Bharatiya Vidya Bhavan

BHAVAN'S VIVEKANANDA COLLEGE

of Science, Humanities and Commerce, Sainikpuri
Autonomous College | Affiliated to Osmania University
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Syllabus - B Sc II Year Physics
W.e.f the academic year: 2025-26

Semester III

Course name: **Electromagnetic Theory** Course Code: **PH323** (60 Hours)

HPW: 4 **CREDITS: 4**

Course Objectives: This course is designed to

COB1: *infer the concepts of Electrostatics.*

COB2: *interpret the concepts of Magnetostatics.*

COB3: *understand the concepts of Electromagnetic induction and properties of electromagnetic waves*

COB4: *analyze phase relation between current and voltage in R, L, C & their combinations and the implications*

Unit -I **(15 hrs)**

Electrostatics (7)

Electric field- Concepts of electric field lines and electric flux, Gauss law (Integral and differential form), application to linear, plane and spherical charge distributions. Conservative nature of electric field, Irrotational field.

Electric Potential (8)

Electric potential- Concepts of electric potential relation between electric potential and electric field, potential energy of a system of charges. Energy density in an electric field. Calculation of potential from electric field for a spherical charge distribution.

Unit-II **(15 hrs)**

Magnetostatics (7)

Concept of magnetic field and magnetic flux, Biot–Savart's law, magnetic field induction (B) due to a straight current carrying conductor, Force on a point charge in a magnetic field. Properties of magnetic field induction B, curl and divergence of B. Integral form of Ampere's Law, Applications of Ampere's Law, field due to straight, circular and solenoidal currents.

Magnetic field Intensity (8)

Energy stored in magnetic field. Magnetic energy in terms of current and inductance. Magnetic force between two current carrying conductors. Magnetic field Intensity. Ballistic Galvanometer-Torque on current loop in a uniform magnetic field, working principle of B.G., current and charge sensitivity, electromagnetic damping, critical damping resistance.

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Unit-III **(15 hrs)**

Electromagnetic induction (7)

Faraday's law of induction (differential and integral form) –Lenz's law–self and mutual inductance, Continuity equation, modification of Ampere's Law.

Electromagnetic waves (8)

Displacement current, Maxwell's equations - Integral and differential form, Maxwell's equations in vacuum and dielectric medium, boundary conditions, Plane wave equation, Transverse nature of electromagnetic waves. Poynting theorem.

Unit-IV **(15 hrs)**

Varying currents (7)

Growth and decay of current in LR, Growth and decay of charge in CR, Growth and decay of charge in LCR circuits. Critical damping.

Alternating currents (8)

Alternating current relation between current and voltage in pure R, C, L, RL, RC and RLC vector diagrams, Power in ac circuits. LCR series and parallel resonant circuit– Q-factor. AC & DC motors-single phase, three phase (basics only).

Course Outcomes: By the end of this course, the student will be able to

CO1: *become cognizant of fundamentals of of Electrostatics*

CO2: *apply the various in the design Ballistic Galvanometer using the concepts of Magnetism*

CO3: *analyze the Laws of EMI and validate the inadequacy of Ampere's Law*

CO4: *construct various circuits using R, L, C & their combinations and assess the Q factor and Power in ac circuits*

Textbooks:

1. Third year Physics, *Telugu Akademi*
2. Electricity and Magnetism, D.N. Vasudeva. *S. Chand & Co.*
3. Electricity and Magnetism, A S Mahajan, A. Rangwala, *Tata Mc. Graw-Hill Education.*
4. Electricity and Magnetism Brijlal and Subramanyam, *Ratan Prakashan Mandir*
5. Berkeley Physics Course, Vol.II, Electricity and Magnetism–Edward M Purcell, *The McGraw-Hill Companies*.
6. Fundamentals of electricity and magnetism, Arthur F. Kip *(McGraw-Hill,* 1968*)*
7. Electricity and magnetism, J. H. Fewkes& John Yarwood. Vol. I *(Oxford Univ. Press,* 1991*)*.
8. Introduction to Electrodynamics, 3rd edition, by David J. Griffiths, (Benjamin Cummings, 1998).
9. Electricity and magnetism, D C Tayal, *Himalaya Publishing House,* 1988
10. Electromagnetics, Joseph A. Edminister 2nd ed. New Delhi, *Tata McGraw Hill,* 2006

