

**TRIPURA UNIVERSITY
(A CENTRAL UNIVERSITY)**

CURRICULUM STRUCTURE

OF

4 YEARS

BACHELOR OF TECHNOLOGY

DEPARTMENT OF ELECTRICAL

ENGINEERING(EE)

5th Semester

2021

5th SEMESTER

Sl. No.	Course Category	Subject Code	Subject Title	L	T	P	Contact Hours/week	Credit	Full Marks
1.	Humanities Science -5	HS501	Professional Practice, Law and Ethics	2	0	0	2	2	100
2.	Program Core-13	PCEE 502	Electrical Machines-II	3	0	0	3	3	100
3.	Program Core-14	PCEE 503	Power System-I	3	0	0	3	3	100
4.	Program Core-15	PCEE 504	Microprocessors & Micro-controller	3	0	0	3	3	100
5.	Program Core-16	PCEE 505	Industrial Measurements and Instrumentation Systems	3	0	0	3	3	100
6.	Program Core-17	PCEE 506	Control Systems	3	0	0	3	3	100
7.	Program Core-18	PCEE 507	Electrical Machines laboratory-II	0	0	4	4	2	100
8.	Program Core-19	PCEE 508	Industrial Measurements and Instrumentation Lab	0	0	2	2	1	100
9.	Program Core-20	PCEE 509	Microprocessors & Microcontroller lab	0	0	2	2	1	100
10.	Summer Internship-	SIEE 510	Industry Internship - I	0	0	0	0	1	100
Total				17	0	8	25	22	1000

PROFESSIONAL PRACTICE, LAW AND ETHICS

Course Code	HS 501
Course Title	Professional Practice, Law & Ethics
Number of Credits	2 (L: 2, T: 0, P: 0)
Prerequisites	-
Course Category	Humanities Science (HS)
Number of classes	26 hours

Course Outcome:- After completion of the course, students will be able to:

CO Number	CO Description	K Level
CO 1	Develop ideas of the professionalism, values and ethics in a profession	K3
CO 2	Develop a good insight into contracts and contracts management in engineering, arbitration and dispute resolution mechanisms	K3
CO 3	Interpret laws governing engagement of labour in construction related works and other related areas	K2
CO 4	Demonstrate an understanding of Intellectual Property Rights and Patents	K2

Module 1: Professionalism, Values and Ethics in Profession (6 hrs)

Professionalism: Professional characteristics, professional education, professional development in Industry. Values and Ethics in Profession- Value system- goodness, means and ends; Ethics-ethical premises, expectation, conflicts and practices; Moral and ego, Ethics and morality Right, virtue ethics and justice, utility and justice, privacy, challenges to privacy, privacy on the Internet. Professional Ethics – Definition of Ethics, Professional Ethics, Business Ethics, Corporate Ethics, Engineering Ethics, Personal Ethics; Code of Ethics as defined in the website of Institution of Engineers (India); Profession, Professionalism, Professional Responsibility, Professional Ethics; Conflict of Interest, Gift Vs Bribery, Environmental breaches, Negligence, Deficiencies in state-of-the-art; Vigil Mechanism, Whistleblowing, protected disclosures.

Module 2: General Principles of Contracts Management and Arbitration (10 hrs)

Indian Contract Act, 1972 and amendments covering General principles of contracting; Valid & Voidable Contracts; Prime and Subcontracts Tenders, Request For Proposals,

Bids & Proposals; Bid Evaluation; Cost escalation; Delays, Suspensions & Terminations; Time extensions & Force Majeure; Delay Analysis; Liquidated damages & Penalties; Insurance & Taxation.

Arbitration, Conciliation and ADR (Alternative Dispute Resolution) system: Arbitration – meaning, scope and types – distinction between laws of 1940 and 1996; Arbitration agreements – essential and kinds, validity, reference and interim measures by court; Arbitration tribunal – appointment, challenge, jurisdiction of arbitral tribunal, powers, grounds of challenge, procedure and court assistance; Award including Form and content, Grounds for setting aside an award, Enforcement, Appeal and Revision.

