EVALUATION SCHEME & SYLLABUS

FOR

B. TECH. 3rd YEAR (EN)

ELECTRICAL & ELECTRONICS ENGINEERING

BASED ON

AICTE MODEL CURRICULUM

[Effective from the Session: 2020-21]
### SEMESTER V

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Subject Codes</th>
<th>Subject</th>
<th>Periods</th>
<th>Evaluation Scheme</th>
<th>End Semester</th>
<th>Total</th>
<th>Credit</th>
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*The Mini Project or internship (4 weeks) conducted during summer break after IV semester and will be assessed during V semester.

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### DEPARTMENT ELECTIVE - I
- KEE051  Robotics
- KEE052  Sensors and Transducers
- KEE053  Industrial Automation and Control
- KEN051  Bio-Medical Instrumentation

### DEPARTMENT ELECTIVE - II
- KEE055  Optimization Techniques
- KEE056  Neural Networks & Fuzzy System
- KEE057  Digital Signal Processing
- KEE058  Analog & Digital Communication
## SEMESTER VI

<table>
<thead>
<tr>
<th>Sl. No.</th>
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### DEPARTMENT ELECTIVE - III

- KEE 061 Special Electrical Machines
- KEN 061 Linear Integrated Circuits
- KEE 063 Digital Control System
- KEN 062 Embedded Systems
B.Tech 3rd Year
V Semester
Syllabus
POWER SYSTEM-I

Pre-requisites of the course: Basic Electrical Engineering, Networks Analysis and Synthesis, Electromagnetic Field Theory.

<table>
<thead>
<tr>
<th>Course Outcome</th>
<th>Knowledge Level, KL</th>
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<tbody>
<tr>
<td>Upon the completion of the course, the student will be able to:</td>
<td></td>
</tr>
<tr>
<td>CO1 Describe the working principle and basic components of conventional power plants as well as the other aspects of power generation.</td>
<td>K2</td>
</tr>
<tr>
<td>CO2 Recognize elements of power system and their functions, as well as compare the different types of supply systems. Illustrate different types of conductors, transmission lines and various performance parameters of transmission line for short, medium and long transmission line.</td>
<td>K4</td>
</tr>
<tr>
<td>CO3 Calculate sag and tension in overhead lines with and without wind and ice loading. Classify different type of insulators, determine potential distribution over a string of insulator, string efficiency and its improvement.</td>
<td>K4</td>
</tr>
<tr>
<td>CO4 Compute the inductance and capacitance of single phase, three phase lines with symmetrical and unsymmetrical spacing, Composite conductors-transposition, bundled conductors, and understand the effect of earth on capacitance of transmission lines.</td>
<td>K4</td>
</tr>
<tr>
<td>CO5 Elucidate different types of cables and assess the Resistance and capacitance parameters of cables, grading of cables and compare overhead lines and cables.</td>
<td>K4</td>
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</table>

KL- Bloom’s Knowledge Level (K1, K2, K3, K4, K5, K6)
K1 – Remember K2 – Understand K3 – Apply K4 – Analyze K5 – Evaluate K6 – Create

Detailed Syllabus:

UNIT-I (Power Generation):
Introduction: Basic structure of power system, sources of electric energy: conventional and non-conventional; Layout of Hydro-electric, Thermal and Nuclear power plants, Concept of cogeneration, combined heat and power, and captive power plants.
Load curve, load duration curve, Concept of Connected Load, Maximum Demand, Average load, Demand Factor, Load factor, Diversity Factor, Capacity Factor, Utilization factor, Plant use factor, Installed capacity, Reserves, role of load diversity in power system economy. Load Sharing between Base load and Peak Load

UNIT-II (Transmission & Distribution of Electric Power- I):
Single line diagram of Power system, choice of transmission voltage, Different kinds of supply system and their comparison.
Configurations of transmission lines: Types of conductors, Bundled Conductors, resistance of line, skin effect, Kelvin’s law, Proximity effect, Corona Effect, factors affecting the Corona, Corona Power Loss, Advantages and Disadvantages.
Performance of Lines: Representation of lines, short transmission lines, medium length lines, nominal T and π-representations, long transmission lines. The equivalent circuit representation of a long Line, A, B, C, D constants, Ferranti Effect.
UNIT-III (Transmission & Distribution of Electric Power- II):
**Mechanical Design of Overheadlines:** Catenary curve, calculation of sag & tension, effects of wind and ice loading, sag template, vibration dampers

**Overhead line Insulators:** Type of insulators and their applications, potential distribution over a string of insulators, methods of equalizing the potential, string efficiency

UNIT-IV (Transmission Line Parameters):
**Inductance and Capacitance Calculations of Transmission Lines:** Line conductors, inductance and capacitance of single phase and three phase lines with symmetrical and unsymmetrical spacing, Composite conductors-transposition, bundled conductors, and effect of earth on capacitance.

