# IPS Academy

## INSTITUTE OF ENGINEERING & SCIENCE

(A UGC Autonomous Institute affiliated to RGPV)

## Electrical and Electronics Engineering Department

### Scheme & Syllabus of II Year

**2nd Year 4th Semester**

| S. No. | Course Code | Course Title | Hrs./ week | | | Credits |
|---|---|---|---|---|---|---|
| | | | L | T | P | |
| 1 | PCC - EEE401 | Electrical Machine-I | 3 | 1 | 2 | 5 |
| 2 | PCC - EEE402 | Digital Electronics & Logic Design | 3 | 0 | 2 | 4 |
| 3 | PCC - EEE403 | Power System I | 3 | 1 | 2 | 5 |
| 4 | PCC - EEE404 | Power Electronics | 3 | 1 | 2 | 5 |
| 5 | PCC - EEE405 | Signals & Systems | 3 | 1 | 0 | 4 |
| 6 | MC4 | NSS/ Indian Constitution | 2 | - | - | 0 |
| Total credits | | | | | | 23 |

| PCC - EEE401 | Electrical Machine-I | 3L: 1T:2P (6 hrs.) | 5 Credits |
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**Course Objective:**

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

**Pre Requisite:**

Fundamentals of electrical engineering.

**Module 1 (08 hrs.)**
Transformer-I: Working principle, e.m.f. equation, construction, phasor diagrams, equivalent circuit, voltage regulation, losses, separation of hysteresis and eddy current losses, efficiency, tests: open circuit and short circuit, load, Sumpner's test, Condition for maximum efficiency and regulation, Power and distribution transformer, all day efficiency. Autotransformer: working, advantages.

**Module 2 (08 hrs.)**
Transformer-II: Three phase transformer: its construction, groups and connections, their working and applications; Scott connection; Parallel operation of Transformers: application, advantages, requirement and load sharing; Tap changers, cooling, conservator and breather.

**Module 3 (09 hrs.)**
Three Phase Induction Motor- I: Working principle, construction, comparison of slip ring and squirrel cage motors, steady state analysis, phasor diagram and equivalent circuit, power flow diagram, torque-speed and power-speed characteristics, Losses and efficiency, No load and block rotor test. Starting of squirrel cage and slip ring motors, power factor control, Cogging & Crawling.

**Module 4 (09 hrs.)**
Three phase Induction Motor- II: Double cage &Deep bar Indication Motor, impact of unbalanced supply and harmonics on performance, speed control, braking, Induction Generator.

Single Phase Motors: Single Phase Induction motor; double revolving field theory, equivalent circuit and its determination, performance calculation, starting methods and types of single phase Induction motors: their working principle and applications, comparison with three phases Induction Motor.

**Module 5 (06 hrs.)**

Stepper Motors: Discretisation of angular position by stepper structures, stepping angle and frequency of excitation. VR and PM rotor structures and their torque production, torque angle characteristics.

Switched reluctance motor, static torque production, partition of energy and the effects of saturation, Dynamic torque production, torque speed characteristics, shaft position sensing, solid rotors.

**List of Experiments**

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

1. Perform turn ratio and polarity test on 1-phasetransformer
2. Perform load test on a 1-phase transformer and plot its load characteristic
3. Perform OC and SC tests on a 1-phase transformer and determine its equivalent circuit. Also find its efficiency and regulation at different load and power factor.
4. Perform OC and SC tests on a 3-phase transformer and determine its equivalent circuit. Also find its efficiency and regulation at different load and power factor.
5. Perform Sumpner's test on two 1-phase transformer and determine its efficiency at various load.
6. Perform No-load and block rotor test on a 3- phase IM and determine its equivalent circuit.
7. Perform load test on a 3- phase IM and plot its performance characteristics.
8. Study various types of starters used for 3- IMs.
9. Perform No-load and block rotor test on a 1- phase IM and determine its equivalent circuit.
10. Perform stepper motor for 90 degree in forward and 90 degree in reverse in 20 sec using PLC.