Module 3: Engagement of Labour & other construction-related Laws (5 hrs)

Role of Labour in Civil Engineering; Methods of engaging labour- on rolls, labour sub-contract, piece rate work; Industrial Disputes Act, 1947; Collective bargaining; Industrial Employment (Standing Orders) Act, 1946; Workmen’s Compensation Act, 1923; Building & Other Construction Workers (regulation of employment and conditions of service) Act (1996) and Rules (1998); RERA Act 2017, NBC 2017

Module 4: Law relating to Intellectual property (5 hrs)

Introduction – meaning of intellectual property, main forms of IP, Copyright, Trademarks, Patents and Designs, Secrets; Copy Rights Act, 1957, Meaning of copyright – computer programs, Ownership of copyrights and assignment, Criteria of infringement, Piracy in Internet – Remedies and procedures in India; Law relating to Patents under Patents Act, 1970 including Concept and historical perspective of patents law in India. Process of obtaining patent – application, examination, opposition and sealing of patents. Duration of patents – law and policy considerations, Infringement and related remedies;

Text/Reference Books:

- 1.B.S. Patil, Legal Aspects of Building and Engineering Contracts, 1974.
2. The National Building Code, BIS, 2017
3. Meena Rao (2006), Fundamental concepts in Law of Contract, 3rd Edn. Professional Offset
4. Neelima Chandiramani (2000), The Law of Contract: An Outline, 2nd Edn. Avinash Publications Mumbai
5. Avtarsingh (2002), Law of Contract, Eastern Book Co. 7. Dutt (1994), Indian Contract

Act, Eastern Law House

6. T. Ramappa (2010), Intellectual Property Rights Law in India, Asia Law House
9. Bare text (2005), Right to Information Act
7. O.P. Malhotra, Law of Industrial Disputes, N.M. Tripathi Publishers
8. Ethics in Engineering- M.W.Martin& R.Schinzinger, McGraw-Hill
9. Engineering Ethics, National Institute for Engineering Ethics, USA.
10. Ethics & Mgmt and Ethos , Ghosh, VIKASH
11. Business Ethics; Concept and Cases, Velasquez, Pearson

ELECTRICAL MACHINES – II

Course Code	PCEE 502
Course Title	Electrical Machines – II
Number of Credits	4 (4L:0T:0P)
Prerequisites	Basic Electrical & Electronics, Electrical Machines – I.
Course Category	Program Core-13
Number of classes	48 hours

Course Outcome:-

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

CO No	CO Description	K-level
CO-1	Understand the concepts of rotating magnetic fields	K2
CO-2	Understand the operation of AC Induction machines	K2
CO-3	Understand the operation of Single-phase induction motors	K2
CO-4	Analyse performance of AC Synchronous machines	K4

Course Content:

Module 1: Fundamentals of AC machine windings and revolving magnetic fields (12 hours)

Physical arrangement of windings in stator and cylindrical rotor; slots for windings; single-turn coil -active portion and overhang; full-pitch coils, concentrated winding, distributed winding, winding axis, 3D visualization of the above winding types, Air-gap MMF distribution with fixed current through winding-concentrated and distributed, sinusoidal distributed winding, winding distribution factor. Constant magnetic field, pulsating magnetic field - alternating current in windings with spatial displacement, Magnetic field produced by a single winding - fixed current and alternating current Pulsating fields produced by spatially displaced windings, Windings spatially shifted by 90 degrees, of pulsating magnetic fields, Three windings spatially shifted by 120 degrees (carrying three-phase balanced currents), revolving magnetic field.