UNIT-V (Insulated Cables):
**Insulated Cables:** Introduction, insulation, insulating materials, Extra high voltage cables, grading of cables, insulation resistance of a cable, Capacitance of a single core and three core cables, Overhead lines versus underground cables, types of cables

**Textbooks:**


**Reference Books:**

2. Deshpande M.V, 'Elements of Electrical Power systems Design’, Pitman, New Delhi, PHI Learning Private Limited,
CONTROL SYSTEM

Pre-requisites of course: Basic signal systems

<table>
<thead>
<tr>
<th>Course Outcome</th>
<th>Knowledge Level, KL</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO 1 Obtain transfer functions to predict the correct operation of open loop and closed loop control systems and identify the basic elements, structures and the characteristics of feedback control systems.</td>
<td>K3</td>
</tr>
<tr>
<td>CO 2 Measure and evaluate the performance of basic control systems in time domain. Design specification for different control action.</td>
<td>K4</td>
</tr>
<tr>
<td>CO 3 Analyze the stability of linear time-invariant systems in time domain using Routh-Hurwitz criterion and root locus technique.</td>
<td>K4</td>
</tr>
<tr>
<td>CO 4 Determine the stability of linear time-invariant systems in frequency domain using Nyquist criterion and Bode plot.</td>
<td>K4</td>
</tr>
<tr>
<td>CO 5 Design different type of compensators to achieve the desired performance of control System by root locus and Bode plot method. Develop and analyze the intermediate states of the system using state space analysis.</td>
<td>K5</td>
</tr>
</tbody>
</table>

KL - Bloom’s Knowledge Level (K1, K2, K3, K4, K5, K6)
K1 – Remember  K2 – Understand K3 – Apply K4 – Analyze K5 – Evaluate K6 – Create

Detailed Syllabus:

Unit-I:
Control System Concepts: Elements of control systems, concept of open loop and closed loop systems, Examples and application of open loop and closed loop systems, Mathematical Modelling of Physical Systems (Electro Mechanical), Determination of transfer function by block diagram reduction techniques and signal flow method using Mason’s gain formula, Basic Characteristics of negative feedback control systems.
Control System Components: Constructional and working concept of AC & DC servomotor, synchro’s, stepper motor and tachometer.

Unit-II:
Time Response Analysis: Standard test signals, time response analysis of first and second order systems, time response specifications of second order system for unit step input, location of roots of characteristics equation and corresponding time response, steady state errors and error constants.
Basic modes of feedback control: Proportional, Derivative, Integral and PID controllers.

Unit-III:
Stability and Algebraic Criteria: Concept of stability and its necessary conditions, Routh-Hurwitz criteria and its limitations.
Unit-IV:
**Frequency Response Analysis:** Frequency Response analysis from transfer function model, Construction of polar and inverse polar plots.

**Stability in Frequency Domain:** Nyquist stability criterion, Determination of gain and phase margin from Bode & Nyquist Plots, Correlation between time and Frequency Responses.

Unit-V

**Introduction to Design:** The design problems and preliminary considerations of lead, lag and lead-lag compensation networks, design of closed loop systems using compensation techniques in time and frequency domains.

**State Space Technique:** The concept of state & space, State-space model of physical system, conversion of state-space to transfer function model and vice-versa, State transition matrix, Concept of controllability and observability and their testing.

