Semester-IV

PC-IC 401	Electrical & Electronic Measurement	**3L:0T:0P**	**Credit- 3**

Course Outcomes (CO):

After the completion of the course the students will be able to:

1. Learn measurement system and their classifications.
2. Compare various electromechanical indicating instruments,
3. Measure power, energy and resistance
4. Design various AC bridges
5. Analyze various electronic and digital instruments and its applications.

Module 1: Introduction (03 hours)

Method of measurement, Measurement system, Classification of instruments, Definition of accuracy, Precision, Resolution, Speed of response, Error in measurement, Classification of errors, loading effect due to shunt and series connected instruments.

Module 2: Electromechanical Indicating Instruments (10 hours)

PMMC, Ohmmeter, Electrodynamometer, Moving iron meter, Rectifier and thermo- instruments, Comparison of various types of indicating instruments.

Module 3: Power and Energy Measurement (03 hours)

Electrodynamometer type of wattmeter and power factor meter, Power in poly phase system: two wattmeter method, Single-phase induction and Electronic energy meters.

Module 4: Resistance Measurement (04 hours)

Measurement of medium, low and high resistances, Megger, Ground resistance measurement, Varley and Murray loop test.

Module 5: Instrument Transformers (03 hours)

Current and Voltage transformers, Constructional features, Ratio and Phase angle errors.

Module 6: Bridge Measurements (07 hours)

AC bridges: Applications and conditions for balance, Maxwell's bridge, Hay's bridge, Schering bridge, Wien's bridge, De Sauty's bridge.

Module 7: Electronic and digital Instruments (10 hours)

Essentials of electronic instruments, Advantages of electronic instruments. True rms reading voltmeter. Electronic multimeters. Digital voltmeters (DVM) - Ramp type DVM, Integrating type DVM, Continuous – balance DVM and Successive - approximation DVM. Q meter. Principle of working of electronic energy meter.

Text Book:

1. Golding, E.W., and Widdis, F.C., Electrical Measurements and Measuring Instruments, Pitman (2003).
2. Helfrick, A.D., and Cooper, W.D., Modern Electronic Instrumentation and Measurement Techniques, Prentice Hall of India (2007).
3. Kalsi, H.S., Electronic Instrumentation, Tata McGraw Hill (2007).
4. Nakra, B.C., Chaudhry, K.K., Instrumentation Measurement and Analysis, Tata McGraw Hill (2003).
5. A.K. Maini, All in One Electronics Simplified, Khanna Publishing House (2018).

PC-IC-402	**SENSORS & TRANSDUCERS**	**3L:0T:0P**	**Credit- 3**

Course Outcome

1. Basic knowledge of physical parameter, electrical parameter and different types of transducers.
2. Understand the working principle of resistive, capacitive, inductive piezoelectric transducer, magnetic sensor and radiation sensor according to basic knowledge of physics.
3. Able to know different types errors in transducer which are arising during measurement, how to eliminate those errors.
4. According to their characteristics which are the suitable sensor for a particular measurement.
5. Acquire the knowledge of design, construction & evolution of different transducer.
6. Know the brief idea of modern technology of transducer in industry.

Module-I (11hours)

Definition, principle of sensing & transduction , classification Mechanical and Electromechanical sensor Resistive (potentiometric type): Forms, material, resolution, accuracy, sensitivity.
Strain gauge: Theory, type, materials, design consideration, sensitivity, gauge factor, variation with temperature, adhesive, rosettes.
· Inductive sensor: common types- Reluctance change type, Mutual inductance change type, transformer action type, Magnetostrictive type, brief discussion with respect to material, construction and input outputvariable,Ferromagnetic plunger type, short analysis.
· LVDT: Construction, material, output input relationship, I/O curve, discussion.

· Proximity sensor.

Module-II (8 hours)

· Capacitive sensors: variable distance-parallel plate type, variable area- parallel plate, serrated plate/teeth type and cylindrical type, variable dielectric constant type, calculation of sensitivity.
· Stretched diaphragm type: microphone, response characteristics.
· Piezoelectric element: piezoelectric effect, charge and voltage co-efficient, crystal model, materials, natural & synthetic type, their comparison, force & stress sensing, ultrasonic sensors.