Module 2: Induction Machines(12 hours)

Construction, Types (squirrel cage and slip-ring), Torque Slip Characteristics, Starting and Maximum Torque. Equivalent circuit. Phasor Diagram, Losses and Efficiency. Effect of parameter variation on torque speed characteristics (variation of rotor and stator resistances, stator voltage, frequency). Methods of starting, braking and speed control for induction motors. Generator operation. Self-excitation. Doubly-Fed Induction Machines.

Module 3: Single-phase induction motors (12 hours)

Constructional features, double revolving field theory, equivalent circuit, determination of parameters. Starting methods, Split-phase starting methods and applications, starting & running characteristics. Stepper Motor: Principle of operation, Different types, Constructional features, Different characteristics, Applications.

Module 4: Synchronous machines (12 hours)

Constructional features, cylindrical rotor synchronous machine - generated EMF, equivalent circuit and phasor diagram, armature reaction, synchronous impedance, voltage regulation. Operating characteristics of synchronous machines, V-curves. Salient pole machine - two reaction theory, analysis of phasor diagram, power angle characteristics. Parallel operation of alternators -synchronization and load division.

References / Suggested Learning Resources:

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", McGraw Hill Education, 2013.
2. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
3. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
4. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.
5. A. S. Langsdorf, "Alternating current machines", McGraw Hill Education, 1984.

POWER SYSTEM I

Course Code	PCEE 503
Course Title	Power System I
Number of Credits	03 (3L:0T:0P)
Prerequisites	Basic circuit laws, Engineering Mathematics & Physics.
Course Category	Program Core (PC)
Number of classes	38

Course Outcomes:

After Completing this course, students will be able to		Knowledge Level
CO -1	Understand the concepts of power systems.	K2
CO -2	Understand the various power system components.	K2
CO-3	Understand the insulation and coordination generation of over-voltages.	K2
CO -4	Evaluate fault currents for different types of faults.	K5

Course Content:

Module 1: Basic Concepts (8 hours)

Evolution of Power Systems and Present-Day Scenario. Structure of a power system. Conventional and Renewable Energy Sources. Distributed Energy Resources. Transmission and Distribution Systems- DC 2 –wire and 3 – wire systems, AC single phase, three phase and 4-wire systems, Comparison of copper efficiency. Distribution Systems: primary and secondary distribution systems, concentrated & uniformly distributed loads on distributors fed at one and both ends, ring distribution, sub-mains and tapered mains, voltage drop and power loss calculations, voltage regulators.

Module 2: Power System Components (13 hours)

Overhead Transmission Lines and Cables: Electrical and Magnetic Fields around conductors, Parameters of lines and cables. Capacitance and Inductance calculations for simple configurations. Types of Conductors, Classification of transmission lines. Characteristics of transmission lines: Generalized ABCD constants and equivalent circuits of short, medium and long lines. Line Performance: regulation and efficiency of short, medium and long lines, Power factor improvement.

Module 3: Insulation and Over Voltages (10 hours)

Overhead Line Insulators- Types, string efficiency, voltage distribution in string of suspended insulators, grading ring, preventive maintenance. Mechanical Design of Transmission Lines- Different types of tower. Sag-tension calculations. Generation of Over-voltages: Lightning and Switching Surges. Corona-corona losses, radio & audio noise, transmission line –

communication line interference.

Module 4: Fault Analysis and Tariffs (10 hours)

Method of Symmetrical Components (positive, negative and zero sequences). Per unit System Balanced and unbalanced Faults. Representation of generators, lines and transformers in sequence networks. Computation of fault Currents. Tariffs & Load Curves- Definition & different tariffs for domestic, commercial, industrial application, Different Load and Load duration curves and their significance. Location of substation and grid substation.