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Reference Books:

1. Electricity and Electronics, D.C. Tayal, *Himalaya Publishing House.*
2. Electricity and Magnetism, C.J. Smith, *Edward Arnold Ltd.*
3. Electricity, Magnetism with Electronics, K K Tewari *S. Chand & Co.*
4. General Physics, Douglass C Giancoli, *Prentice-Hall, Inc, New Jersey.*
5. Introduction to Physics for Scientists and Engineers, F.J Ruche, *McGraw Hill.*

Semester III

Course Name: **Electromagnetic theory Practicals** Course Code: **PH323P**

HPW: 3 **CREDITS: 1**

Course Objectives: This course is designed to

COB1*: develop hands-on experience on electromagnetic related experiments.*

COB2: *provide insights AC response in L C R circuits.*

1. To determine the (a) current sensitivity, (b) charge sensitivity, and (c) Critical Damping Resistance CDR of a B.G.
2. Figure of merit and Voltage sensitivity of a moving coil galvanometer.
3. Conversion of moving coil galvanometer into voltmeter and ammeter.
4. To draw the B-H curve of transformer core and determine magnetic constants & energy loss.
5. To variation of magnetic field in a solenoid with current, number of turns and distanceusingGauss probe.
6. To study the variation of magnetic field with distance along the axis of a circular coil/Solenoid carrying current by Stewart and Gee's method.
7. Determination of frequency AC source using Sonometer.
8. RC circuit-Determination of time constant
9. LCR series Circuit-Determination of resonant frequency and Q-factor
10. LCR parallel Circuit-Determination of resonant frequency and Q-factor

Course Outcomes: By the end of this course, the student will be able to

COB1*: understand concepts of electromagnetism through electromagnetic related experiments.*

COB2: *infer AC response in L C R circuits.*

Recommended Books:

1. B. Sc Practical Physics, C L Arora, *S. CHAND & Company Ltd.*
2. B. Sc Practical Physics, Harnam Singh Dr P S Hemne *S. CHAND & Company Ltd.*
3. Advanced Practical Physics, B. L. Worsnop and H. T. Flint *Asia Publishing House, New Delhi.*
4. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, *Kitab Mahal.*

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Skill Enhancement Course

Semester III

Course Name: **Experimental Methods and Error Analysis**

Course Code: **SE323** (30 Hours)

HPW: 2 **CREDITS: 2**

Course Objectives: ***This course is designed to***

COB1*: familiarize the basics of errors and their importance in experiments.*

COB2*: introduce the concepts of statistical analysis of errors and their elimination.*

Unit - I **(15 hrs)**

Experimental methods

Least count of instruments, Instruments for measuring mass, length, time, angle, current, voltages. Fundamental units. Precision and accuracy of measurements, source of error in measurements, necessity of estimating errors, types of errors, reading error of instrument, calibration error, random error, systematic error, significant digits, order of magnitude and rounding of numbers, rounding error, absolute and relative errors, errors of computation-addition, subtraction, multiplication, division, error in power and roots, Propagation of errors, analysis of data, standard deviation, calculation of mean value.

Unit - II **(15 hrs)**

Statistical Analysis of errors

Mean, Median, Mode and standard deviation, standard deviation of mean, Least squares fitting, Normal distribution, covariance and correlation, Binomial distribution, passion distribution, chi square test

Course Outcomes: *Upon completion of this course student will be able to*

CO1*: implement estimation of errors in measurement of physical quantities.*

CO2*: apply statistical methods to eliminate errors.*

Reference Books:

1. The Theory of errors in physical measurements, J C Pal, *New central book agency-2010.*
2. Data reduction and error analysis for physical science, DK Robinson and P R Bevington, *McGraw-Hill Education.*

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Skill Enhancement Course

Semester III

Course Name: **Basic Instrumentation** Course Code: **SE323A** (30 Hours)

HPW: 2 **CREDITS: 2**

Course Objectives: ***This course is designed to***

COB1: *enable the students to get familiar with basic electrical instruments.*

COB2: *familiarize signal generators and digital instruments.*

Unit-I **(15 hrs)**

Basics of Measurements

Instruments accuracy, precision, sensitivity resolution range etc. Errors in measurements and loading effects. Multimeter: Principles of measurement of dc voltage and dc current, ac voltage, ac current and resistance. Specifications of a multimeter and their significance.