**Text Book:**
5. D. Roy Choudhary, “Modern Control Engineering”, Prentice Hall of India.

**Reference Books:**
ELECTRICAL & ELECTRONICS ENGINEERING

ELECTRICAL MACHINE-II

Pre-requisites of course: Basic Electrical Engineering, Electrical Machine-I

<table>
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<tr>
<th>Course Outcome</th>
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<tbody>
<tr>
<td>Upon the completion of the course, the student will be able to:</td>
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<tr>
<td>CO 1 Demonstrate the constructional details and principle of operation of</td>
<td>K3</td>
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<tr>
<td>three phase Induction and Synchronous Machines.</td>
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<tr>
<td>CO 2 Analyze the performance of the three phase Induction and Synchronous</td>
<td>K4</td>
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<tr>
<td>Machines using the phasor diagrams and equivalent circuits.</td>
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<tr>
<td>CO 3 Select appropriate three phase AC machine for any application and</td>
<td>K4</td>
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<tr>
<td>appraise its significance.</td>
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<tr>
<td>CO 4 Start and observe the various characteristics of three phase Induction</td>
<td>K4</td>
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<tr>
<td>&amp; Synchronous Machines</td>
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<tr>
<td>CO 5 Explain the principle of operation and performance of Single-Phase</td>
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<tr>
<td>Induction Motor &amp; Universal Motor.</td>
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</table>

KL- Bloom’s Knowledge Level (K1, K2, K3, K4, K5, K6)
K1 – Remember K2 – Understand K3 – Apply K4 – Analyze K5 – Evaluate K6 – Create

Detailed Syllabus:

UNIT – I: Synchronous Machine-I
Constructional features, Armature winding, EMF Equation, Winding coefficients, Equivalent circuit and phasor diagram, Armature reaction, O. C. & S. C. tests, Voltage regulation using Synchronous Impedance method, MMF method, Potier’s Triangle method, Voltage and frequency control (Governor system) of alternators, Parallel operation of synchronous generators, Operation on infinite bus, Synchronizing power and torque co-efficient.

UNIT – II: Synchronous Machine II
Two reaction theory, Transient and sub-transient reactance, Power flow equations of cylindrical and salient pole machines, Operating characteristics. Synchronous Motor-Starting methods, Effect of varying field current at different loads, V-curves, Hunting & damping, Synchronous condenser.

UNIT – III: Three phase Induction Machine - I
Constructional features, Rotating magnetic field, Principle of operation, Phasor diagram, Equivalent circuit, Torque and power equations, Torque- slip characteristics, No load & blocked rotor tests, Efficiency.

UNIT – IV: Three phase Induction Machine- II
Starting, Deep bar and double cage rotors, Cogging & Crawling, Speed control (with and without emf injection in rotor circuit).

UNIT – V: Single phase Induction Motor
Double revolving field theory, Equivalent circuit, No load and blocked rotor tests, Starting methods, Repulsion motor, Universal motor.
Text Books:
2. Rajendra Prasad, "Electrical Machines", PHI
3. PS Bimbhra, "Electrical Machinery", Khanna Publisher

Reference Books:
3. PS Bimbhra, Generalized Theory.
POWER SYSTEM LABORATORY - I

Pre-requisites of course: Basic understanding of Scilab/MATLAB/C/C++

<table>
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<th>Course Outcomes:</th>
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<td>CO1</td>
<td>K6</td>
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<tr>
<td>Use programming tools /Software: Scilab, MATLAB or any C, C++ - Compiler and formulate a program/simulation model for calculation of various parameters related to transmission line.</td>
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</tbody>
</table>

Note: Minimum ten experiments are to be performed from the following list, on a software platform preferably on Scilab, MATLAB, or any C, C++ - Compiler

1. Calculate the parameters of single-phase transmission line
2. Calculate the parameters of three phase single circuit transmission line
3. Calculate the parameters of three phase double circuit transmission line
4. Determine the ABCD constant for transmission line.
5. Simulate the Ferranti effect in transmission line
6. Calculate the corona loss of transmission line
7. Calculation of sag & tension of transmission line
8. Calculation of string efficiency of insulator of transmission line
9. Calculation for grading of underground cables
10. Simulate the skin effect in the transmission line
11. Calculation of ground clearance of transmission line
12. Calculate the parameters for underground cable.