References/Suggested Learning Resources:

1. Grainger John, J. and Stevenson, Jr. W.D., "Power System Analysis", McGraw Hill, 1994.
2. Harder Edwin, I., "Fundamentals of Energy Production", John Wiley and Sons, 1982.
3. Deshpande, M.V., "Elements of Electric Power Station Design", A.H. Wheeler and Co. Allahabad, 1979.
4. Burke James, J., "Power Distribution Engineering; Fundamentals and Applications" Marcel Dekker 1996.
5. Chakraborty, Soni, Gupta & Bhatnagar, "Power System Engineering", Dhanpat Rai & Co.
6. Wadhwa, C.L., "Electric Power Systems", Second Edition, Wiley Eastern Limited, 1985.
7. Nagrath, I.J. and Kothari, D.P., "Power System Engineering", Tata McGraw Hill, 1995.

MICROPROCESSOR AND MICROCONTROLLER

Course Code	PCEE 504
Course Title	Microprocessors & Micro-controller
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	10+2 Mathematics & Physics, Digital Electronics
Course Category	Program Core (PC)
Number of Classes	38 hours

Course Outcome: After Completion of this course students will able to

CO Number	CO Description	K-level
CO-1	Understand the Architecture and Instruction set of 8085 Microprocessor.	K2
CO-2	Illustrate the Architecture and Instruction set of 8086 Microprocessor.	K2
CO-3	Analyse the operation of Microprocessor with Interfacing Circuits.	K4
CO-4	Understand the Architecture and Instruction sets of 8051 Microcontroller.	K2

Module 1: Introduction to 8 Bit Microprocessors (12 hours)

Introduction to 8085 Microprocessor, Architecture-Register organization, Pin description and features of 8085 Microprocessor. Interrupts of 8085. Instruction Set, Addressing Modes, T States, Instruction Cycle, Machine Cycles, stack operation & subroutine, Examples of programming in assembly language.

Module 2: Architecture and Instruction set of 8086 Microprocessor (8 Hours)

8086 Architecture, Functional diagram, Register Organisation, Memory segmentation, Architecture of 8086, Signal Description of 8086, Timing Diagrams, Interrupts of 8086, Instruction Set.

Module 3: Microprocessor-Interfacing Circuits (10 Hours):

Interfacing of support chips with 8085 Microprocessor & their applications: Programmable Peripheral Interface 8255 & 8155, Programmable timer/counter (8253), Programmable Keyboard and display controller 8279, DMA Controller 8257, I/O interfacing of ADC & DAC chips, Generation of different periodic signals using DAC.

Module 4: 8051 Architecture and its Instruction set (8 Hours):

Internal Block Diagram, CPU, ALU, address, data and control bus, Working registers, SFRs, Clock and RESET circuits, Stack and Stack Pointer, Program Counter, I/O ports, Memory Structures, Data and Program Memory, Timing diagrams and Execution Cycles Addressing modes of 8051 Microcontroller. 8051 Instruction sets.

References / Suggested Learning Resources:

1. Ramesh S. Gaonkar, Microprocessor Architecture, Programming and Applications with the 8085A/8080A, Wiley Eastern Limited.
2. The 8051 Microcontroller and Embedded Systems: Using Assembly and C, by Muhammad-Ali Mazidi, Janice Gillispie Mazidi and Rolin McKinlay, Pearson Education.
3. K. J. Ayala, "8051 Microcontroller", Delmar Cengage Learning, 2004. 3. R. Kamal, "Embedded System", McGraw Hill Education, 2009.
4. D. V. Hall, "Microprocessors & Interfacing", McGraw Hill Higher Education, 1991.

INDUSTRIAL MEASUREMENTS AND INSTRUMENTATION SYSTEMS

Course Code	PCEE-505
Course Title	Industrial Measurements and Instrumentation Systems
Number of Credits	3 (L : 3, T :0, P:0)
Prerequisites	Basic Electrical Engineering, Analog Electronics.
Course category	Program Core-16
Number of Classes	38 Hours

