IPS Academy

INSTITUTE OF ENGINEERING & SCIENCE

(A UGC Autonomous Institute affiliated to RGPV)

Electrical and Electronics Engineering Department

3rd Year 5th Semester

S.No.	Course Code	Course Title	Hrs./ week			Credits
			L	T	P	
1.	**PCC - EEE501**	Microprocessor & Microcontroller	3	0	2	4
2.	**PCC - EEE502**	Control System	3	0	2	4
3.	**PCC - EEE503**	Electrical Machine-II	3	1	2	5
4.	**PEC - EEE501**	Professional Elective I	3	0	0	3
5.	**OEC - EEE501**	Open Elective I	3	0	0	3
6.	**PCC - EEE504**	Simulation Lab –II	0	0	4	2
7.	**SEMINAR I**	Seminar & Group Discussion	0	0	2	1
8.	Internship (To be completed anytime during Fifth/Sixth semester 90 hours.)		-	-	-	-
Total			15	1	12	22

Professional Elective (PEC-EEE501)	**Open Electives (OEC-EEE501)**
(A) Utilization of Electrical Engineering	(A) Stress Management
(B) Solar & Wind Energy	(B) Business Communications
(C) Electrical Energy Conservation and Auditing	(C)Soft Skills and Interpersonal Communication

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PCC – EEE501	Microprocessor and Microcontroller	3 : 0 : 2 (5 hrs.)	4 Credits

Course Objective:-

Objective of this course is to introduce the students with the architecture and operation of typical microprocessors and microcontrollers and also provide strong foundation for designing real world applications using microprocessors and microcontrollers.

Pre Requisite:-

Should have basic knowledge of Digital Electronics Circuits.

Module 1(08hrs.)

Concepts of RISC and CISC Processor Architecture ,Harvard and Von-Neumann architecture, Introduction to 16-bit 8086 microprocessors, architecture of 8086,Pin Configuration, mode, timing diagram, Memory interfacing, interrupts, Instruction set of 8086, Addressing mode, Assembler directives & operations, assembly and machine language programming, subroutine call and returns, Concept of stack, Stack structure of 8086, timings and delays, and special processor.

Module 2(07hrs.)

Input-Output interfacing: Memory Mapped I/O and Peripherals I/O. PPI 8255 Architecture and modes of operation, Interfacing to 16-bit microprocessor and programming, DMA controller (8257) Architecture, Programmable interval timer 8254, USART 8251,8279 Programmable keyboard/Display Controller.

Module 3 (08hrs.)

Microcontroller 8051 Intel family of 8 bit microcontrollers, Architecture of 8051, Pin description, I/O configuration, interrupts; Interrupt structure and interrupt priorities, Port structure and operation, Accessing internal & external memories and different mode of operations, Memory organization, Addressing mode, instruction set of 8051 and programming.

Module 4 (08 hrs.)

8051 Interfacing, Applications and serial communication 8051 interfacing to ADC and DAC, Stepper motor interfacing, Timer/ counter functions, 8051 based thyristor firing circuit, 8051 connections to RS-232, 8051 Serial communication , Serial communication modes, Serial communication programming, Serial port programming in C.

Module 5 (07 hrs.)
Introduction to Embedded System, Basics of Embedded System, Application of Embedded System, and learn about ARDUINO, ARDUINO History and Family, Controlling embedded system based devices using Arduino.

List of Experiments

1. Addition of two binary number of 8 byte length.
2. To find the maximum no. in a given string (16 bytes long) and store it in location 0310.
3. To sort a string of a no. of bytes in descending order.
4. To multiply an ASCII string of eight numbers by a single ASCII digit. The result is a string of unpacked BCD digits.
5. To study architecture and pin out diagram of 8086.
6. To study architecture and pin out diagram of 8051.
7. Write an 8051 C program to ON/OFF the Buzzer.
8. Write an 8051 C program LEDs blinking.
9. Write a LCD program for character move.
10. Write a C program to read the keypad and display the result on the LCD.
11. Write a program on Stepper Motor's Movement in Forward and Reverse Directions.
12. Write a program to display two different digits at a time on seven segment display.
13. To study architecture and pin out diagram of 8251A (USART).
14. To study architecture and pin out diagram of DMA Controller (8257).

Course Outcomes: After successful completion of course students will be able to:

CO1: Explain about 8086 microprocessor and its application.
CO2: Discuss various controllers like DMA, USART and interface with 8086 microprocessor
CO3: Explain about 8051 microcontroller and its application
CO4: Discuss and interface with various controllers like ADC & DAC with 8051 microcontroller.
CO5: Understand basic concept of embedded systems and aurdino.