Spoken Tutorial (MOOCs):
Spoken Tutorial MOOCs, 'Course on Scilab', IIT Bombay (http://spoken-tutorial.org/)
CONTROL SYSTEM LABORATORY

**Pre-requisites of course:** Basic understanding of Scilab/MATLAB or any equivalent open source software

### Course Outcomes:

<table>
<thead>
<tr>
<th>Course Outcomes</th>
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</thead>
<tbody>
<tr>
<td>Upon the completion of the course, the student will be able to:</td>
<td></td>
</tr>
<tr>
<td>CO 1 Distinguish the characteristics of control system components like ac servo motor, synchro, potentiometer, servo voltage stabilizer and use them in error detector mode.</td>
<td>K4</td>
</tr>
<tr>
<td>CO2 Compare the performance of control systems by applying different controllers / compensators.</td>
<td>K5</td>
</tr>
<tr>
<td>CO3 Analyze the behavior of dc motor in open loop and closed loop conditions at various loads &amp; determine the response of 1st &amp; 2nd order systems for various values of constant K.</td>
<td>K5</td>
</tr>
<tr>
<td>CO4 Apply different stability methods of time &amp; frequency domain in control systems using software &amp; examine their stability.</td>
<td>K4</td>
</tr>
<tr>
<td>CO5 Convert the transfer function into state space &amp; vice versa &amp; obtain the time domain response of a second order system for step input and their performance parameters using software.</td>
<td>K5</td>
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**KL - Bloom’s Knowledge Level (K₁, K₂, K₃, K₄, K₅, K₆)***

K₁ – Remember K₂ – Understand K₃ – Apply K₄ – Analyze K₅ – Evaluate K₆ – Create

**Note:** Minimum 10 experiments are to be performed from the following list:

1. To determine speed-torque characteristics of an AC servomotor.
2. To study
   i) Synchro Transmitter characteristics.
   ii) Obtain Synchro Transmitter – Receiver output vs input characteristics.
3. To determine response of first order and second order systems for step input for various values of constant ‘K’ using linear simulator unit and compare theoretical and practical results.
4. To study characteristics of positional error detector by angular displacement of two servo potentiometers.
5. To simulate and compare the response of 2nd order system with and without lead, lag, Lead- Lag compensator / simulate PID controller for transportation lag.
6. To study P, PI and PID temperature controller for an oven and compare their characteristics.
7. To study performance of servo voltage stabilizer at various loads using load bank.
8. To study behavior of separately excited dc motor in open loop and closed loop conditions at various loads.

**Software based experiments** (Scilab/MATLAB or any equivalent open source software)

9. To determine time domain response of a second order system for step input and obtain performance parameters.
10. To convert transfer function of a system into state space form and vice-versa.
11. To plot root locus diagram of an open loop transfer function and determine range of gain ‘k’ for stability.
12. To plot a Bode diagram of an open loop transfer function.
13. To draw a Nyquist plot of an open loop transfer functions and examine the stability of the closed loop system.

Spoken Tutorial (MOOCs):
Spoken Tutorial MOOCs, 'Course on Scilab', IIT Bombay (http://spoken-tutorial.org/)

Reference Books:
1. K.Ogata,“Modern Control Engineering” Prentice Hall of India.
ELECTRICAL & ELECTRONICS ENGINEERING

ELECTRICAL MACHINE-II LABORATORY

Pre-requisites of course: Basic Electrical engineering Lab, Electrical Machine-I Lab.

Course Outcomes:

<table>
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<tr>
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</thead>
<tbody>
<tr>
<td>Upon the completion of the course, the student will be able to:</td>
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<tr>
<td>CO 1 Perform various tests and demonstrate the various characteristics of three phase induction motor.</td>
<td>K4</td>
</tr>
<tr>
<td>CO2 Demonstrate the working of three phase synchronous machine under different operating conditions.</td>
<td>K4</td>
</tr>
<tr>
<td>CO3 Evaluate the performance of single-phase induction motor under different operating conditions.</td>
<td>K5</td>
</tr>
<tr>
<td>CO4 Develop simulation models for Electrical Machines.</td>
<td>K6</td>
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</tbody>
</table>

KL- Bloom’s Knowledge Level (K₁, K₂, K₃, K₄, K₅, K₆)
K₁ – Remember K₂ – Understand K₃ – Apply K₄ – Analyze K₅ – Evaluate K₆ – Create

Note: Minimum 10 experiments are to be performed from the following list:

