SEMESTER-IV

Name of the Course	**NUMERICAL METHODS**
Course Code: BS-M401	**Semester: Fourth**
L-T-P-C: 2-0-0-2	**Contact: 2 hrs/week**
Objectives:	
1	To understand different numerical methods required to solve engineering problems.
2	To familiarize with numerical solution of equations, finite differences and interpolation.
3	To expose with numerical solutions of linear, non-linear and ordinary differential equations.
Pre-Requisite: Mathematics (10+2)	

M#	Content	Hrs
1	Approximation in numerical computation: Truncation and rounding errors, Fixed and floating-point arithmetic, Propagation of errors. Interpolation: Newton forward/backward interpolation, Lagrange's and Newton's divided difference Interpolation. Numerical integration: Trapezoidal rule, Simpson's 1/3 rule, Expression for corresponding error terms.	11
2	Numerical solution of a system of linear equations: Gauss elimination method, Matrix inversion, LU Factorization method, Gauss-Seidel iterative method. Numerical solution of Algebraic equation: Bisection method, Regula-Falsi method, Newton- Raphson method. Solution of nonlinear algebraic equations	9
3	Numerical solution of ordinary differential equation: Iterative methods for solving differential equations: Euler's method, Runge-Kutta methods, Predictor-Corrector methods and Finite Difference.	6

COURSE OUTCOMES

At the end of the course, students should able to:

1. Demonstrate the use of interpolation methods to find intermediate values in given graphical and/or tabulated data.
2. Apply appropriate algorithms to solve selected problems, both manually and by writing computer programs.
3. Analyze the errors obtained in the numerical solution of problems.
4. Compare different algorithms with respect to accuracy and efficiency of solution.
5. Assess the reliability of the numerical results and find out the effect of round off error.

Text/Reference Books:

1. C.Xavier: C Language and Numerical Methods.
2. Dutta & Jana: Introductory Numerical Analysis.
3. J.B.Scarborough: Numerical Mathematical Analysis.
4. Jain, Iyengar , & Jain: Numerical Methods (Problems and Solution).
5. Balagurusamy: Numerical Methods, Scitech.

6. Baburam: Numerical Methods, Pearson Education.
7. N. Dutta: Computer Programming & Numerical Analysis, Universities Press.
8. Soumen Guha & Rajesh Srivastava: Numerical Methods, OUP.
9. Srimanta Pal: Numerical Methods, OUP.

Name of the Course	**DIGITAL ELECTRONICS & INTEGRATED CIRCUITS**
Course Code: ES-EC401	**Semester: Fourth**
L-T-P-C: 3-0-0-3	**Contact: 3 hrs/week**
Objectives:	
1	To acquire the basic knowledge of digital logic levels and application of knowledge to understand digital electronics circuits.
2	To prepare students to perform the analysis and design of various digital electronic circuits.
Pre-Requisite: Physics (10+2)	

M#	Content	Hrs
1	**Number System & Codes** Number systems: Decimal, binary, octal and hexadecimal number systems, arithmetic operations and their conversions, 1's and 2's complements. Codes: Binary, BCD, excess 3, alphanumeric, EBCDIC and gray codes, code conversions, error detecting and error correcting codes.	6
2	**Boolean Algebra & Logic Gates** Venn diagram, Boolean theorem, Logic Gates, operations, truth tables and universal gates, representation in SOP and POS forms, minimization of logic expressions by algebraic method, K-map and Quine- McClauskey method.	6
3	**Combinational Logic Circuits** Half and Full Adders, Half and Full Subtractors, Binary parallel Adder, Composite Adder, Carry look ahead Adder, BCD Adder, Applications and circuits of Decoder, Encoder, Multiplexer, Demultiplexer, magnitude comparator and Parity Generator, Implementation of combinational logic by standard IC's.	8
4	**Sequential Logic Circuits** S-R latch, J-K flip flop, D & T flip flop, triggering of flip flops, asynchronous inputs, master-slave configuration, conversion and application of flip flops, shift registers, universal shift registers, application of register, asynchronous / ripple counters, synchronous counters, Modulo-N counter, ring and Johnson counter, UpDown counter, preset and load in a counter, typical IC's for counters, State table and state transition diagram, sequential circuits design methodology.	8
5	**Analog To Digital and Digital To Analog Converters** Analog and digital data conversions, specification of D/A converter, R-2R ladder type, weighted resistor type, voltage and current mode, switches for D/A converters, high speed sample and hold circuits, specification for A/D converter, flash type, successive approximation type, dual slope type, sigma-delta converter.	6
6	**Memory Devices & Digital Logic System** Memory Devices: ROM, PROM, EPROM, EEPROM, RAM, SRAM, DRAM, Programmable Logic Array (PLA), Programmable Array Logic (PAL), Field Programmable Gate Array (FPGA), implementation of combinational logic	6