Text/ Reference books:

1. D.V.Hall, Microprocessors and Interfacing. TMH, 2nd edition 2006.
2. Advanced microprocessors and peripherals-A.K ray and K.M. Bhurchandani, TMH, 2nd edition 2006.
3. Embedded Systems- Architecture, Programming and Design by Rajkamal, 2007, TMH.
4. SimonMonk, Programming Arduino ™ Getting Started with Sketches , 2012 McGraw-Hill

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PCC – EEE502	Control System	3 : 0 : 2 (5 hrs.)	4 Credits

Course Objective:-
This course introduces students to foundation of frequency-domain design methods for analysis and design of continuous-time control systems, which form the essentials for industrial practice.

Pre Requisite:-Should have basic knowledge of Ordinary differential equations,Matrix, Laplace and Fourier Series & transform .

Module 1(11hrs.)
Modeling of dynamic systems: Electrical, Mechanical systems, Concept of transfer function, Laplace Transform,: Open and closed loop systems, Signal flow graph, Mason's formula, Components of control systems: Error detectors (Synchros & Potentiometer), Servomotors (AC & DC), tacho-generators, power amplifier, steeper motors. State space description of dynamic systems Solution of state equation: Eigen values & eigenvectors digitalization state transitive matrix

Module 2(07hrs.)
Time – domain analysis of closed loop systems: Test signals, time response of first and second order systems, Time domain performance specifications, Steady state error & error constants Feedback control actions: Proportional, derivative and integral control.

.**Module 3 (07 hrs.)**
Stability: Routh-Hurwitz stability analysis Characteristics equation of closed loop system root loci, construction of loci, Effect of adding, poles and Zeros on the loci, Stability by root loci.

Module 4 (08 hrs.)
Frequency, Domain analysis, Bode plots, Effect of adding, poles and Zeros, Polar plot, Nyquist stability analysis, Relative stability: Gain and phase margins.

Module 5 (07 hrs.)
Design of control systems with PD/PI/PID Control in time domain and Frequency domain, lead- lag, Lag-lead compensation, Design of compensating networks.
Concepts of state variables. State space model. Diagonalization of State Matrix. Solution of state equations. Eigen values and Stability Analysis. Concept of controllability and observability.

List of Experiments

1. Time response of second order system.
2. Characteristics of Synchros.
3. Effect of feedback on servomotors.
4. Determination of transfer function of A-C servomotor
5. Determination of transfer functions of D-C motor.
6. FormulationofPI&PDcontrollerandstudyofclosedloopresponsesof1stand2n d order dynamic systems.
7. State space model for classical transfer function using MATLAB.
8. Simulation of transfer function using operational amplifier.
9. Design problem: Compensating Networks of lead and lag.
10. Temperature controller using PID.
11. Transfer function of a DC generator.
12. Characteristics of AC servomotor.
13. Use of MATLAB for root loci and Bode plots of type-1, type-2systems.
14. Study of analog computer and simulation of 1st order and 2nd order dynamic equations.
15. Formulation of proportional control on 1st orderand2nd order dynamic systems.
16. Feedback control of 3rd order dynamic Systems
17. Study of lead and lag compensating networks.
18. Effect of adding poles & zeros on root loci and bode plots oftype-1, type-2 systems through MATLAB.

Course Outcomes:-After successful completion of course students will be able to:

CO1: Develop block diagrams and obtain model of a given physical systems, such as, voltage control, speed control of motor, etc. and obtain input-output relationship through block diagram reduction/SFG techniques.

CO2: Analyze control systems in time domain by applications of classical control and modern control theory (State Space Technique).

CO3: Investigate stability of control system using root loci.

CO4: Analyze the frequency response and investigate stability using Bode/Nyquist plots.

CO5: Design lag/lead/lag-lead compensator in frequency domain for improvement in system performance.

Text/ Reference books:

1. Nagrath and Gopal , 'Control Systems Engineering' , new age publication
2. K. Ogata, 'Modern Control Engineering',Pearson
3. Stefani ShahianSavant,Hostetter, 'Design of feedback control systems'Oxford
4. S Hasan Saeed ,Automatic Control System, Katson books
5. B.S.Manke, Control system Engineering, Khanna Publishers

PCC-EEE503	Electrical Machine-II	3:1:2(6 hrs.)	5

Course Objective: To teach students basic principle of operation, construction and application of static and rotating electrical machines.

Pre Requisite: Fundamentals of electrical engineering and Electrical machine-I

Module 1 (08 hrs.)