**Course Outcomes: Students will be able to**

**CO1:** Explain the working principle, construction, operation and testing of Single Phase Transformer

**CO2:** Explain the working principle, construction, operation and testing of Three Phase Transformer.

**CO3:** Explain the working principle, construction, operation and testing of Three Phase Induction Motor.

**CO4:** Explain the working principle, construction, operation and testing of Single Phase Induction Motor.

**CO5:** Appraise knowledge about the fundamental principles and classification of special machines.

**Text/ Reference books**


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

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## Electrical and Electronics Engineering Department

| PCC - EEE402 | Digital Electronics & Logic Design | 3L: 0T:2P (5hrs.) | 4 Credits |
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**Course Objective**:
Students will learn and understand the Basics of digital electronics and able to design basic logic circuits, combinational and sequential circuits.

**Pre Requisite:** Basic concepts of number system

**Module 1 (08 hrs)**
**Fundamentals of Digital Systems and Logic Families:**
Number Systems Decimal, Binary, Octal, Hexadecimal, 1's and 2's complements, Codes – Binary, BCD, Excess 3, Gray, Alphanumeric codes, Boolean theorems, Logic gates, Universal gates, Sum of products and product of sums, Minterms and Maxterms, Karnaugh map Minimization , Don't care conditions, and Quine-McCluskey method of minimization.

**Module 2 (08hrs.)**
**Combinational Digital Circuits:**
Design of Half and Full Adders, Half and Full Subtractors, Binary Parallel Adder – Carry look ahead Adder, BCD Adder, Multiplexer, Demultiplexer, Magnitude Comparator, Decoder, Encoder, Priority Encoder.

**Module 3 (06hrs.)**
**Sequential Circuits and Systems:**
Latches, SR latch with NAND & NOR gates, D latch, edge triggered flip flop, J-K flip flop, T flip flop, Master slave flip flop, Analysis of clocked sequential circuit, state table, state diagram, state reduction state equations, state assignments, flip flop excitation table & characteristic equations, Design procedure for sequential circuits, Design with state reduction, Applications of flip flop.

**Module 4 (08hrs.)**
**Registers and Counters**
Asynchronous and Synchronous counter, counters with MOD numbers, Down counter, UP/DOWN counter, propagation delay in ripple counter, programmable counter, Pre- settable counter, BCD counter, cascading, counter applications, Decoding in counter, Decoding glitches, Ring Counter, Johnson counter, Rotate left & Rotate right counter, Registers – Buffer, Shift left, shift right, shift left/Right registers, parallel in parallel out, serial in serial out, parallel in serial out, serial in parallel out registers

**Module 5 (08hrs.)**
**Semiconductor Memories and Programmable Logic Devices (PLD's)**
Memory organization and operation, expanding memory size, classification and characteristics of memories, sequential memory, read only memory (ROM), read and write memory (RAM), FLASH memory, Programmable logic array, Programmable array logic, Field Programmable Gate Array (FPGA), introduction of HDL Programming

**List of Experiments**

1. Verify the truth tables of Logic Gates.
2. Verification of Boolean laws and D Morgan's theorem.
3. Verification of MUX and DEMUX.
4. Realization of combinational circuits (Decoders/Encoders/Code Converters).
5. Design of arithmetic circuits: Half adder, Full adder, subtractor and BCD adder/ subtractor.
6. Design of Flip Flops: S-R, J-K, D type and master slave with truth tables.
7. Realization of Flip Flops using Logic Gates.
8. Design of counters using IC's: Up down, Decade, Synchronous, Binary, BCD counter.
9. Design of counters using flip flops.
10. Design of Ring counter, Johnson counter etc

**Course Outcomes: Students will be able to**

**CO1:** Understand about various number systems and karnaugh map minimization method.
**CO2:** Construct basic combinational circuits and verify their functionalities
**CO3:** Construct Sequential logic circuits.
**CO4:** Analyze various types of registers and counters.
**CO5:** Classify different types of memories.