	circuits using PLA, PAL. Digital Logic System: Logic levels, propagation delay, power dissipation, fan-out and fan-in, IC families and their characteristics – RTL, TTL, ECL, CMOS.	

COURSE OUTCOMES

At the end of the course, students should able to:

1. Understand and explain different kinds of logic families.
2. Analyze digital circuits and arrive at suitable conclusions.
3. Develop digital logic circuits and apply it to solve real life problems.
4. Classify and explain the design of different semiconductor memories.
5. Design and develop applications of combinational and sequential circuits.
6. Engage in self-study to formulate, design, implement, analyze and demonstrate an application of digital electronic circuits.

Text/ Reference Books:

1. S.Salivahanan, S.Aribazhagan, Digital Circuit & Design, 3rd Ed., Vikas Publishing House Pvt. Ltd
2. Anand Kumar, Fundamentals of Digital Circuits- PHI
3. A.K.Maini- Digital Electronics- Wiley-India
4. Kharate- Digital Electronics- Oxford
5. R.P. Jain, "Modern digital Electronics", Tata McGraw Hill, 4th edition, 2009.
6. Schilling & Belove, Digital Integrated Electronics, Tata McGraw Hill,
7. W.H. Gothmann, "Digital Electronics- An introduction to theory and practice", PHI, 2nd edition ,2006.
8. D.V. Hall, "Digital Circuits and Systems", Tata McGraw Hill, 1989
9. Morries Mano- Digital Logic Design- PHI
10. R.P.Jain—Modern Digital Electronics, 2/e , Mc Graw Hill
11. H.Taub & D.Shilling, Digital Integrated Electronics- Mc Graw Hill.
12. D.Ray Chaudhuri- Digital Circuits-Vol-I & II, 2/e- Platinum Publishers

Name of the Course	**BIOSENSORS & TRANSDUCERS**
Course Code: PC-BME401	**Semester: Fourth**
L-T-P-C: 3-0-0-3	**Contact: 3 hrs/week**

Objectives:	
1	To acquire knowledge about the biological sensors and their working principles.
2	To know the principle of working, classification and characteristics of different transducers and their applications in medical field.
3	To understand the physical principles that governs the measurement of a biological variable or system.
4	To familiarize with the constructions and measurement of physiological parameters using sensors and transducers.

Pre-Requisite: Physics-I (BS-PH201), Engineering Anatomy & Physiology (PC-BME301)

M#	Content	Hrs
1	**Introduction to Biological Sensors:** Sensors / receptors in the human body, basic organization of nervous system-neural mechanism, hot and cold receptors, barro receptors, sensors for smell, sound and vision.	3
2	**Transducers principles and Medical applications**: Classification of transducers, characteristic of transducers, Resistance temperature detector (RTD), Thermistor, Thermocouple, p-n junction, chemical thermometry, potentiometer, inductive & capacitive transducer, magnetic sensors, Hall effect sensors, variable capacitance pressure transducers, LVDT transducers, strain gauge transducers, semiconductor transducers, p-i-n transducers, catheter tip transducers, Piezoelectric transducer, LDR, photo-emissive tubes, photodiodes, LED, avalanche photo diode (APD).	15
3	**Optical Sensor and Radiation Detectors:** Principles of optical sensors, optical fiber sensors, indicator-mediated transducers, optical fiber temperature sensors, LASER detector, Proportional counter, Gas-ionisation chamber, Geiger counters, Scintillation detectors.	6
4	**Biochemical Transducers**: Electrode theory: electrode-tissue interface, metal-electrolyte interface, electrode-skin interface, electrode impedance, Biopotential electrodes: microelectrodes, body surface electrodes, needle electrodes, electrodes for ECG, EEG, and EMG. Reference electrodes: hydrogen electrodes, silver-silver chloride electrodes, Calomel electrodes, Ion electrodes: specific ion electrodes, pH electrode, O2 electrode, CO2 electrode.	10
5	**Special Medical Applications of Sensors:** Gas sensor, Microbial sensor, electro analytical sensor, Enzyme based sensor-- Glucose sensor, Electronic nose-halitosis, Advances in sensor technology: Lab-on-a-chip, Smart sensor, MOSFET biosensors, Bio-MEMS and Nano sensor.	6