D.C. Machine-I Basic construction of DC machines; types of DC machines and method of excitation; lap and wave windings; Emf equation; armature reaction and methods of limiting armature reaction; Commutation process and methods for improving commutation; Basic performance of DC generators and their performance characteristics; Metadyne and Amplidyne.

Module 2 (08 hrs.)

D.C. Machine-II Basic operation of DC motors; Torque equation; Operating characteristics of DC motors, Starting of DC motors- 2point, 3 point and 4 point starters; speed control of DC motors; losses and efficiency of DC machines; testing of DC machines, direct testing, Swinburne's test and Hopkinson's test. Application of DC machines.

Module 3 (10 hrs.)

Synchronous Machine-I Construction; types of prime movers; emf equation, generation of harmonics and their elimination; armature reaction; synchronous reactance and impedance, equivalent circuit of alternator, relation between generated voltage and terminal voltage, voltage regulation of alternators using synchronous impedance, mmf, zpf .

Salient pole machines; two reaction theory equivalent circuit model and phasor diagram; determination of Xd and Xq by slip test; SCR and its significance; regulation of salient pole alternator, power angle equation and characteristics; synchronizing of alternator with infinite busbar; parallel operation and load sharing; synchronizing current, synchronizing power and synchronising torque coefficient; synchro scopes and phase sequence indicator.

Module 4 (08 hrs.)

Synchronous machine-II Synchronous motor operation, starting and stopping of synchronous motor, pull in torque, motor under load power and torque, reluctance torque, effect of excitation, effect of armature reaction, power factor adjustment, V curves, inverted V curves, synchronous motors as power factor correcting device, hunting and damper winding efficiency and losses.

Module 5 (06 hrs.)

Brush Less DC Motor construction and principle, speed control, basic concept of torque, outer and inner rotor, magnetic circuit concept, electrical analogy, winding pattern series and parallel, Thermal consideration.

List of Experiments

Experiments can cover any of the above topics, following is a suggestive list:

1. To plot magnetisation characteristic of a separately excited DC generator
2. To perform load test on DC generators.
3. To perform load test on DC series and shunt motor
4. To perform Swinburn's test on a DC machine and find out its efficiency under full load condition.
5. To conduct Hopkinson's test on a pair of DC shunt machine.
6. To perform OCC and SCC test on an alternator and determine its regulation.
7. To determine regulation of alternator using mmf method.
8. To synchronise alternator with infinite bus bar.
9. To plot V and inverted V curves for a synchronous motor
10. Perform BLDC motor for 60 sec with the help of PLC.

Course Outcomes:-After successful completion of course students will be able to:

- **CO1:** Explain working principle, Construction and characteristics of DC Machine
- **CO2:** Analyze starting methods & sketch the speed control Characteristics DC Motor
- **CO3:** Analyze Synchronous generator, evaluate voltage regulation of alternators using synchronous impedance methods, parallel operation & load sharing.
- **CO4:** Analyze Synchronous motor, describe operation, starting and stopping of synchronous motor
- **CO5:** Appraise knowledge about the fundamental principles and classification of special machines.

Text/ Reference books

1. Electrical Machines by P.S. Bimbhra, Khanna Publishers
2. Special Electrical Machine by E.G. Janardanan, PHI Learning
3. Brushless Permanent Magnet & Reluctance Motor Drives – T.J.E. Miller
4. V.Del Toro, "Electrical Machines & Power Systems", 1985, Prentice-Hall, Inc., Englewood Cliffs
5. Ashfaq Hussain, Electrical Machines, DhanpatRai& Co

PEC-EEE501 (A)	**Professional Elective I (Utilization of Electrical Engineering)**	**3 : 0 : 0 (3hrs.)**	**3 credits**

Course Objective: This subject gives a comprehensive idea in utilization of electrical power such as drives, electric heating, electric welding and illumination, electric traction, electrolysis, refrigeration air-conditioning and automobile electric system.

Pre Requisite: Fundamentals of electrical engineering and Electrical machine-I

Module 1 (08 hrs.)

Illumination Engineering

Nature of light, units, sensitivity of the eye, luminous efficiency, glare. Production of Light; Incandescent lamps, arc lamps gas discharge lamps- fluorescent lamps polar curves, effect of voltage variation on efficiency and life of lamps, Distribution and control of light, lighting calculations, solid angle, inverse square and cosine laws, methods of calculations, factory lighting, flood lighting and street lighting, Direct diffused and mixed reflection & transmission factor, refractors, light fittings.

Module 2 (08 hrs.)