Electronic Voltmeter

Advantages over conventional multimeter for voltage measurement with respect to input impedance and sensitivity. Principle of voltage, measurement (block diagram only). Specifications of an electronic Voltmeter/ Multimeter and their significance. AC millivoltmeter: Type of AC milli voltmeters: Amplifier- rectifier and rectifier-Amplifier. Block diagram ac millivoltmeter, specifications and their significance.

Cathode Ray Oscilloscope

Block diagram of basic CRO. Construction and Working of CRT, Electron gun, electrostatic focusing and acceleration, brief discussion on screen phosphor, visual persistence and chemical composition. Time base operation, synchronization, front panel controls of a CRO, specifications of a CRO and their significance

Use of CRO for the measurement of dc and ac voltage, frequency, time period. Special features of dual trace, introduction to digital oscilloscope, probes. Digital storage Oscilloscope: Block diagram and principle of working.

Unit-II **(15 hrs)**

Signal Generators and Analysis Instruments

Block diagram, explanation and specifications of low frequency signal generators, pulse generators, and function generators. Brief idea for testing, specifications, Distortion factor meter, wave analysis.

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Digital Instruments

Principle and working of digital meters. Comparison of analog and digital instruments. Characteristics of a digital meter. Working principles of a digital meterDigital Multimeter: Block diagram and working of Digital multimeter, Working principles of time interval, frequency and period measurements using universal counter/frequency counter, time-base stability, accuracy and resolution.

Course Outcomes: *Upon completion of this course student will be able to*

CO1: *become accustomed to use of basic electrical instruments.*

CO2: *adapt the use of signal generators and digital instruments.*

Reference Books:

1. A textbook of Electrical Technology, B L Theraja, *S. Chand & Co.*
2. Performance and design of AC machines, M G Say, *ELBS Edn.*
3. Digital Circuits and systems, Venugopal, *Tata Mcgraw Hill -2011.*
4. Digital Electronics, Subrata Ghoshal, *Springer-2012.*
5. Electronic Devices and circuits, S .Salivahanan and N S Kumar, 3rd., *Tata Mcgraw Hill-2012.*
6. Electronic Circuits: Handbook of design and applications, U. Tietze, Ch. Schenik, *Springer-2008.*
7. Electronic Devices 7/e, Thomas L Floyd, *Pearson India-2008.*

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Syllabus - B Sc II Year Physics
W.e.f the academic year: 2025-26

Semester IV

Course Name: **Waves and Optics** Course Code: **PH423** (60 Hours)

HPW: 4 **CREDITS: 4**

Course Objectives: This course is designed to

COB1: *explain the fundamental concepts of waves in strings and bars.*

COB2: *understand the concept of interference.*

COB3: *infer the concept of diffraction.*

COB4: *describe methods of polarization and its applications.*

Unit-I **(15 hrs)**

Waves in Strings (7)

Transverse wave propagation along a stretched string, general solution of the wave equation and its significance, Expression for velocity, modes of vibration of stretched string clamped at both ends, overtones, energy transport, transverse impedance.

Waves in Bars (8)

Longitudinal vibrations in bars – wave equation and its general solution. Expression for velocity. Special cases i) bar fixed at both ends ii) bar fixed at the midpoint iii) bar free at both ends iv) bar fixed at one end, free at other end.

Unit – II **(15 hrs)**

Interference (7)

Coherence, temporal and spatial coherence, conditions for Interference of light

Interference by division of wave front: Young's double slit experiment, Theory of interference. Fresnel's Bi-prism: Determination of wavelength of light, determination of thickness of a transparent material. Change of phase on reflection, Lloyd's mirror experiment.