Course outcomes

CO Number	Corse description	K-level
	After the completion of the course students will be able to	
PCEE-505:OC.01	Understand the different measurement techniques for industries using Sensors & Transducers.	K2
PCEE-505:OC.02	Understand the Measurements techniques for flow, Level and Pressure.	K2
PCEE-505:OC.03	Analyse the techniques for using the PLC for Industrial Systems.	K4
PCEE-505:OC.04	Examine the techniques for controlling different variables for Industrial Systems.	K4

Module 1: Sensors & Transducers –characteristic and their implementation (11 Hours)

Sensors & Transducers- classifications and characteristics, Linearization of sensors. Measurement of displacement using linear variable differential transducers (LVDTs), Introduction to rotary variable differential transducers (RVDTs), Strain Gauge-its characteristics & working Principles, Capacitive transducers: variable air gap, variable plate overlap, variable dielectric. Level gauge, Thickness gauge. Thermocouples-classifications, characteristics and its compensation technique, Signal conditioning circuits for capacitive transducers: reactive bridges, transformer ratio bridges, Piezoelectric transducers: fundamental concepts, materials, charge sensitivity, voltage sensitivity.

Module 2: Measurements of Flow, Pressure and Level for Industries (10 hrs.)

Measurement of flow. Hot wire anemometers: constant-current and constant temperature varieties for measurement of static and dynamic flow rate. Dynamic compensation. Electromagnetic flow meters: dc, ac and interrupted dc excitation for magnet system. Pressure transducers: Primary sensing elements: bourdon tube, diaphragm, bellows. Electronic pressure gauges. Level Measurement techniques. Industrial Standard Current to Pressure and Pressure to Current converters-their constructions and their working principles.

Module 3: Programmable Logic Controller and its Programming Techniques (8 Hours.)

Introduction to Programmable logic Controllers (PLC): Architecture and functional components, I/O Processing Methodologies, Programming Languages. Sequence Function Chart, Relay logic and switching algebra, Ladder diagram representation of sequential systems & design, PLC input/output Diagram. Applications of PLC in Industries-case studies.

Module 4: Instrumentation & control techniques of Flow, Pressure, Level in Industries. (9 Hours.):

Concepts of Industrial instrumentation Systems for industrial production processes and their terminologies, Industrial Process dynamics of different type of Industrial production processes. Modeling of Standard first order Industrial production processes, instrumentation systems for flow rate control, level control, temperature Control and Pressure control. Time and frequency responses of standard first order Industrial production process systems with and without delay.

References / Suggested Learning Resources:

1. Anand, M.M.S., Electronic Instruments & Instrumentation techniques, PHI, 2004
2. D. Patranabish, Industrial Industrial Instrumentation
3. Krishna Kanth, Computer based Industrial Control, PHI, 2005.
4. SeborG-Edgar-Doyle, Process Dynamics and Control, John wiley, 2011
5. C. D. Johnson, Process Control Instrumentation Technology, PHI, 2004
6. Gray Dunning, Introduction of Programmable Logic Controller, Thomson Press, 2005.
7. Surekha Bhanot, Process Control Principal and Applications, PHI, 2008.
8. Chemical Process Control, Stephanopoulous, PHI, 1984

CONTROL SYSTEMS

Course Code	PCEE 506
Course Title	Control Systems
Number of Credits	3 (L : 3, T :0, P:0
Prerequisites	Analog Electronics, Electrical Circuits Analysis and Practical experience of Basic Measurements.
Course category	Program Core-17
Number of Classes	38

Course outcomes

CO Number	Corse description	K-level
	After the completion of the course students will be able to	
PCEE-506:OC.01	Understand the modeling & characteristics of time response of control systems.	K2
PCEE-506:OC.02	Understand about AC & DC Servomechanisms and	K2

	frequency response analysis of closed loop systems.	
PCEE-506:OC.03	Analyse the Stability of control Systems and their necessity in control systems.	K4
PCEE-506:OC.04	Illustrate the State Variable Analysis of Control Systems for applications in higher courses of Electrical Engineering.	K2

Module 1: Introduction to control problem and Time Response Analysis (10 hours):

Introduction to Control Systems: Classification of control systems with examples. Block diagram representation and Signal flow graph representation of Systems. Properties of Control Systems: System dynamics, sensitivity, steady-state & transient errors, Error constants, System types. Time response of system: Time domain specifications, Step response of second order system, concept of dominant poles, Effect of addition of Poles & Zeroes in second Order Systems. Basic Control actions: Proportional, integral, derivative, and their combinations.

