Systems.

Reference Books:

1. Electronic Devices and Circuit Theory. Robert L. Boylestad, Louis Nashelsky. Prentice Hall Publisher, 11th Edition, 2012.
2. Electronic Principles. Albert Malvino and David J Bates. Tata McGraw Hill, 7th Edition, 2007.
3. Digital Logic and Computer Design. M. Morris Mano. Prentice Hall Publisher, 11th Edition, 2002

4. A text book of Electronics by – Santanu Chattopadhyay, New Central Book Agency, Kolkata, 2006.
5. Digital Principles and Applications, A.P. Malvino and D.P. Leach, Tata McGraw-Hill Publishing Co, New Delhi, 1996.
6. Electronic Principles and Applications, A.B. Bhattacharya, New Central Book Agency, Kolkata, 2007.
7. Introduction to Microprocessors, A.P. Mathur, Tata McGraw-Hill Publishing Co, New Delhi, 2005.
8. Digital Fundamentals, Floyd T L, 8th Edition, Person Education Asia Publications, 2002.
9. Basar E. (1976), Biophysical and physiological system Analysis, Addison-Wesley.
10. Cameron J. R. and Skofronick J.G. (1978), Medical Physics, John Wiley and sons.
11. Handbook of Biomedical Instrumentation, R.S. Khandpur, Second Edition, Tata McGraw-Hill Publishing Company Limited, 2003.
12. Introduction to Biomedical Equipment Technology, Joseph J. Carr and John M. Brown, Fourth Edition, Pearson Education, 2001.
13. Medical Instrumentation: Application and Design, Fourth Edition, John G Webster (Ed), John Wiley, 2010.