1. To perform no load and blocked rotor tests on a three phase squirrel cage induction motor and determine equivalent circuit.
2. To perform load test on a three phase induction motor and draw Torque -speed characteristics
3. To perform no load and blocked rotor tests on a single phase induction motor and determine equivalent circuit.
4. To study speed control of three phase induction motor by varying supply voltage and by keeping V/f ratio constant.
5. To perform open circuit and short circuit tests on a three phase alternator.
6. To determine V-curves and inverted V-curves of a three phase synchronous motor.
7. To determine the direct axis reactance (Xd) and quadrature axis reactance (Xq) of synchronous machine.
8. To study synchronization of an alternator with the infinite bus by using: (i) dark lamp method (ii) two bright and one dark lamp method.
9. To determine speed-torque characteristics of three phase slip ring induction motor and study the effect of including resistance, or capacitance in the rotor circuit.
10. To determine speed-torque characteristics of single phase induction motor and study the effect of voltage variation.
11. To determine speed-torque characteristics of a three phase induction motor by (i) keeping v/f ratio constant (ii) increasing frequency at the rated voltage.
12. To draw O.C. and S.C. characteristics of a three phase alternator from the experimental data and determine voltage regulation at full load, and unity, 0.8 lagging and leading power factors.
14. Load Test on Three Phase Alternator.

*The available Experiments from above list may be performed on virtual lab on following virtual lab link: http://vlab.co.in/
B.Tech 3rd Year
VI Semester
Syllabus
POWER SYSTEMS-II

Pre-requisites of course: Basic Electrical Engineering, Networks Analysis and Synthesis, Electromagnetic Field Theory, Power System-I, Electrical Machines-II

Course Outcomes:

<table>
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</tr>
<tr>
<td>CO1 Identify power system components on one line diagram of power system and its representation including the behaviour of the constituent components and sub systems and Analyse a network under both balanced and unbalanced fault conditions and design the rating of circuit breakers.</td>
<td>K4</td>
</tr>
<tr>
<td>CO2 Perform load flow analysis of an electrical power network and interpret the results of the analysis.</td>
<td>K4</td>
</tr>
<tr>
<td>CO3 Describe the concept of travelling waves in transmission lines and use the travelling wave theory to determine the over voltage caused by surge propagation in transmission networks.</td>
<td>K4</td>
</tr>
<tr>
<td>CO4 Assess the steady state and transient stability of the power system under various conditions.</td>
<td>K4</td>
</tr>
<tr>
<td>CO5 Describe Operating Principle of a relay and classify them according to applications. Explain working principle of Circuit breaker and phenomenon of arc production and quenching.</td>
<td>K3</td>
</tr>
</tbody>
</table>

KL- Bloom’s Knowledge Level (K1, K2, K3, K4, K5, K6)
K1 – Remember K2 – Understand K3 – Apply K4 – Analyze K5 – Evaluate K6 – Create

Detailed Syllabus:

UNIT-I (Fault Analysis in Power System):
One-line diagram, Impedance and reactance diagram, per unit system changing the base of per unit quantities, advantages of per unit system.

Symmetrical Components: Significance of positive, negative and zero sequence components, Average 3-phase power in terms of symmetrical components, sequence impedances and sequence networks.

Fault Calculations: Fault calculations, sequence network equations, single line to ground fault, line to line fault, double line to ground fault, three phase faults, faults on power systems, and faults with fault impedance, reactors and their location, short circuit capacity of a bus

UNIT-II (Load Flow Analysis):
Introduction, Formation of $Z_{BUS}$ and $Y_{BUS}$, development of load flow equations, load flow solution using Gauss Siedel and Newton-Raphson method, Comparison of Gauss Siedel and Newton Raphson Method, approximation to N-R method, fast decoupled method.

UNIT-III (Travelling Waves in Power System):

Travelling Waves on Transmission Lines: Production of traveling waves, open circuited line, short circuited line, line terminated through a resistance, line connected to a cable, reflection and refraction at T-junction line terminated through a capacitance, capacitor connection at a T-junction, Attenuation of travelling waves, Bewley’s Lattice diagram.

UNIT-IV (Stability in Power System):
Power flow through a transmission line, Stability and Stability limit, Steady state stability study, derivation of Swing equation, transient stability studies by equal area criterion. Factors affecting steady state and transient stability and methods of improvement.

UNIT-V (Introduction to Power System Protection):
Relays: Operating Principle of a general relay,
Basic Terminology: Relay, Energizing Quantity, setting, Pickup, drop out, Flag, fault clearing time, Relay time, Breaker time, Overreach, Underreach; Classification of Relays according to applications, according to time. Overcurrent Relay, Distance Protection, Differential Protection.