Module-III (11 hours)

Thermal sensors:
· Material expansion type: solid, liquid, gas & vapor
· Resistance change type: RTD materials, tip sensitive & stem sensitive type,Thermister material, shape, ranges and accuracy specification.
· Thermoemf sensor: types, thermoelectric power, general consideration,
· Junction semiconductor type IC and PTAT type.
· Radiation sensors: types, characteristics and comparison.
· Pyroelectric type

Module-IV (10 hours)

Magnetic sensors:· Sensor based on Villari effect for assessment of force, torque, proximity,Wiedemann effect for yoke coil sensors, Thomson effect, Hall effect, and Hall drive, performance characteristics.
· Radiation sensors: LDR, Photovoltaic cells, photodiodes, photo emissive cell types, materials, construction, response.
· Geiger counters, Scintillation detectors. Introduction to smart sensors.

Text books:

1. Sensor & transducers, D. Patranabis, 2nd edition, PHI
2. Instrument transducers, H.K.P. Neubert, Oxford University press.
3. Measurement systems: application & design, E.A.Doebelin, McGraw Hill.
4. Introduction to Measurements & Instrumentation, A.K.Ghosh, PHI.
5. A.K. Maini, All in One Electronics Simplified, Khanna Publishing House.

PC-IC403	Microprocessor and Microcontroller	3L:0T:0P	3 credits

Detailed contents:

Module	Content	Hour
1	**Introduction to Computer architecture:** Architecture of a typical Microprocessor, Bus configuration, The CPU module, ROM & RAM families, Introduction to assembly language & machine language programming, Instruction set of typical microprocessor (e.g. 8085), Subroutine & stack, Timing diagram, Memory Interfacing, Interfacing input output- port, Interrupt & interrupt handling, Serial & parallel data transfer scheme, Programmed & interrupt driven data transfer, Direct memory access, Programmable peripheral devices, Programmable interval timer, Analog input-output using AD & DA converter.	23
2	**Assembly language programme of a typical Microprocessor:** Use of compilers, assembler, linker & debugger.	5
3	**Basic 16 bit Microprocessor (e.g. 8086):** Architecture, Min-max mode.	4
4	**Introduction to microcontroller**: Architecture & instruction set of a typical microcontroller (e.g. PIC16F84 device), Feature of popular controller (processor 8031/8051), its programming & interfacing.	8

Text Books:

1. Microprocessor architecture, programming & application with 8085, R. Gaonker, Penram International.
2. Advanced Microprocessors and Peripheral, Ajay Kumar Ray, Koshor M Bhurchandi, Tata MC Graw hill Publishing Company.
3. Microprocessor & Interfacing, D.V. Hall, McGraw Hill.
4. The 8051 microcontroller, Ayala, Thomson.

Reference Books:

1. Advanced Microprocessors, Y. Rajasree, New Age international Publishers.
2. An introduction to the Intel family of Microprocessors, James L. Antonakos, Pearson Education.
3. The 8051 Microcontroller and Embedded systems, Muhammad Ali Mazidi& J. G. Mazidi, Pearson Education.
4. The 8086 Microprocessors: Programming & Interfacing the PC, K.J.Ayala, Thomson.
5. Microprocessor & Peripherals, S.P. Chowdhury & S. Chowdhury, Scitech.
6. Microchip technology data sheet, www.microchip.com

Course Outcomes:

At the end of this course students will demonstrate the ability to:-

1. Do assembly language programming
2. Do interfacing design of peripherals like, I/O, A/D, D/A, timer etc.
3. Develop systems using different microcontrollers
4. Understand RSIC processors and design ARM microcontroller based systems

PC-IC-404	**CONTROL SYSTEM-I**	**3L:0T:0P**	**Credit- 3**

Course Objective:
• To introduce different types of system and identify a set of algebraic equations to represent and model a complicated system into a more simplified form to interpret different physical and mechanical systems in terms of electrical system to construct equivalent electrical models for analysis.
• To employ time domain analysis to predict and diagnose transient performance parameters of the system for standard input functions and identify the needs of different types of controllers and compensator to ascertain the required dynamic response from the system
• Formulate different types of analysis in frequency domain to explain the nature of stability of the system.

Detailed contents:

Module 1: (8 lectures)

Concept of feedback and Automatic control, Effects of feedback, Objectives of control system, Examples of feedback control systems, transfer function concept. Pole and Zeroes of a transfer function. Properties of Transfer function, Definition of linear and nonlinear systems, Elementary concepts of sensitivity and robustness. Types of control systems. Block diagram representation of control systems. Block diagram algebra. Signal flow graph. Mason's gain formula Translational systems, Rotational systems, Mechanical coupling, Electrical analogy of Spring– Mass-Dashpot system.