Heating, Welding and Electrolysis

Electrical heating-advantages, methods and applications, resistance heating, design of heating elements, efficiency and losses control. Induction heating: core type furnaces, core less furnaces and high frequency eddy current heating, dielectric heating: principle and special applications, arc furnaces: direct arc furnaces, Indirect arc furnaces, electrodes, design of heating elements, power supply and control. Different methods of electrical welding, resistance welding, arc welding, energy storage welding, laser welding, electro beam welding, and electrical equipment for them. Arc furnaces transformer and welding transformers. Review of electrolytic principles, laws of electrolysis, electroplating, anodizing-electro-cleaning, extraction of refinery metals, power supply for electrolytic process, current and energy efficiency.

Module 3 (08 hrs.)

Traction

Special features of Traction motors, selection of Traction Motor, Different system of electric traction and their Advantages and disadvantages, Mechanics of train movement: simplified speed time curves for different services, average and schedule speed, tractive effort, specific energy consumption, factors affecting specific energy consumption, acceleration and braking retardation, adhesive weight and coefficient of adhesion,

Module 4 (08 hrs.)

Electric Drives

Individual and collective drives- electrical braking, plugging, rheostatic and regenerative braking load equalization use of fly wheel criteria for selection of motors for various industrial drives, calculation of electrical loads for refrigeration and air-conditioning, intermittent loading and temperature rise curve.

Module 5 (08 hrs.)

Introduction to Electric and Hybrid Vehicles

Configuration and performance of electrical vehicles, traction motor characteristics, tractive effort, transmission requirement, vehicle performance and energy consumption.

Course Outcomes:-After successful completion of course students will be able to:

- **CO1:** Design an Illumination scheme.
- **CO2:** Select a suitable scheme for the process. Methods of electrolysis and its applications,
- **CO3:** Analyze specific power consumptions.
- **CO4:** Apply the control and selection of drives for various industrial applications.
- **CO5:** Evaluate performance of Electric Hybrid Vehicles.

Text/ References Books:

1. Open Shaw, Taylor, .Utilization of electrical energy. Orient Longmans, 1962.
2. H. Pratap, Art and Science of Utilization of Electrical Energy.
3. Gupta, J.B., Utilization of Elect. Energy, Katariya and sons, New Delhi.
4. Garg, G.C., Utilization of Elect. Power and Elect. Traction.
5. N V Suryanarayan, Utilization of Elect. Power including Electric Drives and Elect. Traction, New Age International.

PEC-EEE501 (B)	**Professional Elective I (Solar and Wind Energy)**	**3 : 0: 0 (3hrs.)**	**3 Credits**

Course Objective:

The students are expected to identify the new methodologies / technologies for comprehensive and rigorous study of solar passive architecture as well as understand the technologies that used to harness the power of the wind.

Module 1: (6 Hrs)

Introduction, solar radiation spectra, solar geometry, Earth Sun angles, observer Sun angles, solar day length, Estimation of solar energy availability, V-I characteristics of a PV cell, PV module, array,

Module2: (8Hrs)

Power Electronic Converters for Solar Systems, Maximum Power Point Tracking (MPPT) algorithms. Converter Control. Technologies, Parabolic trough, central receivers, parabolic dish, Fresnel, solar pond, elementary analysis.

Module3: (6 Hrs)

History of wind power, Indian and Global statistics, Wind physics, Tip speed ratio, stall and pitch control, Wind speed statistics-probability distributions, Wind speed and power-cumulative distribution functions.

Module4: (8 Hrs)

Review of modern wind turbine technologies, Fixed and Variable speed wind turbines, Induction Generators, Doubly-Fed Induction Generators and their characteristics, Permanent-Magnet Synchronous Generators, Power electronics converters. Generator-Converter configurations, Converter Control.

Module5: (8 Hrs)

Overview of grid code technical requirements. Fault ride-through for wind farms - real and reactive power regulation, voltage and frequency operating limits, solar PV and wind farm behavior during grid disturbances. Power quality issues. Power systems inter connection experiences in the world. Hybrid and isolated operations of solar PV and wind systems.

Course Outcomes:-After successful completion of course students will be able to:

CO1: Understanding of solar power generation.

CO2: Importance of Power Electronics convertors to obtain maximum power from solar energy.

CO3: Understanding of wind power generation along with its design.

CO4: Demonstration of power electronic interfaces for wind generation.

CO5: Understand the issues related to the grid-integration of solar and wind energy systems.

Text/ Reference books:

1. T. Ackermann, "Wind Power in Power Systems", John Wiley and Sons Ltd., 2005.
2. G. M. Masters, "Renewable and Efficient Electric Power Systems**",** John Wiley and Sons, 2004.
3. S. P. Sukhatme, "Solar Energy: Principles of Thermal Collection and Storage", McGraw Hill, 1984.
4. H. Siegfried and R. Waddington, "Grid integration of wind energy conversion systems" John Wiley and Sons Ltd., 2006.