Text Books:
6. B. Ravindranath and M. Chander, Power system Protection and Switchgear, Wiley Eastern Ltd.

Reference Books:
MICROPROCESSOR AND MICROCONTROLLER

Pre-requisites of course: Digital Electronics, Computer Basics

Course Outcomes:

<table>
<thead>
<tr>
<th>Knowledge Level, KL</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO 1 Demonstrate the basic architecture of 8085 &amp; 8086 microprocessors</td>
</tr>
<tr>
<td>CO2 Illustrate the programming model of microprocessors &amp; write program using 8085 microprocessor</td>
</tr>
<tr>
<td>CO3 Interface different external peripheral devices with 8085 microprocessor</td>
</tr>
<tr>
<td>CO4 Comprehend the architecture of 8051 microcontroller</td>
</tr>
<tr>
<td>CO5 Compare advance level microprocessor &amp; microcontroller for different applications</td>
</tr>
</tbody>
</table>

KL- Bloom’s Knowledge Level (K₁, K₂, K₃, K₄, K₅, K₆)

K₁ – Remember  K₂ – Understand  K₃ – Apply  K₄ – Analyze  K₅ – Evaluate  K₆ – Create

Detailed Syllabus:

Unit- I:

Introduction to Microprocessor: Microprocessor architecture and its operations, Memory, Input & output devices, The 8085 MPU- architecture, Pins and signals, Timing Diagrams, Logic devices for interfacing, Memory interfacing, Interfacing output displays, Interfacing input devices, Memory mapped I/O.

Basic Programming concepts: Flow chart symbols, Data Transfer operations, Arithmetic operations, Logic Operations, Branch operation, Writing assembly language programs, Programming techniques: looping, counting and indexing. Additional data transfer and 16 bit arithmetic instruction, Logic operation: rotate, compare, counter and time delays, 8085 Interrupts.

Unit-II:

Intel 8086 microprocessor: Internal architecture (Bus Interface Unit, Execution unit, Pipelining, Register organization), Pin Diagram, Memory addressing, Physical memory organization, Interrupts (hardware & software interrupts)

Unit-III:

Peripheral Devices: 8237 DMA Controller, 8255 programmable peripheral interface, 8253/8254programmable timer/counter, 8259 programmable interrupt controller, 8251 USART and RS232C.

Fundamental of Programming: Program structure & programming techniques for microprocessors, 8085 Addressing modes, 8085 Instruction set, Assembly language programming of 8085 microprocessor with examples (arithmetic operations on 8-bit numbers – add, subtract, multiply, divide, square & square root etc, largest/ smallest number; ascending/ descending order).

Unit-IV:

8051 Microcontroller Basics: Inside the Computer, Microcontrollers and Embedded Processors, Block Diagram of 8051, PSW and Flag Bits, 8051 Register Banks and Stack, Internal Memory Organization of 8051, IO Port Usage in 8051, Types of Special Function Registers and their uses in 8051, Pins Of 8051. Memory Address Decoding, 8031/51 Interfacing With External ROM And RAM. 8051 Addressing Modes.
Unit-V:

Assembly programming and instruction of 8051: Introduction to 8051 assembly programming, Assembling and running an 8051 program, Data types and Assembler directives, Arithmetic, logic instructions and programs, Jump, loop and call instructions, IO port programming. Programming 8051 Timers. Serial Port Programming, Interrupts Programming, Comparison of Microprocessor, Microcontroller, PIC and ARM processors and their application areas.

Text Books:
5. Fundamental of Microprocessor and Microcontrollers, B. RAM, Dhanpat Rai Publication
6. Soumitha Kumar Mandal, Microprocessor and Microcontrollers Architecture Programming and Interfacing using 8085, 8086 and 8051, McGraw Hill
7. K. Ayala, 8051 Microcontroller, Cengage learning

Reference Books:
POWER ELECTRONICS

Pre-requisites of course: Basic Electrical Engineering, Network Analysis & Synthesis