COURSE OUTCOMES

At the end of the course, students should able to:

1. Classify sensors and transducers based on functions.
2. Explain the working principles of biosensors and transducers.
3. Select appropriate transducers for measurements of physical parameters.

4. Analyze various electrical parameters with accuracy and precision.
5. Measure physiological parameters and interpret the data.
6. Design and develop systems for tailor made applications.

Text/ Reference Books:

1. R. S. Khandpur, "Handbook of Biomedical Instrumentation", Tata McGraw Hill.
2. S.C. Cobbold, "Transducers for Biomedical Instruments", Prentice Hall.
3. Brown & Gann, "Engineering Principles in Physiology Vol. I", Academic Press.
4. Jon Cooper, "Biosensors A Practical Approach" Bellwether Books, 2004.
5. Carr & Brown, Introduction to Biomedical Equipment Technology Pearson Edn, Asia.
6. Rao & Guha,"Principles of Medical Electronics & Biomedical Instrumentation", University Press, India.
7. Iberall & Guyton, Regulation & Control in Physiological System, Instruments Soc.USA.
8. A.V.S. De Renck , "Touch Heat & Pain", Churchill Ltd. London.
9. Harry Thomas, "Handbook of Bio medical Instrumentation", Reston, Virginia.
10. D. L. Wise, "Applied Bio Sensors", Butterworth, London.

Name of the Course	**BIOMEDICAL INSTRUMENTATION**
Course Code: PC-BME402	**Semester: Fourth**
L-T-P-C: 3-1-0-4	**Contact: 4 hrs/week**
Objectives:	
1	To study the instrumentation concerned with measuring various physiological parameters.
2	To understand the purpose of measurement, the method of measurement and errors associated with measurement.
3	To understand the operation, applications and underlying physiological principles associated with medical devices.
4	To give a complete exposure of various recording mechanism and to understand the basic principles, working of biomedical instruments.
Pre-Requisite: Physics-I (BS-PH201), Engineering Anatomy & Physiology (PC-BME301), Biophysics & Biochemistry (PC-BME303)	

M#	Content	Hrs
1	**Introduction to Medical Instrumentation** Sources of Biomedical Signals, Basic medical Instrumentation system, Performance requirements of medical Instrumentation system, Microprocessors in medical instruments, PC based medical Instruments, General constraints in design of medical Instrumentation system, Regulation of Medical devices.	5
2	**Measurement, Display & Recording Systems** Units and standards of measurements, systematic and random error, accuracy and precision index, linearity, hysteresis, threshold, sensitivity, speed of response, fidelity, calibration, digital voltmeter & multimeter, PMMC, MI and dynamometer type instruments, dc potentiometers, AC bridges, general features of ink-jet, thermo-sensitive and optical recorders, CRT, General purpose oscilloscope, Dual trace, Dual beam, Sampling oscilloscope, Digital storage oscilloscope, Function generator.	15
3	**Biosignal Measurement Systems** Biosignals characteristics, frequency and amplitude ranges, ECG- Einthoven's triangle, standard 12 lead system, Principles of vector cardiography, ECG block diagram and circuits. Evoked potential, EEG-10-20 electrode system, unipolar, bipolar and average mode, EEG bio-feedback instrumentation. EMG-unipolar and bipolar mode, EMG bio-feedback instrumentation, Recording of EOG, Blood ERG, EGG, PCG & GSR.	12
4	**Bioamplifier & Signal Conditioning Circuits** Bio-amplifier and its characteristics, single ended bio-amplifier, differential bio-amplifier, Impedance matching circuit, isolation amplifiers-transformer and optical isolation, isolated DC amplifier and AC carrier amplifier, Power line interference, Right leg driven ECG amplifier, Band pass and notch filtering, data acquisition system.	11
5	**Patient Monitoring Systems & Biotelemetry** Introduction to patient monitoring system, selection of parameters, computerized patient monitoring system, bedside and central monitoring system, heart rate monitor, pulse rate monitor, Holter monitor and Cardiac	9

	stress test, Cardiac catheterization instrumentation, phonocardiography, Organization and equipments used in ICCU & ITU.	