**Text/ Reference books**


1. M. Morris Mano, "Digital logic and Computer design", 1st edition, Pearson Prentice Hall, 2016.
2. Anand Kumar, "Fundamentals of Digital Circuits", Prentice-Hall India, 4th edition, 2016.
3. Ronald J Tocci, Neal Widmer, Greg Moss,"Digital systems principles and applications" 11th edition, Pearson Education, 2010..
4. Donald Leech, Albert Malvino, Goutam Saha," Digital Principles and Applications", 8th edition, McGraw Hill Education, 2014.

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## Electrical and Electronics Engineering Department

| PCC - EEE403 | Power System -I | 3L:0T:2P (5 hrs.) | 4 credits |
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**Course Objective**: The course deals with exploring the knowledge of Power generation, transmission and distribution. Also to expose the students to the different electrical & mechanical aspects of the power network.

**Pre Requisite:** Student should be aware about inductance, capacitance, KCL-KVL and fundamentals of Electrical Machines.

**Module 1 (08hrs.)**

An overview of Electrical Energy Generation General background, structure and components of power network. Power generation – Introduction to conventional, non-conventional & distributed generation, Effect of transmission voltage on power system economy. Selection of size of feeder. Power Plant Economics - Load curves, base load, peak load, load factor, demand factor, diversity factor, capacity factor, utilization factor, cost of electricity, capital cost, fuel and operation cost.

**Module 2 (10hrs.)**

**Transmission Line Components & Under Ground Cabling**

Inductance resistance and capacitance of transmission line, Calculation of inductance for 1-Φ and 3-Φ, Single and double circuit line, Concept of GMR and GMD, Symmetrical & asymmetrical conduction configuration, Calculation of capacitance for 2 wire and 3 wire systems, Effect of ground or capacitance, Capacitance calculation for symmetrical and asymmetrical 1-phase and three phase, Single and double circuit line, Charging current, Transposition of line, Composite conductor, bundle conductor, Skin and proximity effect,. Underground Cable Comparison of cables and overhead transmission lines, Classification of cables, construction of cable, capacitance of single and multi-core cable, economic core diameter, dielectric stress in cable, Grading of cables, ionization of Heating of cables, Phenomena of dielectric losses and sheath loss in cables, Thermal resistance of cables

**Module 3 (08hrs.)**

**Transmission systems & performance of transmission line**

Various systems of transmission, effect of system voltage, comparison of conductor materials required for various overhead systems. Short, Medium & long transmission line and their representation, Nominal T, Nominal Л, Equivalent T and equivalent Л, network models, ABCD constants for symmetrical & asymmetrical network, Mathematical solution to estimate regulation & efficiency of all types of lines. Surge Impedance, loading, Interpretation of long line equation and its equivalent equation. Tuned power lines. Power flow through transmission line.

**Module 4 (08hrs.)**
**Insulator & Mechanical design**

Mechanical Design Types of conductors used in overhead transmission line, Types of line supports and towers, Distribution of conductors over transmission towers, Spacing between conductors, Length of span and sag- tension calculation for transmission line, Wind & ice loading, support of line at two different levels, string chart, Sag template, Stringing of conductor, Vibration and Vibration dampers. Insulator Materials used for transmission line insulations, Types of insulator for overhead transmission line failure of insulator, Voltage distribution of suspension insulator, String efficiency, Shielding and grading

**Module 5 (08hrs.)**
**Voltage control & Distribution system**

Ac single phase, 3 phase, 3wire & 4 wire distribution, Types of distribution system Kelvin's law for most economical size of conductor ,Substation layout showing substation equipment, bus bar single bus bar and sectionalized bus bar, main and transfer for bus bar system, sectionalized double bus bar system, ring mains

**List of Experiments**

1. To study the Thermal Power Station.
2. To study the Hydro Power Station.
3. To study the Nuclear Power Station.
4. To study & draw Towers used in Transmission lines.
5. To study & draw the different types of insulator.
6. To study & design Electrical Power Transmission line.
7. Determination of Transmission Parameters of a transmission line
8. Study of Ferranti Effect.