<table>
<thead>
<tr>
<th>Course Outcomes:</th>
<th>Knowledge Level, KL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upon the completion of the course, the student will be able to:</td>
<td></td>
</tr>
<tr>
<td>CO 1</td>
<td>Demonstrate the characteristics as well as the operation of BJT, MOSFET, IGBT, SCR, TRIAC and GTO and identify their use in the power switching applications.</td>
</tr>
<tr>
<td>CO2</td>
<td>Comprehend the non-isolated DC-DC converters and apply their use in different Power electronics applications.</td>
</tr>
<tr>
<td>CO3</td>
<td>Analyze the phase controlled rectifiers and evaluate their performance parameters.</td>
</tr>
<tr>
<td>CO4</td>
<td>Apprehend the working of single-phase ac voltage controllers, cyclo-converters and their various applications.</td>
</tr>
<tr>
<td>CO5</td>
<td>Explain the single-phase and three phase bridge inverters differentiate between CSI and VSI and apply PWM for harmonic reduction.</td>
</tr>
</tbody>
</table>

KL- Bloom’s Knowledge Level (K₁, K₂, K₃, K₄, K₅, K₆)
K₁ – Remember  K₂ – Understand  K₃ – Apply  K₄ – Analyze  K₅ – Evaluate  K₆ – Create

Detailed Syllabus:

Unit-I: Power semiconductor devices:
Introduction: Concept of Power Electronics, scope and applications, desired Characteristics of controllable switches
Power semiconductor switches and their characteristics: Power Diode, Power BJT, Power MOSFET, IGBT, SCR, TRIAC, GTO.

Unit-II:
Thyristor: Rating & protection, Methods of SCR commutation, Gate Drive Circuit, Series and Parallel operation.
DC-DC Converters: Introduction, Control Strategies, Buck converter, Boost Converter, Buck-Boost converter, Analysis of buck converter, Switched Mode power Supply (SMPS).

Unit-III: Phase Controlled Converters:
Single phase half wave controlled rectifier with various loads, Effect of freewheelingdiode, Single phase fully controlled and half controlled bridge converters with various loads. Performance Parameters of single phase uncontrolled and controlled converters, three phase half wave converters, Three phase fully controlled and half controlled bridge converters, Effect of source impedance, Single phase and three phase dual converters

Unit-IV: AC Voltage Controllers:
Principle of On-Off and phase controls, Single phase ac voltage controller with resistive and inductive loads, sequence control, Introduction to Matrix converter.
Cyclo Converters: Basic principle of operation, single phase to single phase, three phase to single phase output voltage equation.

Unit-V: Inverters:
Single phase and Three phase bridge inverters, voltage source inverters, current source inverters, Voltage control of single phase inverters, Pulse width modulation, Introduction to Multi level inverter.

Text Books:


Reference Books:

1. M.S. Jamil Asghar, “Power Electronics” Prentice Hall of India Ltd., 2004
ELECTRICAL & ELECTRONICS ENGINEERING

POWER SYSTEM LAB-II

Pre-requisites of course: Power System-I Lab

Course Outcomes:

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Knowledge Level, KL</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1 Test various relays for different characteristics and compare with the performance characteristics provided by manufacturers.</td>
<td>K4</td>
</tr>
<tr>
<td>CO2 Select the power system data for load-flow and fault studies and to develop a program to solve power flow problem using NR and GS methods</td>
<td>K6</td>
</tr>
<tr>
<td>CO3 Analyze various types of short circuit faults</td>
<td>K4</td>
</tr>
<tr>
<td>CO4 Demonstrate different numerical integration methods and factors influencing transient stability</td>
<td>K3</td>
</tr>
<tr>
<td>CO5 Determine the effect of load in long transmission line</td>
<td>K3</td>
</tr>
</tbody>
</table>

Note: - Minimum 10 experiments are to be performed from the following list:

(A) Hardware Based Experiments:

2. To Study the over-current relay and the effect of PSM and TSM.
3. To study percentage differential relay.
4. To study Impedance, MHO and Reactance type distance relays and zones of protection.
5. To study Ferranti effect of a transmission line/cable.
6. To measure the dielectric Strength of transformer oil.
7. To study the Synchronization of alternator with infinite bus bar.
8. To determine positive sequence, negative sequence and zero sequence reactance of an alternator.
9. To Study the effect of different shape of electrodes on dielectric (air) breakdown.
10. To Study the gas actuated Buchholz relay for oil filled transformer.
11. To determine the sub-transient (xd\"), transient (xd\') and steady state reactance (xd) of a synchronous machine.

