SHRI VENKATESHWARA UNIVERSITY

Syllabus

Diploma

(Electrical Engineering)
V SEMESTER
(THREE Years Programme)

(w.e.f. 2019-20)

SCHOOL OF ENGINEERIN & TECHNOLOGY

SEMESTER- IV

Electrical Engineering SEMESTER V													
Sl. No.	Subject Codes	Subject	Periods			Evaluation Scheme				End Semester		Total	Credit
			L	T	P	CT	TA	Total	PS	TE	PE		
1	PEE- 501	Microcontroller Applications	3	0	0	20	10	30		70		100	3
2	PEE- 502	Energy Conservation and Audit	3	0	0	20	10	30		70		100	3
3	PEE-503	INDUSTRIAL AUTOMATION AND CONTROL	2	1	0	20	10	30		70		100	3
4	PEE-504	ELECTRICAL TESTING AND COMMISIONING	3	0	0	20	10	30		70		100	3
5	POE-051	Operations Research	3	0	0	20	10	30		70		100	3
6	PEE- 511	Microcontroller Applications Lab	0	0	2				10		15	25	1
7	PEE- 512	Energy Conservation and Audit Lab	0	0	2				10		15	25	1
8	PEE- 513	INDUSTRIAL AUTOMATION AND CONTROL Lab	0	0	2				10		15	25	1
9	PEE- 514	ELECTRICAL TESTING AND COMMISIONING Lab	0	0	2				10		15	25	1
10	PEE- 515	Summer Internship - II	0	0	0				50			50	3
11	PEE-516	Project Phase-I	0	0	4				50		50	100	2
	Summer Internship-II (6 weeks) after IV Sem											750	24

Course Code		*PPE-501*
Course Title		*MICROCONTROLLER APPLICATIONS*
Number of Credits		*3 (L: 3, T: 0, P: 0)*
Prerequisites (Course code)		*NIL*
Course Category		*PC*

Course objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- *Maintain different types of microcontroller based systems.*

Course contents:

Unit – I Introduction to Microcontrollers

Evolution of Microcontrollers block diagram of Microcomputer, elements of Microcomputer, types of buses Von Neuman and Harward Architecture
Compare Microprocessor and Microcontrollers Need of

Microcontroller

Family of Microcontrollers and their specifications

Versions of Microcontroller 8951, 89C1051, 89C2051, 89C4051 with their specifications and comparison

Unit – II Architecture of Microcontroller8051 *Block*

diagram of 8051, function of each block Pin diagram,

function of each pin

Concept of Internal memory and External memory (RAM and ROM)

Internal RAM structure Reset and clock circuit

Various registers and SFRs of 8051

Unit– III 8051 Instruction Set and Programs *Overview*

of 8051 instruction set Various addressing modes

Classification of instructions

Data transfer instructions Arithmetic instructions Logical

instructions Branching instructions

Bit manipulation instructions

Stack, subroutine and interrupt related instructions

Programs based on above instructions.

Unit– IV Assembly Language Programming

Software development steps

Software development tools like Editor, Assembler, Linker, Loader and Hex

converters.

Role of various files created at various levels in running a Assembly program using

simulators like RIDE or KEIL.

Various directives of Assembly language programming

Programs using directives.

Unit– V 8051 Internal Peripherals and Related Programs

I/O ports- List, diagram, read write operation, instructions and related SFRs Timers/counters – list, related SFRs, programming modes, operations with diagram.

Serial communication- Basics of serial communication, baud rate, related SFRs, program- ming modes, operations with diagram.

Interrupts- related SFRs, types, operations with diagram.

Power saving operation- modes, related SFR.

References:

1. *Kenneth, Ayala, 8051 Microcontroller Architecture Programming and Application, PHI Learning, New Delhi,ISBN: 978-1401861582*
2. *Mazidi, Mohmad Ali; Mazidi, Janice Gelispe; MckinlayRoline D., The 8051 Microcontroller and Embedded system, Pearson Education, Delhi, ISBN 978-8177589030*
3. *Pal, Ajit, Microcontroller Principle and Application, PHI Learning, New Delhi, ISBN13: 978-81- 203-4392-4*
4. *Deshmukh, Ajay, Microcontroller Theory and Application, McGraw Hill., New Delhi, ISBN- 9780070585959*
5. *Kamal, Raj, Microcontroller Architecture Programming, Interfacing and System Design, Pearson Education India, Delhi, ISBN: 9788131759905*
6. *Mathur; Panda, Microprocessors and Microcontrollers, PHI Learning, New Delhi, ISBN:978-81- 203-5231-5*
7. *Krishna Kant, Microprocessors and Microcontrollers: Architecture programming and System Design, PHI Learning, New Delhi, ISBN:978-81-203-4853-0*