COURSE OUTCOMES

At the end of the course, students should able to:

1. Measure various electrical parameters with accuracy, precision, resolution.
2. Illustrate and explain the mode of operation of various instrument and its medical applications.
3. Demonstrate and adjust the technical factors of the instruments.
4. Understand electrical safety and the ability to design relevant protection systems.
5. Analyze and interpret the static and dynamic characteristics of bioinstrumentation systems
6. Identity and solve the problem and servicing the instrument properly.

Text/ Reference Books:

1. R. S. Khandpur "Handbook of Bio-Medical Instrumentation", 2nd Edition, Tata McGraw Hill.
2. J.J.Carr & J.M.Brown, "Introduction to Biomedical Equipment Technology" Pearson Education, Asia.
3. Cromwell, Weibell & Pfeiffer, "Biomedical Instrumentation & Measurement", Prentice Hall, India
4. Joseph Bronzino, "Biomedical Engineering and Instrumentation", PWS Engg . , Boston.
5. J.Webster, "Bioinstrumentation", Wiley & Sons.
6. Joseph D.Bronzino, "The Biomedical Engineering handbook", CRC Press.

Name of the Course	**ANALYTICAL AND DIAGNOSTIC EQUIPMENTS**
Course Code: PC-BME403	**Semester: Fourth**
L-T-P-C: 3-0-0-3	**Contact: 3 hrs/week**
Objectives:	
1	To familiarize the students with the principles and applications various analytical and diagnostic instruments.
2	To expose the students to the diagnostic features of medical devices used routinely in hospitals.
3	To impart fundamental knowledge of versatile analytical and diagnostic equipments used in the healthcare system.
Pre-Requisite: Physics-I (BS-PH201), Engineering Anatomy & Physiology (PC-BME301).	

M#	Content	Hrs
1	**Clinical Equipments** Principles of photometric measurement, Radiation sources, Optical filters, Colorimeter, Spectrometer, Design of Monochromators, Flame photometer, Atomic absorption spectrophotometer, Automated biochemical analyzer-Auto analyzer, Electromechanical analyzer-Chromatographs, Microscopes, Scanning Electron Microscope, Transmission Electron Microscope, Centrifuge-principles and applications.	10
2	**Blood Gas Analyzers and Oximeters** Blood pH measurement, Blood pCO2 measurement, Blood pO2 measurement, complete blood gas analyzer, Fiber optic based blood gas sensors, Oximetry, Principles of oximetric measurements, Ear oximeter, Pulse oximeter, Intravascular oximeter.	7
3	**Blood Cell Counters and Blood Pressure Measurement** Blood cell counters, optical method-Flow Cytometry, electrical impedance method-Coulter Counters, automatic recognition and differential counting of cells, blood pressure measurement, indirect method-auscultatory & oscillatory, automated indirect method, direct method-electronic manometer, pressure amplifiers, systolic, diastolic and mean detector circuit.	7
4	**Blood Flow and Cardiac Output Measurement** Electromagnetic blood flow meter, Ultrasonic blood flow meter-Transit time and Doppler blood flow meter, Cardiac output measurement-Dye dilution, thermal dilution and Impedance method.	6
5	**Pulmonary Function Analyzers** Lung volume and vital capacity, Compliance and related pressure, Spirometer, Pneumotachometer, impedance pneumograph / plethysmograph, apnea monitor.	6
6	**Endoscopy** Basic endoscopic equipments, Fibreoptic instruments and video-endoscopes, Accessories-illumination, instrument tips, instrument channels, tissue sampling devices, suction traps and fluid-flushing devices, Various endoscopic applications, Maintenance and storage.	4

COURSE OUTCOMES

At the end of the course, students should able to:

1. Classify and explain different types of clinical instruments for medical diagnosis.
2. Demonstrate the basic principle of working, mode of operation and various advancements.
3. Choose appropriate instruments for specific application and accurate measurement.
4. Integrate knowledge of engineering and biology to repair and calibrate the instruments.
5. Make measurement, analyze and interpret the results for clinical purposes.
6. Exhibit competency in suggesting, designing and offering reliable and optimum solution.