Interference by division of amplitude (8)

Oblique incidence of a plane wave on a thin film due to reflected and transmitted light (Cosine law), Colors of thin films. Non Reflecting films, Interference by a film with two non-parallel reflecting surfaces: Wedge shaped film, determination of diameter of wire. Newton's rings in reflected light Determination of wavelength of monochromatic light. Michelson's Interferometer: Types of fringes, Determination of wavelength of monochromatic light, Difference in wavelength of sodium D1, D2 lines and thickness of a thin transparent plate.

Unit III **(15 hrs)**

Fraunhofer Diffraction (8)

Introduction: Distinction between Fresnel and Fraunhofer diffraction. Fraunhofer diffraction: Diffraction due to single slit and circular aperture, Limit of resolution. Fraunhofer diffraction due to double slit, Fraunhofer diffraction pattern with N slits (diffraction grating). Resolving Power of grating-derivation. Determination of wavelength of light in normal and oblique incidence methods by using diffraction grating.

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Fresnel's Diffraction (7)

Fresnel's half period zones, area of the half period zones. zone plate – Comparison of zone plate with convex lens, Phase reversal zone plate. Diffraction at a straight edge. Distinction between interference and diffraction.

Unit – IV **(15 hrs)**

Polarization

Methods of Polarization, Polarization by reflection, refraction, Double refraction, selective absorption. Scattering of light, Brewster's law, Malus law, Nicol's prism - polarizer, analyzer. Refraction of plane wave incident on negative and positive crystals - Huygens explanation. Quarter wave plate and half wave plate. Babinet's compensator: Optical activity. Laurent's half shade polarimeter - analysis of light.

Course Outcomes: By the end of this course, the student will be able to

CO1: use the concepts of waves in various applications like musical instruments.

CO2: apply knowledge of interference to calculate the wavelength of monochromatic radiation.

CO3: discriminate between the Fresnel's and Fraunhofer diffraction.

CO4: analyze the different modes of polarization of light.

Textbooks:

1. B.Sc First year Physics, *Telugu Akademi.*
2. B.Sc. Second Year Physics, *Telugu Akademi.*
3. Optics, Ajoy Ghatak. *The McGraw-Hill companies.*
4. Optics, Subramanian and Brijlal. *S. Chand & Co.*
5. Optics and Spectroscopy, R. Murugeshan and Kiruthiga Siva Prasath. *S. Chand & Co.*
6. Fundamentals of Optics, Jenkins A. Francis and White E. Harvey, *McGraw Hill Inc.*
7. Fundamentals of Physics, Halliday, Resnick, and Walker. C, *Wiley India Edition 2007.*
8. Waves and Oscillations, N. Subramaniyam and Brijlal *Vikas Publishing House Private Ltd.*
9. Waves and Oscillations, S. Badami, V. Balasubramanian and K. Rama Reddy *Orient Longman.*
10. The Physics of Waves and Oscillations - N K Bajaj, *Tata-McGraw Hill Company Edition, 2008.*

Reference Books:

1. Optics, Eugene Hecht and A R Ganesan, *Pearson Education India.*
2. Understanding optics, M K Sinha *Tata McGraw Hill Education Pvt. Ltd.*
3. Sears and Zemansky's University Physics, Hugh D. Young, Roger A. Freedman. *Pearson Education Eleventh Edition.*
4. Fundamentals of Physics- An Introduction, Sanat Kumar Chatterjee, *Narosa Publications.*
5. Feynman's Lectures on PhysicsVol. 1,2,3 & 4. *Narosa Publications.*
6. Physics Laboratory Manual, David H Loyd, *Brooks/cole Ceneage Learning.*
7. The Physics of Vibrations and Waves, H. J. Pain, *John Wiley and Sons.*
8. Fundamentals of Physics, Alan Giambattista et al, *Tata-McGraw Hill Company Edition, 2008.*

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Semester IV

Course Name: **Waves and Optics Practicals** Course Code: **PH423P**

HPW: 2 **CREDITS: 1**

Course Objectives: ***This course is designed to***

COB1*: develop hands-on experience in experiments based on interference, diffraction and polarization.*