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a) *Interpret the salient features of various types of microcontrollers.*
b) *Interpret the salient features of architype of types microcontrollers IC 8051*
c) *Maintain the program features of the Microcontroller based application*
d) *Develop assembly language program*
e) *Develop programs to interface 8051 microcontrollers with LED/SWITCH*

Course Code		***PEE-502***
Course Title		***ENERGY CONSERVATION AND AUDIT***
Number of Credits		***3 (L: 3, T: 0, P: 0)***
Prerequisites		***NIL***
Course Category		***PC***

Course objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- *Undertake energy conservation and energy audit.*

Course contents:

Unit – I Energy Conservation Basics

Energy Scenario: Primary and Secondary Energy, Energy demand and supply, National scenario.

Energy conservation and Energy audit; concepts and difference Indian Electricity Act 2001; relevant clauses of energy conservation BEE and its Roles

MEDA and its Roles

Star Labelling: Need and its benefits.

Unit – II Energy Conservation in Electrical Machines

Need for energy conservation in induction motor and transformer. Energy conservation techniques in induction motor by:Improving Power quality.

Motor surve Matching motor with loading.

Minimizing the idle and redundant running of motor.

Operating in star mode.

Rewinding of motor.

Replacement by energy efficient motor

Periodic maintenance

Energy conservation techniques in Transformer.

Loading sharing

Parallel operation

Isolating techniques.

Replacement by energy efficient transformers. Periodic maintenance.

Energy Conservation Equipment: Soft starters, Automatic star delta convertor, Variable Frequency Drives, Automatic p. f. controller (APFC), Intelligent p. f. controller (IPFC)

Energy efficient motor; significant features, advantages, applications and limitations.

Energy efficient transformers, amorphous transformers; epoxy Resin cast transformer / Dry
type of transformer.

Unit– III Energy conservation in Electrical Installation systems

Aggregated Technical and commercial losses (ATC); Power system at state, regional, national and global level.

Technical losses; causes and measures to reduce by.

a) *Controlling I^2R losses.*
b) *Optimizing distribution voltage*
c) *Balancing phase currents*
d) *Compensating reactive power flow*

Commercial losses: pilferage, causes and remedies

Energy conservation equipment: Maximum Demand Controller , kVAR Controller, Automatic
Power Factor controller(APFC)

Energy Conservation in Lighting System

a) *Replacing Lamp sources.*
b) *Using energy efficient luminaries.*
c) *Using light controlled gears.*
d) *Installation of separate transformer / servo stabilizer for lighting.*
e) *Periodic survey and adequate maintenance*

programs. Energy Conservation techniques in fans, Electronic
regulators.

Unit– IV Energy conservation through Cogeneration and Tariff

Co-generation and Tariff; concept, significance for energy conservation

Co-generation

Types of cogeneration on basis of sequence of energy use (Topping cycle, Bottoming cycle)

Types of cogeneration basis of technology (Steam turbine cogeneration, Gas turbine cogene- ration, Reciprocating engine cogeneration).

Factors governing the selection of cogeneration system.

Advantages of cogeneration.

Tariff: Types of tariff structure: Special tariffs; Time-off-day tariff, Peak-off-day tariff, Power
factor tariff, Maximum Demand tariff, Load factor tariff.

Application of tariff system to reduce energy bill.

Unit– V Energy Audit of Electrical System

Energy audit (definition as per Energy Conservation Act)

Energy audit instruments and their use.

Questionnaire for energy audit projects. Energy
flow diagram (Sankey diagram)

Simple payback period, Energy Audit procedure (walk through audit and detailed audit). Energy Audit report format.