Text/ Reference Books:

1. R. S. Khandpur "Handbook of Bio-Medical Instrumentation", 2nd Edition, Tata McGraw Hill.
2. J.J.Carr & J.M.Brown, "Introduction to Biomedical Equipment Technology" Pearson Education, Asia.
3. Cromwell, Weibell & Pfeiffer, "Biomedical Instrumentation & Measurement", Prentice Hall, India
4. Joseph Bronzino,"Biomedical Engineering & Instrumentation",PWS Engg Boston.
5. J.Webster, "Bioinstrumentation", Wiley & Sons.
6. Joseph D.Bronzino, "The Biomedical Engineering handbook", CRC Press.

Name of the Course	**ELECTRIC CIRCUITS AND NETWORK ANLYSIS**
Course Code: PE-EE401	**Semester: Fourth**
L-T-P-C: 3-0-0-3	**Contact: 3 hrs/week**
Objectives:	
1	To understand the structure and properties of different type of electric circuits and sources.
2	To learn circuit analysis techniques such as nodal analysis, mesh analysis, theorems, source transformation and several methods to simplify electric networks.
3	To acquire problem solving skills of electric circuit through the application of techniques and principles of electrical circuit analysis to common circuit problems.
Pre-Requisite: Basic Electrical Engineering (ES-EE-101), Mathematics (BS-M-102, BS-M202), Signals & Systems in Biomedical Engineering (PC-BME301).	

M#	Content	Hrs
1	**Voltage & Current Sources:** Current sources: active, passive, dependent, independent, ideal & practical current sources; AC & DC current, AC & DC voltage, Voltage sources: dependent, independent, ideal & practical voltage sources.	6
2	**A.C. Fundamentals** Sinusoidal voltage and currents, mathematical and graphical representation, concept of cycle period, frequency, instantaneous, peak, average, r.m.s. values, peak and form factor, phase difference, lagging, leading and in phase quantities, phasor representation: Rectangular and polar representation of phasors.	8
3	**Resonance Circuits and Coupled Circuits** Series and Parallel Resonance, Impedance and Admittance Characteristics, Q-factor, Half-Power Points, Bandwidth, Resonant voltage rise, Transform diagrams, Magnetic Coupling, polarity of coils, polarity of induced voltage, concept of self and mutual inductance, coefficient of coupling, modeling of coupled circuits, Solution of Problems.	10
4	**Methods of Analyzing Circuits** Concept of Tree, Branch, Tree Link, junctions, Incident matrix, Tie-set matrix, Cut-set matrix, determination of loop current and node voltages, formulation of mesh equation, formulation of node equation, nodal and super nodal analysis, solution of problems with DC and AC sources, analyzing simple biomedical circuits.	6
5	**Network Theorem and Transient Analysis** Network equations: Kirchoff's Voltage Law & Current Law, Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Reciprocity Theorem, Compensation Theorem, Maximum Power Transfer Theorem, Millman's Theorem, Star-Delta transformations, representation of network in time and frequency domain, free and forced responses of RL, RC RLC circuits with DC and AC excitation, applying theorems in biomedical circuits.	10

COURSE OUTCOMES

At the end of the course, students should able to:

1. Apply different techniques for analysis of electrical circuit.

2. Analyze circuits using mesh current and nodal voltage method.
3. Analyze and solve transient behavior of the network.
4. Analyze RLC circuits and coupled circuits.
5. Design resonant circuits for given bandwidth.
6. Compute responses of first order and second order networks using time domain analysis.