Module 2: (8 lectures)

Time domain analysis of a standard second order closed loop system. Concept of undamped natural frequency, damping, overshoot, rise time and settling time.Dependence of time domain performance parameters on natural frequency and damping ratio. Step and Impulse response of first and second order systems. Effects of Pole and Zeros on transient response. Stability by pole location.

Module 3: (8 lectures)

Routh-Hurwitz criteria and applications. Steady state errors in control systems due to step, ramp and parabolic inputs. Concepts of system types and error constants. Root locus techniques, Construction of Root Loci for simple systems, Effects of gain on the movement of Pole and Zeros, Bode plots, Determination of margins in Bode plot.

Module 4: (8 lectures)

Polar plots, Nyquist criteria, Measure of relative stability, phase andgain margin. Nichols chart, Concept ofresonance frequency of peak magnification. M-circle and M-Contours inNichols chart. Improvement of system performance through compensation. Lead, Lag and Lead- lag compensation, PI, PD control, PID control

Module 5: (8 lectures)

Servomechanisms and regulators, examples of feedback control systems, Potentiometer, Synchros, Resolvers, Position encoders. DC and AC tacho-generators. Actuators. Block diagram level description of feedback control systems for position control, speed control of DC motors, temperature control, liquid level control, voltage control of an Alternator.

Recommended Books:

1. Automatic Control Systems (With Matlab Programs), HASAN SAEED, S. K. Kataria& Sons
2. Control systems, K.R. Varmah, McGraw hill
3. Control System Engineering, D. Roy Chowdhuri, PHI
4. Digital Control system, B.C. Kuo, Oxford University Press.
5. Control System Engineering, I. J. Nagrath& M. Gopal. New AgeInternational Publication
6. Modern Control Engineering, K. Ogata, 4th Edition, Pearson Education
7. Control Systems, A. Ambikapathy, Khanna Publishing House

BSC 401	**Biology**	2L:1T:0P	**3 credits**

Course Outcomes

After studying the course, the student will be able to:

- Describe how biological observations of 18th Century that lead to major discoveries.
- Convey that classification per se is not what biology is all about but highlight the underlying criteria, such as morphological, biochemical and ecological.
- Highlight the concepts of recessiveness and dominance during the passage of genetic material from parent to offspring
- Convey that all forms of life have the same building blocks and yet the manifestations are as diverse as one can imagine.
- Classify enzymes and distinguish between different mechanisms of enzyme action.
- Identify DNA as a genetic material in the molecular basis of information transfer.
- Analyse biological processes at the reductionistic level
- Apply thermodynamic principles to biological systems.
- Identify and classify microorganisms.

Detailed Syllabus:

Module 1:

Introduction (2 hours)

Purpose: To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry. Bring out the fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft. Mention the most exciting aspect of biology as an independent scientific discipline. Why we need to study biology? Discuss how biological observations of 18th Century that lead to major discoveries. Examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor. These examples will highlight the fundamental importance of observations in any scientific inquiry.

Module 2:

Classification (3 hours)

Purpose: To convey that classification per se is not what biology is all about. The underlying criterion, such as morphological, biochemical or ecological be highlighted. Hierarchy of life forms at phenomenological level. A common thread weaves this hierarchy Classification. Discuss classification based on (a) cellularity- Unicellular or multicellular (b) ultrastructure- prokaryotes or eucaryotes. (c) energy and Carbon utilization -Autotrophs, heterotrophs, lithotropes (d) Ammonia excretion – aminotelic, uricotelic, ureotelic (e) Habitata- acquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life. A given organism can come under different category based on classification. Model organisms for the study of biology come from different groups. E.coli, S.cerevisiae, D. Melanogaster, C. elegance, A. Thaliana, M. musculus

Module 3: Genetics (4 hours)

Purpose: To convey that "Genetics is to biology what Newton's laws are to Physical Sciences". Mendel's laws, Concept of segregation and independent assortment. Concept of allele. Gene mapping, Gene interaction, Epistasis. Meiosis and Mitosis be taught as a part of genetics. Emphasis to be give not to the mechanics of cell division nor the phases but how genetic material passes from parent to offspring. Concepts of recessiveness and dominance. Concept of mapping of phenotype to genes. Discuss about the single gene disorders in humans. Discuss the concept of complementation using human genetics.