References:

1. *Guide Books No. 1 and 3 for National Certification Examination for Energy Managers and Energy Auditors, Bureau of Energy Efficiency (BEE), Bureau of Energy Efficiency (A Statutory body under Ministry of Power, Government of India) (Fourth Edition 2015).*
2. *O.P. Gupta, Energy Technology, Khanna Publishing House, New Delhi*
3. *Henderson, P. D., India - The Energy Sector, University Press, Delhi, 2016. ISBN: 978-0195606539*
4. *Turner, W. C., Energy Management Handbook, Fairmount Press, 2012, ISBN 9781304520708*
5. *Sharma, K. V., Venkataseshaiah; P., Energy Management and Conservation, I K International Publishing House Pvt. Ltd; 2011 ISBN 9789381141298*
6. *Mehta ,V. K., Principles of Power System, S. Chand &Co.New Delhi, 2016, ISBN 9788121905947*
7. *Singh, Sanjeev; Rathore, Umesh, Energy Management, S K Kataria&Sons,New Delhi ISBN-13: 9789350141014.*
8. *Desai, B. G.; Rana, J. S.; A. Dinesh, V.; Paraman, R., Efficient Use and Management of Electricity in Industry, Devki Energy Consultancy Pvt. Ltd.*
9. *Chakrabarti, Aman, Energy Engineering And Management, e-books Kindle Edition*

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a) *Interpret energy conservation policies in India.*
b) *Implement energy conservation techniques in electrical machines.*
c) *Apply energy conservation techniques in electrical installations.*
d) *Use Co-generation and relevant tariff for reducing losses in facilities.*
e) *Undertake energy audit for electrical system.*

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Course Code		***PEE-503***
Course Title		***INDUSTRIAL AUTOMATION AND CONTROL***
Number of Credits		***3 (L: 3, T: 0, P: 0)***
Prerequisites		***NIL***
Course Category		***PE***

Course objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- *Maintain Industrial Automation Systems.*

Course contents:

Unit – I Introduction to Industrial Automation

Automation: Need and benefits.

Types of automation system: Fixed, Programmable, Flexible

Different systems used for Industrial automation: PLC, HMI, SCADA, DCS, Drives. Evolution of PLC.

Unit – II PLC Fundamentals

Building blocks of PLC: CPU, Memory organization, Input- output modules (discrete and ana- log), Specialty I/O Modules, Power supply

Fixed and Modular PLC and their types, Redundancy in PLC module

I/O module selection criteria

Interfacing different I/O devices with appropriate I/O modules

Unit– III PLC Programming and Applications

PLC I/O addressing

PLC programming Instructions: Relay type instructions, Timer instructions: On delay, off de- lay, retentive, Counter instructions: Up, Down, High speed, Logical instructions, Comparison Instructions, Data handling Instructions, Arithmetic instructions.

PLC programming language: Functional Block Diagram (FBD), Instruction List. Structured text, Sequential Function Chart (SFC), Ladder Programming.

Simple Programming examples using ladder logic: Language based on relay, timer counter, logical, comparison, arithmetic and data handling instructions.

PLC Based Applications: Motor sequence control, Traffic light control, Elevator control, Tank Level control, Conveyor system, Stepper motor control, Reactor Control Gate trigger circuits – Resistance and Resistance-Capacitance circuits.

Unit– IV Electric Drives and special machines

Electric drives: Types, functions, characteristics, four quadrant operation. DC and AC drive controls: V/F control, Parameters, direct torque control. Drives: Specifications, Applications- Speed control of AC motor /DC Motor.

Unit– V Supervisory Control and Data Acquisition System (SCADA)

Introduction to SCADA: Typical SCADA architecture/block diagram, Benefits of SCADA

Various editors of SCADA

Interfacing SCADA system with PLC: Typical connection diagram, Object Linking & embed- ding for Process Control(OPC) architecture, Steps in Creating SCADA Screen for simple ob- ject, Steps for Linking SCADA object (defining Tags and Items) with PLC ladder program us- ing OPC.

Applications of SCADA: Traffic light control, water distribution, pipeline control.