Text/Reference Books:

1. Van, Valkenburg.; "Network analysis" ; Prentice hall of India, 2000
2. Sudhakar, A., Shyammohan, S. P.; "Circuits and Network" ; Tata McGraw-Hill New Delhi, 1994
3. A William Hayt, "Engineering Circuit Analysis" 8th Edition, McGraw-Hill Education
4. AChakrabarty," Circuit Theory Analysis & Synthesis", DhanpatRai
5. S P Ghosh, "Circuit Theory and Networks", Tata McGraw Hill.
6. Hayt"Engg Circuit Analysis 6/e Tata McGraw-Hill
7. D.A.Bell- Electrical Circuits- Oxford
8. Skilling H.H.: "Electrical Engineering Circuits", John Wiley & Sons.
9. Edminister J.A.: "Theory & Problems of Electric Circuits", McGraw-Hill Co.
10. Kuo F. F., "Network Analysis & Synthesis", John Wiley & Sons.
11. R.A.DeCarlo & P.M.Lin- Linear Circuit Analysis- Oxford
12. P.Ramesh Babu- Electrical Circuit Analysis- Scitech
13. Roy Choudhury D., "Networks and Systems", New Age International Publishers.
14. D.Chattopadhyay and P.C.Rakshit: "Electrical Circuits" New Age

Name of the Course	**ELECTRICAL AND ELECTRONIC MEASUREMENTS**
Course Code: PE-EE402	**Semester: Fourth**
L-T-P-C: 3-0-0-3	**Contact: 3 hrs/week**
Objectives:	
1	To gain knowledge about the electrical and electronic measuring instruments and the methods of measurement.
2	To acquire knowledge about the working and operation of various analog and digital signal recording and analysing instruments.
3	To introduce students with PC based instrumentation and data acquisition system.
Pre-Requisite: Basic Electrical Engineering (ES-EE-101)	

M#	Content	Hrs
1	**Basic Measurement System** Measurement and generalized measurement system, static and dynamic characteristics, units and standards of measurements, errors analysis, moving iron meters, dynamometer, wattmeter, multimeter, true rms meters, Bridge measurements: Wheatstone Bridge, Kelvin, Wein, Maxwell, Hay, Schering and Anderson Bridge. D.C. and A.C. potentiometers, Measurement of high voltage, Measurement of power in polyphase circuits.	10
2	**Data Display and Recording System** Electronic multimeter, current measurement with analog electronic instruments, chopper stabilized amplifier for measurement of very low voltage and currents, graphic recorders, Cathode Ray Oscilloscopes- Block Schematic, Principles and applications. Dual Trace and Dual Beam Oscilloscopes, sampling oscilloscope, Digital Storage Oscilloscope.	9
3	**Signal Generator and Analysis** Function Generators, RF Signal Generators, Sweep Generators, Frequency Synthesizer, Wave Analyzer, Harmonic Distortion Analyzer, Spectrum Analyzer.	7
4	**Digital Instruments** Comparison of analog & digital techniques, digital voltmeter, mutlimeter, frequency counters and time interval, extension of frequency range, measurement errors.	7
5	**Data Acquisition Systems** Elements of digital data acquisition system, interfacing of transducers, multiplexing, Computer controlled instrumentation: IEEE 488 Bos. Optical Power Measurement, Optical Time Domain Reflectometer.	7

COURSE OUTCOMES

At the end of the course, students should able to:

1. Explain the working principles and operation of measuring instruments.
2. Analyze the performance characteristics of measuring instruments.
3. Measure various electrical parameters with accuracy and precision.
4. Select appropriate measuring instruments for measuring the specific physical parameters.
5. Test and troubleshoot electronic circuits using various measuring instruments.

6. Propose data acquisition system and transfer data for digital signal processing and analysis.

Text/Reference Books:

1. Modern Electronic Instrumentation & Measurement Techniques – Albert D. Helfrick & William D. Copper,Prentice Hall of India, 2003
2. Elements of Electornics Instrumentation & Measurement, Pearson Education 2003
3. Measurement System- Application & Design – Ernest O.Doeblin, Tata McGraw Hill 2004.
4. Electronic Instrumentation by H. S. Kalsi. 3rd Ed. Tata McGraw-Hill Education
5. A Course in Electrical and Electronic Measurements and Instrumentation by A.K. Sawhney, Puneet Sawhney, Dhanpati Rai Publication.