**Course Outcomes: Students will be able to**

**CO1:** Understand the electrical energy generation power plant economics.
**CO2:** Analyze the transmission line components & under Ground Cabling.
**CO3:** Analyze the transmission systems & performance of transmission line,
**CO4:** Understand insulator & mechanical design of conductors used in overhead transmission line
**CO5:** Understand voltage control & distribution system..

**Text/ Reference books**


1. William Stevenson, Elements of Power System Analysis, McGraw Hill.
2. C.L. Wadhwa, Electrical Power System Analysis, New Age International.
3. D.P. Kothari, I.J. Nagrath, Modern Power System Analysis TMH, III Ed. Reprint 2008.
4. John Grainger and William Stevenson, Power system Analysis, McGraw Hill.
5. Ashfaq Husain, Electrical Power Systems, Vikas Publishing House.

| PCC – EEE404 | Power Electronics | 3L: 0T: 2P (5 hrs.) | 4 Credits |
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**Course Objective:** The objectives are to study
1. To understand and acquire knowledge about various power semiconductor devices.
2. To prepare the students to analyze and design different power converter circuits.

**Pre Requisite**

Knowledge of Basic Electrical Engineering, Network Analysis & Engineering Mathematics.

**Module 1**: **(10 Hrs)**
**Power Semiconductor Devices -** Advantages and application of power electronic devices, Study of switching devices, Power Diode, SCR, TRIAC, GTO, BJT, MOSFET, IGBT, Static characteristics: SCR, MOSFET and IGBT, Triggering and commutation circuit for SCR, SCR rating & protection of SCR, Design of snubber circuit, heating, cooling & mounting of SCR, series and parallel operation of SCR, String efficiency

**Module 2: (10 Hrs)**
**AC-DC Converters -** Operation and analysis of single phase (Half wave & Full Wave) and multiphase (Three Phase) uncontrolled and controlled rectifier circuit with resistive, resistive & inductive load (continuous & non continuous conduction, FW small & very large inductive loads) and RLE Loads, Effect of freewheeling diode and source inductance on performance rectifier circuits, Comparison of mid-point & Bridge rectifier circuits, Harmonic analysis.

**Module 3: (7 Hrs)**
**DC-AC Converters -** Introduction & Classification of inverter, Operating principle, Voltage source & current source inverter, Single phase and three phase bridge inverter, PWM techniques, Multiple PWM, Sinusoidal PWM, modified sinusoidal PWM, Mc- murray & MC murray bed ford inverters, Harmonics analysis and elimination techniques.

**Module 4: (7 Hrs)**
**DC-DC Converters -** Introduction of chopper, Basic chopper classification, Step-down and step-up chopper, Steady state analysis of chopper circuits, types of choppers-A, B, C, D and E, Switched mode regulators- Buck, Boost, Buck- Boost regulator, Resonant Converters, Applications-Battery operated vehicles.

**Module 5: (6 Hrs)**

**AC-AC Converters -** Single phase and Three phase AC voltage controllers, Control strategy, Power Factor Control, Multistage sequence control, Cyclo converter-Operation, control problems, various power circuits, single phase and three phase cyclo converters, Applications

**List of Experiments**

1. Plot the VI Characteristics of SCR (Silicon Control Rectifier)
2. Study of Different Commutation Techniques of SCR
3. Study of SCR Triggering circuits
4. Performance evaluation of single phase uncontrolled converter
5. Performance evaluation of single phase controlled converter
6. To plot waveforms for output voltage and current of 3φ SCR Half Controlled Converter
7. To plot waveforms for output voltage and current of 3φ SCR Full Controlled Converter
8. Performance evaluation of Step up Chopper
9. Performance evaluation Study of Series Inverter using SCR's
10. Phase control of TRIAC using DIAC and RC circuit in light dimming circuit.