References:

1. *Dunning, G., Introduction to Programmable Logic Controllers, Thomson /Delmar learning, New Delhi, 2005,ISBN 13 : 9781401884260*
2. *Jadhav, V. R., Programmable Logic Controller, Khanna publishers, New Delhi, 2017, ISBN : 9788174092281*
3. *Petruzella, F.D., Programmable Logic Controllers, McGraw Hill India, New Delhi, 2010, ISBN: 9780071067386*
4. *Hackworth, John; Hackworth, Federic, Programmable Logic Controllers, PHI Learning, New Delhi, 2003, ISBN : 9780130607188*
5. *Stenerson Jon, Industrial automation and Process control, PHI Learning, New Delhi, 2003, ISBN : 9780130618900*
6. *Mitra, Madhuchandra; Sengupta, Samarjit, Programmable Logic Controllers and Industrial Automation - An introduction, Penram International Publication, 2015, ISBN: 9788187972174*
7. *Boyar, S. A., Supervisory Control and Data Acquisition, ISA Publication, USA, ISBN: 978-1936007097*

8.Elec Bailey David ; Wright Edwin, Practical SCADA for industry, Newnes (an imprint of Elsevier), UK 2003, ISBN:0750658053

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a) *Identify different types of automation systems.*
b) *Interface I/O devices with the PLC modules.*
c) *Develop PLC ladder programs for various applications.*
d) *Select the suitable motor drives for different applications*
e) *Prepare simple SCADA applications.*

Course Code		***PEE-504***
Course Title		***ELECTRICAL TESTING AND COMMISIONING***
Number of Credits		***3 (L: 3, T: 0, P: 0)***
Prerequisites		***NIL***
Course Category		***PC***

Course objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- *Follow standard safety procedures in testing and commissioning of electrical equipment.*

Course contents:

Unit – I Electrical Safety and Insulation

Do's and don'ts regarding safety in domestic electrical appliances as well for substation/ power station operators

Electrical safety in industry/power stations/ substations at the time of operation/ control/ maintenance. Fire detection alarm, fire-fighting equipments

Factors affecting life of insulating materials, classifications of insulating materials as per IS:1271-1958

Measuring insulation resistance by different methods such as i) Polarization, ii) Dielectric absorption, iii) Megger and to predict the condition of insulation

Reconditioning of insulation,

Insulating oil - properties of insulating oil, causes of deterioration of oil,

testing of transformer oil as per IS 1866-1961

Unit – II Installation and Erection

Concept of foundation for installation of machinery. Requirements of foundation for static and rotating electrical machinery.

Concept of leveling and aligning Procedure for leveling and aligning alignment of direct cou- pled drive, effects of mis-alignment

Installation of transformer as per I.S.-1886-1967 and procedure of installation of transform- er, Requirements of installation of pole mounted transformer

Requirements of installation of rotating electrical machines as per I.S. 900 - 1965

Devices and tools required for loading, unloading, lifting, and carrying heavy equipment and precautions to be taken while handling them.

Unit– III Testing and Commissioning

Concept of testing, Objectives of testing. Roles of I.S.S. in testing of electrical equipment, Types of tests and concepts, Routine tests, type tests, supplementary test, special tests, Methods of testing - Direct/Indirect/Regenerative testing.

Tolerances for the various items for equipment –transformer, induction motor, dc motor, syn- chronous machines

Commissioning, Tests before Commissioning for transformer, induction motor, alternator Testing

of transformer as per I.S.1886- 1967 and I.S.2026- 1962

Testing of three-phase Induction motor as per I.S.325 - 1970.
Testing of single-phase induction motor as per I.S.990-1965.
Testing of synchronous machines as per ISS
Testing of D.C. machines

Unit– IV Troubleshooting Plans

Internal and external causes for failure / abnormal operation of equipment.

List of mechanical faults, electrical faults and magnetic faults in the electrical equipment remedies, applications

Use of tools like bearing puller filler gauges, dial indicator, spirit level, megger, earth tester,
and growler. Common troubles in electrical equipments and machines.

Preparation of trouble shooting charts for D.C. Machines, AC Machines and transformers.

Unit– V Maintenance

Concept of maintenance, types of maintenance, Routine, preventive and breakdown mainte- nance.

Causes of failure of electrical machines

Preventive maintenance-procedure or developing maintenance schedules for electrical machines.