Module 2: Control System Components and frequency response of systems (8-Hours.)

Control System Components: DC & AC Servo motors, Amplidyne, Synchros, Position & velocity Sensors, encoders, Gears and different Mechanical Parameters, Examples of DC and AC servomechanisms, Effect of velocity feedback with or without controller. Frequency response of Second order System: Frequency Domain Specifications in open loop, closed loop systems and their significance, Concept of Bandwidth and Cut-off frequency, frequency responses of different function of Systems.

Module 3: Stability analysis of Control Systems (10 Hours)

Concept of Stability of Control Systems: Routh-Hurwitz Criteria. Relative Stability analysis. Root-Locus technique. Construction of Root-loci. Relationship between time and frequency response in Control systems, Stability analysis: Polar plots, Bode plots. Nyquist stability criterion. Relative stability using Nyquist criterion – gain and phase margins.

Module 4: State variable Analysis of Control Systems(10 Hours)

Concepts of state variables. State space model. Diagonalisation of System Matrix. Solution of state equations. Representation of State space systems in cascade form, Parallel form, Controllable canonical form and Observable canonical form. Eigen values, Eigen Vectors and concept of Modal Matrix, Concepts of controllability and Observability with physical examples. Testing methods of Controllability & Observability, Control law design for full state feedback design of linear control systems, Pole-placement by state feedback.

References / Suggested Learning Resources:

1. Norman S. Nise, Control Systems Engineering, 6th edition, Wiley, 2011.
2. I.J. Nagrath and M. Gopal, Control Systems Engineering, 5th edition, New Age International, 2009.

3. D. Roy Chowdhury, Modern Control Engineering, PHI Publication.
4. Benjamin C. Kuo and Farid Golnaraghi, Automatic Control Systems, 9th edition, Wiley; 2009.
5. M. Gopal, Control Systems Principles and Design, 3rd edition, Tata Mgraw Hill, 2008.
6. Naresh K. Sinha, Control Systems, 3rd edition, New Age International, 2004.
7. Richard C. Dorf and Robert H. Bishop, Modern linear Control Systems, 12th Edition
8. B. C. Kuo, Digital Control System.
9. Ogata, Discrete Data Control System.

ELECTRICAL MACHINES LAB-II

Course Code	PCEE 507
Course Title	Electrical Machines Lab-II
Number of Credits	1(0L:0T:2P)
Prerequisites	Theory of AC Machines
Course Category	Program Core-18
Number of classes	24 hours

Course Outcome:

After end of the lab course students will be able to

CO Number	CO Description	K-level
CO-1	Experiment with synchronous motors for obtaining different parameters	K3
CO-2	Demonstrate various tests on alternators and obtain their performance indices using standard analytical as well as graphical methods.	K2
CO-3	Demonstrate various tests on induction machines.	K2
CO-4	Apply the knowledge synchronous motor and induction motor in different area.	K3

Course Content:

List of experiments

1. To Perform the Brake Test 3 Phase AC Induction Motor.
2. To Perform the No load and Blocked Rotor Test on 3-Phase AC Induction Motor.
3. To Perform the No load and Blocked Rotor Test of Single Phase Induction Motor.
4. To study the V-curve of Synchronous Motor.
5. To study the Inverse V-curve of Synchronous Motor.