**Course Outcomes: Students will be able to**

**CO1:** Acquire knowledge about fundamental concepts and switches used in power electronics
**CO2:** Analyze various AC-DC converter (Rectifier) circuits and understand their applications
**CO3:** Illustrate working principles of various DC-AC converter (Inverters) circuits
**CO4:** Illustrate working principles of various DC-DC converter (Choppers) circuits
**CO5:** Illustrate working principles of various AC-AC converter (Cyclo-Converter) circuits

**Text Books:**


1. Dr. P. S. Bimbhra, "Power Electronics", Khanna Publishers, 3rd Edition, 2003.
2. M D. Singh, K B. Khanchandani, "Power Electronics", Tata McGraw Hill Publishing company limited, 2nd Edition, 2006.
3. M H Rashid, "Handbook of Power Electronics", Pearson Education India, 2008.


**Reference Books:**


1. C. M. Pauddar, "Semiconductor Power Electronics (Devices and Circuits)", 1st Edition, Jain Brothers New Delhi, 1999.
2. Joseph Vithayathil, "Power Electronics, Principles and Applications", McGraw Hill Series, 6th Reprint, 2013.
3. Ned Mohan Tore. M. Undel and, William. P. Robbins, 'Power Electronics: Converters, Applications and Design', John Wiley and sons, 3rd edition, 2003.
4. Sen, P.C., "Power Electronics", Tata McGraw Hill Publishing Company limited, 1nd Edition, 2001.

| PCC - EEE405 | Signals & Systems | 3L : 1T : 0P (4 hrs.) | 4 Credits |
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**Course Objective:-**

The course will provide strong foundation on signals and systems which will be useful for creating foundation of communication and signal processing. The students will learn basic continuous time and discrete time signals and systems. Student will understand application of various transforms for analysis of signals and systems both continuous time and discrete time.

**Pre Requisite:-** Should have knowledge of mathematics, differential equations and difference equation, Laplace transform and Fourier series.

**Module 1 (11 hrs.)**

Introduction of signals and systems: Some special continuous time signals (CT signals) & discrete time signals (DT signals) - Step, ramp, pulse, impulse, sinusoidal and exponential signals, basic operations on signals, classifications of CT and DT signals- Periodic and aperiodic signals, energy and power signals, random & deterministic signal, even & odd signal, causal & non causal signal, Classification of system - CT systems and DT systems – Static & Dynamic, Linear & Nonlinear, Time-variant & Time-invariant, Causal & Non-causal, Stable & Unstable.

**Module 2 (08 hrs.)**

Analysis of continuous time signals: Time and frequency domain analysis, Fourier series analysis, spectrum of CT signals, Fourier transform and Laplace transform, region of convergence.

**Module 3 (07 hrs.)**

Linear time invariant continuous time systems: Differential equations representation, block diagram representation, state variable representation and matrix representation of systems, impulse response, step response, frequency response, reliability of systems, analog filters.

**Module 4 (07 hrs.)**

Analysis of discrete time signals: Convolution sum and properties, sampling of CT signals and aliasing, DTFT and properties, Z transform and properties, inverse Z transform.

**Module 5 (07 hrs.)**

Linear time invariant discrete time systems: Difference equations representation, block diagram representation, state variable equations and matrix representation of systems, impulse response, analysis of DT LTI systems using DTFT and Z transform, Digital filters.

**Course Outcomes:-**

**CO1:** Classify different types of commonly used signals & systems and describe how to perform mathematical operations on signals.

**CO2:** Analyze continuous time signals in time domain and frequency domain.

**CO3:** Analyze linear time invariant continuous time systems using differential equation, block diagram and state variable representations.

**CO4:** Analyze discrete time signal using Z transform and convolution.

**CO5:** Analyze DT LTI systems using DTFT and Z-Transform.

**Text/ Reference books**


1. Alan V. Oppenheim, Alan S. Willsky, S Hamid Nawab, 'Signals and Systems', 2nd edition 2015 Pearson New International Edition.
2. Anand Kumar, Signals and Systems, PHI, III edition, 2015 Pearson Education
3. Mahmood Nahvi, Signals and Systems, McGraw Hill
4. Tarun Kumar Rawat, ' Signals & Systems', Oxford University Press