Factors affecting preventive maintenance schedules, Concept of TPM, Pillars of TPM

Identification of different types of faults developed such as mechanical/ electrical/ magnetic
faults

Maintenance schedules of the following as per I.S.S.

a) *Distribution transformer as per I.S.1886-1967*
b) *Single phase and three phase Induction motors as per I.S.900-1965.*
c) *Batteries*

References:

1. *Deshpande.M. V. PHI Learning Pvt. Ltd., 2010, Design and Testing of Electrical Machines ISBN No 8120336453, 9788120336452.*
2. *Rao, B V S Asia Club House, First Reprint, 2011, Operation and Maintenance of Electrical Equipment Vol-I, ISBN No 8185099022*
3. *Rosenberg. Mc GRAW-HILL, 1st Edition, May 2003, Maintenance and Repairs, ISBN No 9780071396035*
4. *Sharotri, S.K. Glencoe/ Mcgraw- Hill; 2ndEdition , June 1969; Preventive Maintenance of Electrical Apparatus, ISBN No 10: 007030839X 13: 978-0070308398*

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a) *Follow safety procedures with respect to earthing and insulation of electrical equipment*
b) *Select proper tools, equipment, for installation, testing, maintenance of electrical machines and transformers*
c) *Test and commission electrical equipment in accordance with IS codes*
d) *Make plans for troubleshooting electrical machines.*
e) *Undertake regular preventive and breakdown maintenance.*

Course Code		***PPE-511***
Course Title		***MICROCONTROLLER APPLICATIONS LABORATORY***
Number of Credits		***1 (L: 0, T: 0, P: 2)***
Prerequisites		***NIL***
Course Category		***PC***

Course objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- *Maintain microcontroller based systems.*

Practicals:

2. *Interpret details of Hardware kit for Microcontroller and practice to write and execute pro- grams.*
3. *Identify different menus available in a simulator software RIDE/KEIL and demonstrate their use.*
4. *Develop and execute Assembly language programs using Arithmetic Instructions and demon- strate outcome for a given input data*
5. *Develop and execute Assembly language programs using Logical Instructions and demonstrate outcome for a given input*
6. *Develop and execute an Assembly language program for Addition of series of 8 bit nos, 16 bit result and demonstrate outcome for a given input data*
7. *Develop and execute Assembly language program for addition/subtraction of 16 bit no/multi- byte nos. and demonstrate outcome for a given input data*
8. *Develop and execute Assembly language program for Block transfer from and to Internal/Ex- ternal memory using directives and demonstrate outcome for a given input data.*
9. *Develop and execute Assembly language program Largest/smallest of given series of no. from Internal/External memory and demonstrate outcome for a given input data.*
10. *Develop and execute Assembly language program arrange no in ascending/descending order from Internal/External memory and demonstrate outcome for a given input data.*
11. *Develop and execute Assembly language program for LED blinking/LED sequences using de- lay/timer mode.*
12. *Develop and execute Assembly language program to interface LED with microcontroller.*

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a) *Interpret the salient features of various types of microcontrollers.*
b) *Interpret the salient features of architype of types microcontrollers IC 8051*
c) *Maintain the program features of the Microcontroller based application*
d) *Develop assembly language program*

e) *Develop program to interface 8051 microcontrollers with LED/SWITCH*

Course Code		***PEE-512***
Course Title		***ENERGY CONSERVATION AND AUDIT LABORATORY***
Number of Credits		***1 (L: 0, T: 0, P: 2)***
Prerequisites		***NIL***
Course Category		***PC***

Course objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- *Undertake energy conservation and energy audit.*

Practicals:

1. *Identify star labelled electrical apparatus and compare the data for various star ratings.*
2. *Determine the '% loading' of the given loaded Induction motor.*
3. *Determine the reduction in power consumption in star mode operation of Induction motor compared to delta mode.*
4. *Use APFC unit for improvement of p. f. of electrical load.*
5. *Compare power consumption of different types of TL with choke, electronic ballast and LED lamps by direct measurements.*
6. *Determine the reduction in power consumption by replacement of lamps in a class room / laboratory.*
7. *Determine the reduction in power consumption by replacement of Fans and regulators in a class room / laboratory.*
8. *Collect electricity bill of an industrial consumer and suggest suitable tariff for energy conser- vation and its impact on energy bill.*
9. *Collect electricity bill of a commercial consumer and suggest suitable tariff for conservation and reduction of its energy bill.*
10. *Collect electricity bill of a residential consumer and suggest suitable means for conservation and reduction of the energy bill.*
11. *Estimate energy saving by improving power factor and load factor for given cases.*
12. *Prepare a sample energy audit questionnaire for the given industrial facility.*
13. *Prepare an energy audit report (Phase-I)*
14. *Prepare an energy audit report (Phase-II)*
15. *Prepare an energy audit report (Phase-III)*