6. To observe the effect of excitation and speed on induced e.m.f of a three-phase alternator and plot the O.C.C. of the alternator.
7. To observe the effect of excitation and speed on armature current of a three-phase alternator and plot the S.C.C. of the alternator.
8. To Observe the Pre Determination of Regulation of Synchronous Machine by EMF and MMF Method.
9. To Observe the Predetermination of Regulation of Alternator by ZPF Method.
10. To Observe the Synchronization of alternator with main power supply or another alternator.
11. To Observe the Determination of Transient and Sub transient Reactance of synchronous generator.
12. To Study of characteristics of SCR based speed control of squirrel cage 3-phase Induction motor at different firing angles.
13. To Study of static Kramer drive using slip-ring Induction motor at different Electric loads.
14. To Study the Open and Closed loop speed control of IGBT based 3-phase squirrel cage Induction motor keeping the constant V/f ratio.

References / Suggested Learning Resources:

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", McGraw Hill Education, 2013.
2. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
3. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
4. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.
5. A. S. Langsdorf, "Alternating current machines", McGraw Hill Education, 1984.

**INDUSTRIAL MEASUREMENTS AND INSTRUMENTATION
LABORATORY**

Course Code	PCEE-508
Course Title	Industrial Measurements and Instrumentation laboratory
Number of Credits	1(L : 0, T :0, P:2)
Prerequisites	Hand on Practices on laboratory Experiments of Basic Electrical Engineering, Analog Electronics Laboratory.
Course category	Program Core-20
Number of Classes	24 Hours

Course outcomes

CO Number	Corse description	K-level
	After the Completion of the Course students will be able to	
PCEE-508:OC.01	Describe different measurement techniques for industries using Sensors & Transducers.	K2
PCEE-508:OC.02	Apply the knowledge of different techniques for measurement of flow, Level and Pressure.	K3
PCEE-508:OC.03	Examine the techniques of PLC system for Industrial application.	K4
PCEE-508:OC.04	Understand the techniques for controlling different variables for Industrial Systems using Instrumentation Systems.	K2

List of Experiments

1. Study of Measurements of Temperature using Thermocouple and its compensation technique.
2. Study of Characteristics of LVDT and Linear Variable Capacitor (LVC) for the measurement of displacement.
3. Study of Characteristics of Strain Gauge by developing Analog Circuit.
4. Hand on practices on Programming techniques of PLC.
5. Hand on practice on Programming PLC for bidirectional rotation of a Small incremental D.C. Motor and also for sorting the Sizes of Metallic pieces on a moving Conveyor belt.
6. Experiment for the Measurements of flow rate and its control techniques.
7. Experiment for the Measurements of Level of liquid and its control techniques.
8. Experiment for the Measurement of Air Pressure and its control techniques.

References / Suggested Learning Resources:

1. Anand, M.M.S., Electronic Instruments & Instrumentation techniques, PHI, 2004
2. D. Patranabish, Industrial Industrial Instrumentation
3. Krishna Kanth, Computer based Industrial Control, PHI, 2005.
4. SeborG-Edgar-Doyle, Process Dynamics and Control, John wiley, 2011
5. C. D. Johnson, Process Control Instrumentation Technology, PHI, 2004
6. Gray Dunning, Introduction of Programmable Logic Controller, Thomson Press, 2005.
7. Surekha Bhanot, Process Control Principal and Applications, PHI, 2008.
8. Chemical Process Control, Stephanopoulous, PHI, 1984

MICROPROCESSORS AND MICROCONTROLLER LAB

Course Code	PC EE 509
Course Title	Microprocessors and Microcontroller Lab
Number of Credits	1 (L: 0; T: 0; P: 2)
Prerequisites	Microprocessors and Microcontroller
Course Category	Program Core-20
Number of Classes	24

Course Outcome: After Completion of this course students will able to

CO Number	CO Description	K-level
CO-1	Develop Simple programming in Assembly Language of 8085 Microprocessor.	K3
CO-2	Build the connection of peripheral devices with microprocessor using Programming in Assembly level Language	K3
CO-3	Apply ADC and DAC to find various parameters/waveforms	K3
CO-4	Analyze, comprehend, design microprocessor/microcontroller based systems used for control and monitoring.	K4