COB2: *provide insights into concepts of waves and oscillation in strings.*

1. Determination of refractive index of a glass and liquid (Boy's Method).
2. To obtain the Refractive index of the material of the prism by determining the angle of minimum deviation from the I-D curve.
3. Determination of dispersive power of a prism.
4. Determination of thickness of a wire-wedge method.
5. Determination of Radius of curvature of a given convex lens- Newton's rings.
6. Determination of wavelength of light using diffraction grating minimum deviation method.
7. Wavelength of light using diffraction grating – normal incidence method.
8. Determination of wavelength of a given Laser light using diffraction grating.
9. Study of optical rotation using polarimeter.
10. Verification of Laws of a stretched string (Three Laws).
11. Velocity of Transverse wave along a stretched string
12. Determination of frequency of a bar- Melde's experiment

Course Outcomes: ***By the end of this course, the student will be able to***

COB1*: understand concepts of interference, diffraction and polarization through related experiments.*

COB2: *interpret waves in strings.*

Recommended Books:

1. B.Sc Practical Physics, C L Arora, *S. CHAND & Company Ltd.*
2. B.Sc Practical Physics, Harnam Singh Dr P S Hemne. *S.CHAND & Company Ltd.*

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Skill Enhancement Course

Semester IV

Course Name: **Electrical Circuit Networking** Course Code: **SE423** (30 Hours)
HPW: 2 **CREDITS: 2**

Course Objectives: ***This course is designed to***

COB1: *enable the students to get familiar with basic electrical circuit elements, schematics of electrical drawing, identify current flow and voltage drop.*

COB2: *provide hands on experience to electrical wiring and types of protection to be employed for electrical circuits.*

Unit-I **(15 hrs)**

Basic Electricity Principles

Voltage, Current, Resistance and Power. Ohm's law. Series, parallel and series-parallel combinations. AC Electricity and DC Electricity. Familiarization with multimeter, voltmeter and ammeter.

Understanding Electrical circuits

Electric circuit elements and their combination. Rules to analyse DC sourced electrical circuits. Current andVoltage drop across the DC circuit elements. Single phase and three phase alternating current sources. Rules to analyse AC sourced electrical circuits. Inductance, capacitance, and impedance. Real, imaginary and complex power components of Ac source. Power factor, Saving energy and money.

Electrical Drawing and Symbols

Drawing symbols. Blueprints. Reading Schematics. Ladder diagrams. Electrical schematics. Power circuits, control circuits. Reading of circuit schematics. Tracking the connections of elements and identifying current flow and voltage drop.

Generators and Transformers

DC power sources. AC/DC generators. Operation of transformers.

Unit-II **(15 hrs)**

Electrical protection

Relays, Fuses and disconnect switches. Circuit breakers. Overload devices. Ground- fault protection. Grounding and isolating. Phase reversal surge protection. Interfacing DC or AC source to control elements (relay protection device)

Electrical wiring

Different types of conductors and cable. Basic of wiring- starand delta connection. Voltage drops and losses across cables and conductors. Instruments to measure current, voltage, power in DC

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and AC circuits. Insulation. Solid and stranded cable. Conduit. Cable trays. Splices: wire nuts, crimps, terminal blocks, split bolts and solder. Preparation of extension board.

Course Outcomes: *Upon completion of this course student will be able to*

CO1: *understand basic electrical circuit elements, schematics of electrical drawing, current flow and voltage drop.*

CO2: *to understand basic electrical wiring and types of protection for electrical circuits.*

References Books:

1. A textbook of Electrical Technology, B L Theraja - *S Chand & Co.*
2. A textbook of Electrical Technology, A K Theraja
3. Performance and design of AC machines, M G Say - *ELBS Edn.*

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Skill Enhancement Course

Semester IV

Course Name: **Circuit Simulation** Course Code: **SE423A** (30 Hours)

HPW: 2 **CREDITS: 2**

Course Objective: ***This course is designed to***

COB1*: familiarize the students with the PSpice simulation package.*

Unit-I **(15 hrs)**

Introduction to KVL and KCL – applying KVL and KCL to simple D.C Networks. Introduction to PSpice Simulation –opening, saving and closing the Schematic files – Tool bars – Selection of Components, placing the components on the schematic, drawing and labelling wires, series and parallel connections, placing the D.C and A.C sources and ground symbols, setting up analyses, simulation of circuit, viewing results, viewing bias point voltages and currents, showing voltages and currents.