PEC-EEE501 (C)	**Professional Elective I (Electrical Energy Conservation and Auditing)**	**3 :0:0 hrs.)**	**3 Credits**

Course Objective:

To impart basic knowledge to the students about current energy scenario, energy conservation, audit and management. To inculcate among the students systematic knowledge and skill about assessing the energy efficiency, energy auditing and energy management.

Module1: **(8 Hrs) Basic Principles of Energy Audit:**

Energy audit- definitions, concept , types of audit, energy index, cost index ,pie charts, Sankey diagrams, load profiles, Energy conservation schemes- Energy audit of industries- energy saving potential, energy audit of process industry, thermal power station, building energy audit.

Module2: (6 Hrs) Energy Management:

Principles of energy management, organizing energy management program, initiating, planning, controlling, promoting, monitoring, reporting- Energy manger, Qualities and functions, language, Questionnaire – check list for top management.

Module3: (8 Hrs) Energy Efficient Motors:

Energy efficient motors, factors affecting efficiency, loss distribution , constructional details , characteristics – variable speed , variable duty cycle systems, RMS hp- voltage variation-voltage unbalance- over motoring- motor energy audit

Module:4 (8 Hrs) Power Quality:

Power Factor Improvement, Power factor – methods of improvement, location of capacitors, Power factor with non linear loads, effect of harmonics on power factor, power factor motor controllers – Good lighting system design and practice, lighting control, lighting energy audit – Energy Instruments- wattmeter, data loggers, thermocouples, pyrometers, lux meters, tongue testers ,application of PLC's.

Module5: (8 Hrs) Economic Aspects and Analysis:

Economics Analysis-Depreciation Methods, time value of money, rate of return , present worth method , replacement analysis, life cycle costing analysis- Energy efficient motors- calculation of simple pay back method, net present worth method- Power factor correction, lighting – Applications of life cycle costing analysis, return on investment .

Course Outcomes:-After successful completion of course students will be able to:

CO1: Explain necessity of energy audit.

CO2: Demonstrate Energy Management Systems.

CO3: Analyze energy efficient Electric motor.

CO4: Analyze the power factor and to design a good illumination system.

CO5: Determine pay back periods for energy saving equipment.

Text/ Reference books:

1. Instructions to Energy Auditors, Vol. - I & Vol. - II – National Technical Information Services U. S. Department of Commerce Springfield, VA 22161.
2. G.G. Ranjan: Optimizing Energy Efficiencies in Industry ,Edition-2003 McGraw Hill
3. Energy efficient electric motors by John .C. Andreas, Marcel Dekker Inc Ltd-2nd edition, 1995-
4. Energy management hand book by W.C.Turner, John wiley and sons

PCC – EEE504	Simulation Lab -II	0: 0 : 4 (4 hrs.)	2 Credits

Course Objective: To teach students the fundamental of software based simulation process.
Pre Requisite: Engineering Mathematics & Basic Electrical Engineering.

List of Experiments

Experiments can cover any of the above topics, following is a suggestive list:

1. Introduction of MATLAB/SIMULINK
2. Study of Various Toolboxes in MATLAB
3. Use of MATLAB as a Calculator (performing basic Mathematics Operation)
4. Creating matrix and apply different commands of matrix and apply arithmetic operation in matrix
5. Finding the value of trigonometric functions, power and square root of number and plotting of graphs
6. Creating multi-plots line styles & colors of a plot
7. Introduction to Programming in MATLAB (Control Flow & Operations, Debugging M-File)
8. Program to generate a sinusoidal signal
9. Introduction of Basic Electrical & Network Applications Using MATLAB
10. Analysis of Transient circuits using MATLAB

Course Outcomes:- After successful completion of course students will be able to:

CO1: Explain importance of software's in research by simulation work.
CO2: Create 2-D & 3-D plot of the electrical system.
CO3: Make use of programming for various electrical networks.

Text/ Reference books:

1. Dr. Shailendra Jain, "Modeling and Simulation using MATLAB - Simulink", 2nd Edition, John wiley& sons.
2. MATLAB and its Applications in Engineering, Raj kumar Bansal, Pearson Publishers, ISBN-10: 8131716813, 2009.
3. MATLAB: An Introduction with Applications, by Amos Gilat, 2nd edition, Wiley,ISBN-13 978-0471694205, 2004.
4. MATLAB: A Practical Introduction to Programming and Problem Solving. Attaway, Stormy, 2012.