Course Content:

List of experiments

1. Hands on practices of Simple programming in Assembly Language of 8085 Microprocessor.
2. Study of 8255 PPI in Input/output (I/O) and Bit set Reset (BSR) Modes using Programming in Assembly level Language of 8085 Microprocessor.
3. Study of 8253 timer / Counter in different Modes using programming in Assembly level Language of 8085 Microprocessor.
4. Study of DMA Mode of data transfer techniques using Programming in Assembly level language of 8085 Microprocessor.
5. Measurement of Voltage, Current & physical quantities with the help AD Conversion technique using Programming in Assembly level language of 8085 Microprocessor.
6. Generation of different periodic wave forms with the help of D/A Conversion technique using Programming in Assembly level language of 8085 Microprocessor.
7. Study of Speed control of Small Incremental DC servo motor / Stepper Motor using Programming in Assembly level language of 8085 Microprocessor.
8. Study of interfacing & triggering techniques of SCRs at different angles using Micro-processor based programming in Assembly language of 8085 Microprocessor//8051 Microcontroller.
9. Study of interfacing & characteristics of SCR based Half controlled /Fully controlled converter using Micro-processor based Programming in Assembly level language

of 8085 Microprocessor/8051 Microcontroller

References / Suggested Learning Resources:

1. Ramesh S. Gaonkar, Microprocessor Architecture, Programming and Applications with the 8085A/8080A, Wiley Eastern Limited.
2. The 8051 Microcontroller and Embedded Systems: Using Assembly and C, by Muhammad-Ali_Mazidi, Janice Gillispie Mazidi and Rolin McKinlay, Pearson Education.
3. K. J. Ayala, “8051 Microcontroller”, Delmar Cengage Learning, 2004. 3. R. Kamal, “Embedded System”, McGraw Hill Education, 2009.
4. D. V. Hall, “Microprocessors & Interfacing”, McGraw Hill Higher Education, 1991.

INDUSTRY INTERNSHIP – I

Course Code	SI EE 510
Course Title	Industry Internship – I
Number of Credits	1 (L: 0, T: 0, P: 0)
Prerequisites	Nil
Course Category	Summer Internship (SI)
Number of classes	-

Course Outcome:-

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

CO Number	CO Description	K-level
CO-1	Solve real life challenges in the workplace by analysing work environment and conditions, and selecting appropriate skill sets acquired from the course of study	K3
CO-2	Develop a right work attitude, self-confidence, interpersonal skills and ability to work as a team in a real organisational setting	K3
CO-3	Demonstrate the skill to communicate and collaborate effectively and appropriately with different professionals in the work environment through written and oral means	K2
CO-4	Show professional ethics by displaying positive disposition during internship.	K2
CO-5	Decide career options by considering opportunities in company, sector, industry, professional, educational advancement and entrepreneurship;	K5

Course Content:-

The industry internship aims to provide the student with:

1. A practice-oriented and 'hands-on' working experience in the real world or industry, and to enhance the student's learning experience.
2. An opportunity to develop a right work attitude, self-confidence, interpersonal skills and ability to work as a team in a real organisational setting.
3. An opportunity to further develop and enhance operational, customer service and other life-long knowledge and skills in a real world work environment.
4. Pre-employment training opportunities and an opportunity for the company or organisation to assess the performance of the student and to offer the student an employment opportunity after his/her graduation, if it deems fit.

Each student shall

- 1) Identify an internship program of relevance in his/her branch of engineering to undergo during summer break between 4th and 5th semester,
- 2) Get approval of the concerned HOD,
- 3) Undergo the industry internship program for minimum 4 weeks duration
- 4) Prepare their own report
- 5) Present in the class among fellow students and faculty members / deliver viva voce.
- 6) Submit the report and participation/course completion certificate.