PRACTICAL

Name of the Course		**DIGITAL ELECTRONIC CIRCUITS LABORATORY**
Course Code: ES-EC491		**Semester: Fourth**
L-T-P-C: 0-0-2-1		**Contact: 2 hrs/week**
Objectives:		
1	To introduce students with the working of basic components of digital electronics.	
2	To familiarize students with different Digital ICs corresponding to different logic gates	
3	To familiarize students with the design of sequential and combinational circuits.	
4	To introduce with small counter circuits using simple ICs.	

LIST OF EXPERIMENTS:

1. Realization of basic gates using Universal logic gates.
2. Code conversion circuits- BCD to Excess-3 & vice-versa.
3. 4-bit parity generator & comparator circuits.
4. Construction of simple Decoder & Multiplexer circuits using logic gates.
5. Design of combinational circuit for BCD to decimal conversion to drive 7-segment display using multiplexer.
6. Construction of simple arithmetic circuits-Adder, Subtractor.
7. Realization of RS-JK & D flip-flops using Universal logic gates.
8. Construction of Adder circuit using Shift Register & full Adder.
9. Realization of Asynchronous Up/Down counter.
10. Realization of Synchronous Up/Down counter.
11. Realization of Ring counter & Johnson's counter.
12. Mandatory Design and Implementation of Mini Project.

Note: An Institution/College may opt for some other software or hardware simulation wherever possible in place of MATLAB.

COURSE OUTCOMES

At the end of the course, students should able to:

1. Understand the basic of the Digital systems to solve real life problems.
2. Explain the application of Digital ICs in the designing circuit.
3. Describe, design and analyze sequential and combinational circuits.
4. Design various functional circuits using simple ICs.

Name of the Course	**BIOSRNSORS & TRANSDUCERS LABORATORY**
Course Code: PC-BME491	**Semester: Fourth**
L-T-P-C: 0-0-2-1	**Contact: 2 hrs/week**
Objectives:	
1	To study and analyze the theory and practical characteristics of the various transducers for the measurement of vital physiological parameters.
2	To get familiar with the various types of transducers and to study the compatibility for any clinical measurements.

LIST OF EXPERIMENTS:

1. Characteristics of temperature sensors: RTD, Thermocouple, P-N junction diode transistor.
2. Measurement of displacement: Capacitive transducer, LVDT
3. Characteristics of light sensors: LDR, Photodiode, Phototransistor
4. Study of load cell with tensile and compressive load
5. Measurement of torque using strain gauge transducer
6. Study of proximity detector: ultrasonic, IR
7. Measurement of respiration rate: Thermistor, Piezoelectric sensors.
8. Study of the characteristics of level sensor for saline IV set.
9. Study & characterization of Biotransducers: Pressure, Temparature, Humidity
10. Study & characterization of Bioelectrodes: ECG, EMG, EEG
11. Mandatory Design and Implementation of Mini Project.

COURSE OUTCOMES

At the end of the course, students should able to:

1. Select proper sensors and transducers for measurement of biophysical phenomenon.
2. Conduct experiments and analyze the result practically.
3. Evaluate and compare the measure data for clinical representation.
4. Design and test system for detection of physiological signals.

Name of the Course	**BIOMEDICAL INSTRUMENTATION LABORATORY**
Course Code: PC-BME492	**Semester: Fourth**
L-T-P-C: 0-0-2-1	**Contact: 2 hrs/week**
Objectives:	
1	To make students aware about the measuring instruments and the methods of measurement routine used in the medical field.
2	To acquaint student with signal acquisition, recording and analysis of physiological parameters.
3	To familiarize students with the measuring principles, probable troubleshoot and maintenance of biomedical instruments.

LIST OF EXPERIMENTS:

1. Power isolation: isolation transformer and DC-DC converters
2. Timer circuits: ON delay and OFF delay study
3. Characterization of biopotential amplifier for ECG & EMG signals
4. Isolation of bio-signal (EMG / ECG)
5. Study on ECG lead selection circuits
6. ECG processing and analysis
7. EMG processing and analysis
8. EEG processing and analysis
9. PCG processing and analysis / electronic stethoscope
10. Detection of QRS component from ECG signals
11. Measurement of heart rate using F-V converter
12. Mandatory Design and Implementation of Mini Project.