Unit-II **(15 hrs)**

Analysis – D.C sweep, A.C Sweep and Transient analysis. Simulation of V – I characteristics of a Resistor with D.C source, RC transient and frequency response, RLC series and parallel circuits with A.C source. V – I characteristics of a p – n junction diode – static and dynamic resistance calculations. Digital logic gates – verification of truth tables.

Course Outcome: *Students will be able to learn*

CO1*: usage of virtual components and instruments*

CO2: *to make simulated measurements. They will become proficient in designing and testing simple Digital and Analog circuits.*

Recommended Books:

1. Introduction to PSpice using Orcad circuits and Electronics, Mohammad H Rashid, *PHI Learning*.
2. Spice for circuits and Electronics using PSpice, Mohammad H Rashid, *PHI Learning*.

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Skill Enhancement Course

Semester IV

Course Name: **Biomedical Instrumentation** Course Code: **SE423B** (30 Hours)

HPW: 2 **CREDITS: 2**

Course Objectives: This course is designed to

COB1: *provide insights into the measurement of biological non-electrical parameters*

COB2: *understand the acquisition and analysis of electrical parameters associated with major body systems.*

Unit–I **(15 hrs)**

Fundamentals of Biomedical Engineering

Cell and its structure -Resting and Action Potential - Nervous System and its fundamentals -Basic Components of a biomedical System -Cardiovascular System - Respiratory Systems- Kidney and Blood Flow - Biomechanics of Bone - Biomechanics of Soft Tissues - Basic Mechanics of Spinal Column and Limbs - Physiological Signals and Transducers – Transducers- Selection Criteria – Piezoelectric, Ultrasonic Transducer - Temperature Measurements - Fibre Optic Temperature Sensors.

Non-Electrical Parameters Measurement and Diagnostic Procedures

Measurement of Blood Pressure - Cardiac Output - Heart Rate - Heart Sound - Pulmonary Function Measurements - Spirometer - Photo Plethysmography, Body Plethysmography - Blood Gas Analyzers, pHof Blood - Measurement of Blood pCO2 pO2 – Finger-tip Oximeter, ESR, GSR Measurements

Unit - II **(15 hrs)**

Electrical Parameters Acquisition and Analysis

Electrodes - Limbo Electrodes - Floating Electrodes – Pre-Gelled Disposable Electrodes - Micro Needle and Surface Electrodes -Amplifiers Preamplifiers, Differential Amplifiers, Chopper Amplifier, Isolation Amplifiers ECG-EEG-EMG- ERG- Lead Systems and Recording Methods -Typical Waveforms - Electrical Safety in Medical Environment, Shock Hazards- Leakage Current - Instruments for Checking Safety Parameters of Biomedical Equipments.

Imaging Modalities and Analysis

Radiographic and fluoroscopic techniques - Computer tomography – MRI -Ultrasonography -Endoscopy -Thermography - Different types of biotelemetry systems -Retinal imaging -Imaging applications in Biometric systems- Analysis of digital images.

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Life Assisting, Therapeutic and Robotic Devices

Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators – Diathermy – Heart – Lung machine – Audio meters – Dialysers – Lithotripsy – ICCU patient monitoring system – Nano Robots – Robotic surgery – Advanced 3D surgical techniques – Orthopedic prosthesis fixation. Simulations on synthesis and characterization of nano materials

Course Outcomes: *By the end of this course, the student will be able to*

CO1*: infer physics involved in the function of the major body system.*

CO2: *be able to measure biological electrical and non-electrical parameters*

Reference Books:

1. Handbook of Biomedical instrumentation, R. S.Khandpur, *Tata McGraw Hill.*
2. Medical Instrumentation Application and Design, J. G. Webster, *John Wiley and Sons.*
3. Introduction to Biomedical Equipment Technology, Joseph J Carr, John M. Brown, *Pearson Education, Inc.*

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