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a) *Interpret energy conservation policies in India.*
b) *Implement energy conservation techniques in electrical machines.*
c) *Apply energy conservation techniques in electrical installations.*
d) *Use Co-generation and relevant tariff for reducing losses in facilities.*
e) *Undertake energy audit for electrical system.*

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Course Code		***PEE-513***
Course Title		***INDUSTRIAL AUTOMATION AND CONTROL LABORATORY***
Number of Credits		***1 (L: 0, T: 0, P: 2)***
Prerequisites(Course code)		***NIL***
Course Category		***PE***

Course objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- *Maintain Industrial Automation Systems.*

Practicals:

1. *Identify various automation systems available in different appliances/ devices/ machines in day to day use.*
2. *Identify various parts of the given PLC and front panel status indicators.*
3. *Use PLC to test the START STOP logic using two inputs and one output.*
4. *Develop/Execute a ladder program for the given application using following: - timer, counter, comparison, logical, arithmetic instructions.*
5. *Use PLC to control the following devices like lamp, motor, push button switches, proximity sensor*
6. *Measure the temperature of the given liquid using RTD or Thermocouple and PLC.*
7. *Develop/test ladder program to blink the LED/lamp.*
8. *Develop / test the Ladder program for sequential control application of lamps/ DC motors.*
9. *Develop ladder program for Traffic light control system.*
10. *Develop and test ladder program for pulse counting using limit switch /Proximity sensor.*
11. *Develop /test ladder program for Automated car parking system.*

12. *Develop / test ladder program for Automated elevator control.*
13. *Develop / test ladder program for rotating stepper motor in forward and reverse direction at constant speed.*
14. *Develop /test ladder program for tank water level control.*
15. *Develop / test ladder program for control of speed of stepper motor with suitable drivers.*
16. *Identify various front panel controls of VFD (smart drive).*
17. *Control speed of AC/DC motor using VFD. (VFD-Variable Frequency Drive)*
18. *Use various functions of SCADA simulation editors to develop simple project.*
19. *Develop a SCADA mimic diagram for Tank level control.*
20. *Develop SCADA mimic diagram for Flow control in a given system.*
21. *Simulate Tank level control using available SCADA system.*

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a) *Identify different types of automation systems.*
b) *Interface I/O devices with the PLC modules.*
c) *Develop PLC ladder programs for various applications.*
d) *Select the suitable motor drives for different applications.*
e) *Prepare simple SCADA applications.*

Course Code		***PEE-514***
Course Title		***ELECTRICAL TESTING AND COMMISIONING LABORA- TORY***
Number of Credits		***1 (L: 0, T: 0, P: 2)***
Prerequisites		***NIL***
Course Category		***PE***

Course objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- *Follow standard safety procedures in testing and commissioning of electrical equipment.*

Practicals:

1. *Determine breakdown strength of transformer oil.*
2. *Perform insulation resistance test on any one motor/transformer.*
3. *Prepare trouble shooting charts for electrical machines such as Transformer, D.C. machines, Induction motor, and Synchronous machines*
4. *Measure impedance voltage and load losses of three-phase transformer.*
5. *Find regulation and efficiency of single-phase transformer by direct loading and back-to-back connection method and compare the results.*
6. *Determine efficiency of D.C. machine by Swinburne's test.*
7. *Determine efficiency of D.C. machine by Hopkinson's test.*

8. *Perform reduced voltage running up test on three-phase Induction motor as per I.S.325 -1967.*
9. *Measure no load losses and no load current of a transformer as per IS.*
10. *Perform no load test on single phase Induction motor for the measurements of no load current, power input, and speed at rated voltage as per I.S.*
11. *Perform temperature rise test on single-phase transformer.*
12. *Find efficiency of M.G. set*

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a) *Follow safety procedures with respect to earthing and insulation of electrical equipment*
b) *Select proper tools, equipment, for installation, testing, maintenance of electrical machines and transformers*
c) *Test and commission electrical equipment in accordance with IS codes*
d) *Make plans for troubleshooting electrical machines*

Undertake regular preventive and breakdown maintenance