Module 4:

Biomolecules (4 hours)

Purpose: To convey that all forms of life has the same building blocks and yet the manifestations are as diverse as one can imagine. Molecules of life. In this context discuss monomeric units and polymeric structures. Discuss about sugars, starch and cellulose. Amino acids and proteins. Nucleotides and DNA/RNA. Two carbon units and lipids.

Module 5:

Enzymes (4 Hours)

Purpose: To convey that without catalysis life would not have existed on earth. Enzymology: How to monitor enzyme catalysed reactions. How does an enzyme catalyse reactions? Enzyme classification. Mechanism of enzyme action. Discuss at least two examples. Enzyme kinetics and kinetic parameters. Why should we know these parameters to understand biology? RNA catalysis.

Module 6:

Information Transfer (4 hours)

Purpose: The molecular basis of coding and decoding genetic information is universal. Molecular basis of information transfer. DNA as a genetic material. Hierarchy of DNA structure- from single stranded to double helix to nucleosomes. Concept of genetic code. Universality and degeneracy of genetic code. Define gene in terms of complementation and recombination.

Module 7:

Macromolecular analysis (5 hours)

Purpose: To analyse biological processes at the reductionistic level. Proteins- structure and function. Hierarch in protein structure. Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.

Module 8:

Metabolism (4 hours)

Purpose: The fundamental principles of energy transactions are the same in physical and biological world. Thermodynamics as applied to biological systems. Exothermic and endothermic versus endergonic and exergonic reactions. Concept of Keq and its relation to standard free energy. Spontaneity. ATP as an energy currency. This should include the breakdown of glucose to CO2 + H2O (Glycolysis and Krebs cycle) and synthesis of glucose from CO2 and H2O (Photosynthesis). Energy yielding and energy consuming reactions. Concept of Energy charge.

Module 9.

Microbiology (3 hours) Concept of single celled organisms. Concept of species and strains. Identification and classification of microorganisms. Microscopy. Ecological aspects of single celled organisms. Sterilization and media compositions. Growth kinetics.

Text / References:

1. N. A. Campbell, J. B. Reece, L. Urry, M. L. Cain and S. A. Wasserman, “Biology: A global approach”, Pearson Education Ltd, 2014.

2. E. E. Conn, P. K. Stumpf, G. Bruening and R. H. Doi, “Outlines of Biochemistry”, John Wiley and Sons, 2009.

3. D. L. Nelson and M. M. Cox, “Principles of Biochemistry”, W.H. Freeman and Company, 2012.

4. G. S. Stent and R. Calendar, “Molecular Genetics”, Freeman and company, 1978.

5. L. M. Prescott, J. P. Harley and C. A. Klein, “Microbiology”, McGraw Hill Higher Education, 2005.

HM-HU-401	**VALUES & ETHICS IN PROFESSION**	**2L:0T:0P**	**2 credits**

Science, Technology and Engineering as knowledge and as Social and Professional Activities

Effects of Technological Growth:

Rapid Technological growth and depletion of resources, Reports of the Club of Rome. Limits of growth: sustainable development.
Energy Crisis: Renewable Energy Resources

Environmental degradation and pollution. Eco-friendly Technologies. Environmental Regulations, Environmental Ethics
Appropriate Technology Movement of Schumacher; later developments
Technology and developing notions. Problems of Technology transfer, Technology assessment impact analysis.
Human Operator in Engineering projects and industries. Problems of man, machine, interaction, Impact of assembly
line and automation. Human centered Technology.

Ethics of Profession:

Engineering profession: Ethical issues in Engineering practice, Conflicts between business demands and professional ideals. Social and ethical responsibilities of Technologists. Codes of professional ethics. Whistle blowing and beyond, Case studies.

Profession and Human Values:

Values Crisis in contemporary society
Nature of values: Value Spectrum of a good life.
Psychological values: Integrated personality; mental health.
Societal values: The modern search for a good society, justice, democracy, secularism, rule of law, values in Indian Constitution.
Aesthetic values: Perception and enjoyment of beauty, simplicity, clarity
Moral and ethical values: Nature of moral judgements; canons of ethics; ethics of virtue; ethics of duty; ethics of responsibility.