COURSE OUTCOMES

At the end of the course, students should able to:

1. Explain the principle of operation and design background of medical instrument for specific application.
2. Make measurement on and interpret data from living systems, and ability to communicate properly.
3. Design and conduct experiments, as well as to analyze and interpret data.
4. Check and calibrate medical instruments at par with standard protocol.

Name of the Course	**CIRCUITS AND NETWORK LABORATORY**
Course Code: PE-EE491	**Semester: Fourth**
L-T-P-C: 0-0-2-1	**Contact: 2 hrs/week**
Objectives:	
1	To gain the practical knowledge about the basic electrical circuits and the circuit theorems.
2	To understand the transient response of RL, RC and RLC circuits, and transient analysis of AC circuits.
3	To gain hand on experience in Thevinin & Norton theorem, KVL & KCL, and Super Position Theorems.

LIST OF EXPERIMENTS:

1. Characteristics of Series & Parallel Resonant circuits
2. Verification of Network Theorems
3. Transient Response in R-L & R-C Networks ; simulation / hardware
4. Transient Response in RLC Series & Parallel Circuits & Networks; simulation/hardware
5. Determination of Impedance (Z), and Admittance (Y) parameters of networks.
6. Frequency response of LP and HP filters
7. Frequency response of BP and BR filters
8. Generation of periodic, exponential, sinusoidal, damped sinusoidal, step, impulse, and ramp signals using MATLAB
9. Representation of Poles and Zeros in z-plane, determination of partial fraction expansion in z-domain and cascade connection of second-order systems using MATLAB
10. Determination of Laplace Transform, different time domain functions, and Inverse Laplace Transformation using MATLAB
11. Spectrum analysis of different signals /Analysis of simple biomedical signals.
12. Mandatory Design and Implementation of Mini Project.

Note: An Institution / college may opt for some other hardware or software simulation wherever possible in place of MATLAB

COURSE OUTCOMES

At the end of the course, students should able to:

1. Generate various signals, represent poles and zeros, determine partial functions and cascade connection using software tools / simulation kits.
2. Characterize Series and Parallel Resonant circuits, and validate network theorems.
3. Design Transient Response in R-L & R-C Networks and Transient Response in RLC Series & Parallel Circuits & Networks.
4. Determine Laplace transform, different time domain functions and inverse Laplace.

Name of the Course	**ELECTRICAL AND ELECTRONIC MEASUREMENTS LABORATORY**
Course Code: PE-BME492	**Semester: Fourth**
L-T-P-C: 0-0-2-1	**Contact: 2 hrs/week**
Objectives:	
1	To acquire knowledge of internal structure of electrical and electronic measuring instruments and calibrate different types of ammeter, voltmeter and wattmeter and single phase AC energy meter.
2	To gain knowledge about the measuring of low resistance, inductance and capacitance using DC and AC Bridges.

LIST OF EXPERIMENTS:

1. Instrument workshop- observe the construction of PMMC, Dynamometer, Electro thermal and Rectifier type instrument, Oscilloscope and digital multimeter
2. Calibrate moving iron and electrodynamometer type ammeter/volmeter by potentiometer
3. Calibrate dynamometer type Wattmeter by potentiometer
4. Calibrate A.C. energy meter
5. Measure the resistivity of material using Kelvin Double Bridge
6. Measurement of Power using Instrument transformer
7. Measurement of Power in Polyphase circuits
8. Measurement of Frequency by Wien Bridge using Oscilloscope
9. Measurement of Inductance by Anderson Bridge
10. Measurement of Capacitance by De Sauty Bridge
11. Measurement of Capacitance by Schering Bridge
12. Mandatory Design and Implementation of Mini Project.

COURSE OUTCOMES

At the end of the course, students should able to:

1. Identify various measuring equipment/meters and to evaluate their performance.
2. Measure Resistance, Inductance, Capacitance, Frequency, Voltage, Current, Power and Energy.
3. Demonstrate variety of practical electrical circuits and conduct experiments to analyze and interpret data.
4. Prepare graphical presentations of laboratory data and computational results, incorporating standard data analysis methods to develop technically sound reports of outcomes.