Books:

1. Premvir Kapoor, Professional Ethics and Human Values, Khanna Publishing House (2018)
2. Stephen H Unger, Controlling Technology: Ethics and the Responsible Engineers, John Wiley & Sons, New York 1994 (2nd Ed)
3. Deborah Johnson, Ethical Issues in Engineering, Prentice Hall, Englewood Cliffs, New Jersey 1991.
4. A N Tripathi, Human values in the Engineering Profession, Monograph published by IIM, Calcutta 1996.

PC-IC-491	**Electrical & Electronic Measurement Lab**	**0L:0T:3P**	**1.5 credits**

1. Instrument workshop- Observe the construction of PMMC, Dynamometer, Electro thermal and Rectifier type of instruments, Oscilloscope and Digital multimeter.

2. Calibrate moving iron and electrodynamometer voltmeter by potentiometer.

3. Calibrate AC energy meter.

4. Measurement of resistance using Kelvin double bridge.

5. Measurement of power using Instrument transformer.

6. Measurement of power in Polyphase circuits.

7. Measurement of Inductance by Anderson bridge

8. Measurement of capacitance by De Sauty Bridge.

9. Measurement of capacitance by Schering Bridge.

PC-IC-492	**SENSORS & TRANSDUCERS LABORATORY**	**0L:0T:3P**	**1.5 credits**

1. Temperature measurement using AD590 Semiconductor temperature sensor.

2. Displacement measurement by Linear Variable Displacement Transducers (LVDT).

3. Study of load cell. (To study the load cell behavior for tensile & compressive load)

4. Torque measurement by Strain Gauge Transducers.

5. Displacement measurement by Magnetic Bi-Polar Digital Position Sensor (using Hall Effect)

6. Measurement of speed using Magnetic Pick-Up Proximity Sensor.

7. Study of LDR.

PC-IC493	**Microprocessor & Microcontroller Lab**	**0L:0T:3P**	**1.5 credits**

Detailed Contents:

1. Familiarization with 8085 register level architecture and trainer kit components including the memory map. Familiarization with process of storing and viewing the contents of memory as well as registers.

2. (a) Study of prewritten program on trainer kit using the basic instruction set (data transfer, load/store, arithmetic, logical)

   (b) Assignment based on that.

3. (a) Familiarization with 8085 simulator on PC

   (b) Study of prewritten program using basic instruction set (data transfer, load/store, arithmetic, logical).

   (c) Assignment based on that.

4. Programming using kit/simulator.

   (a) Lookup table

   (b) Copying a block of memory

   (c) Shifting a block of memory.

   (d) Packing and unpacking of BCD numbers.

   (e) Addition of BCD number

   (f) Binary to ASCII conversion

   (g) String matching

5. Program using subroutine calls and using IN/OUT instruction using 8255 PPI on the trainer kit e.g. subroutine for delay, reading switch state and glowing LEDs accordingly, finding out frequency of pulse train etc.

6. Interfacing any 8 bit latch (74LS373) with trainer kit as a peripheral mapped output port with absolute address decoding.

7. Interfacing with I/O module :

   (a) ADC

   (b) Speed control of DC motor with DAC

   (c) Keyboard

   (d) Multi digit display with multiplexing.

   (e) Stepper motor

8. Study of 8031/8051 Micro controller kit and writing program for the following task using the kit

   (a) table look up

   (b) basic arithmetic and logical operation

   (c) interfacing of keyboard and stepper motor.

PC-IC494	**Control system I Lab**	**0L:0T:3P**	**1.5 credits**

1. Familiarization with MATLAB control system tool box, Simulink tool box & PSPICE

2. Determination of Step response for first order and second order system with unity feedback on CRO and calculation of control system specification: Time constant, percentage peak overshoot, settling time from the response.

3. Determination of Step response and Impulse response for type-0, type-1 and type-2 system with unity feedback using MATLAB/PSPICE.

4. Determination of Root locus, BODE plot, Nyquist plot for 2nd order system & determination of different control system specification from the plot using MATLAB.

5. Determination of PI, PD and PID controller action for first order simulated processes.

6. Evaluation of steady state error, settling time, percentage peak overshoot, gain margin, phase margin, with addition of lead compensator and lag compensator in the forward path transfer function for unity feedback control system.

7. Study of practical position control system and determination of control system specification for different system parameters.