*The available Experiments from above list may be performed on virtual lab on following virtual lab link: [http://vlab.co.in/](http://vlab.co.in/)

(B) Simulation Based Experiments (using Scilab/MATLAB or any other equivalent open source software platform)

1. To obtain formation of Y-bus.
4. To perform symmetrical fault analysis in a power system.
5. To perform unsymmetrical fault analysis in a power system.
7. Determination of the stability of a SMIB system in occurrence of a fault by solving the Swing equation by Euler’s Method.

Text Books: -

### MICROPROCESSOR AND MICROCONTROLLER LAB

**Pre-requisites of course:** Digital Electronics, Computer Basics

<table>
<thead>
<tr>
<th>Course Outcomes:</th>
<th>Knowledge Level, KL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upon the completion of the course, the student will be able to:</td>
<td></td>
</tr>
<tr>
<td>CO 1 Study of microprocessor system</td>
<td>K2</td>
</tr>
<tr>
<td>CO2 Development of flow chart for understanding the data flow</td>
<td>K3</td>
</tr>
<tr>
<td>CO3 Learning assembly language to program microprocessor based system</td>
<td>K3</td>
</tr>
<tr>
<td>CO4 Interfacing different peripheral devices with the microprocessor</td>
<td>K4</td>
</tr>
<tr>
<td>CO5 Building logic for microprocessor based system</td>
<td>K4</td>
</tr>
</tbody>
</table>

**KL - Bloom’s Knowledge Level** (K₁, K₂, K₃, K₄, K₅, K₆)

- K₁ – Remember
- K₂ – Understand
- K₃ – Apply
- K₄ – Analyze
- K₅ – Evaluate
- K₆ – Create

**Note:** Minimum ten experiments are to be performed from the following list (on 8085 / 8086 microprocessor)

1. To study 8085 / 8086 based microprocessor system
2. To perform mathematical operations (addition & subtraction) on two 8-bit numbers
3. To perform multiplication on two 8-bit numbers
4. To perform division on two 8-bit numbers
5. To develop and run a program for finding out the largest number from given two 8-bit numbers
6. To develop and run a program for finding out the smallest number from given two 8-bit numbers
7. To develop and run a program for arranging in ascending order of a given set of 8-bit numbers
8. To develop and run a program for arranging in descending order of a given set of 8-bit numbers
9. To perform conversion of temperature from degree F to degree C
10. To perform computation of square root of a given number
11. To obtain interfacing of 8255 – PPI with 8085 microprocessor
12. To perform microprocessor based traffic light control
13. To perform microprocessor based stepper motor operation through 8085 / 8086 kit
14. To obtain interfacing of DMA controller with 8085 / 8086 microprocessor
PART B SUGGESTIVE LIST OF EXPERIMENTS (Through Virtual Lab Link):

1. Write a program using 8085 Microprocessor for Decimal, Hexadecimal addition and subtraction of two Numbers. (Through Virtual Lab Link)
2. Write a program using 8085 Microprocessor for addition and subtraction of two BCD numbers. (Through Virtual Lab Link)
3. To perform multiplication and division of two 8 bit numbers using 8085. (Through Virtual Lab Link)
4. To find the largest and smallest number in an array of data using 8085 instruction set.
5. To write a program using 8086 to arrange an array of data in ascending and descending order. (Through Virtual Lab Link)
6. To convert given Hexadecimal number into its equivalent ASCII number and vice versa using 8086 instruction set.
7. To convert given Hexadecimal number into its equivalent BCD number and vice versa using 8086 instruction set.
8. To interface 8253 programmable interval timer and verify the operation of 8253 in six different modes.
9. To write a program to initiate 8251 and to check the transmission and reception of character.
10. Serial communication between two 8085 through RS-232 C port.
11. Write a program of Flashing LED connected to port 1 of the 8051 Micro Controller
12. Write a program to generate 10 kHz square wave using 8051.
13. Write a program to show the use of INT0 and INT1 of 8051.
14. Write a program for temperature & to display on intelligent LCD display.
15. Interfacing of Stepper motor to 8051.
16. Interfacing of ADC to 8051.

Virtual Lab Link: http://vlabs.iitb.ac.in/vlabs-dev/labs_local/microprocessor/labs/explist.php

Available on: http://www.vlab.co.in/broad-area-electronics-and-communications
POWER ELECTRONICS LABORATORY

Pre-requisites of course: Basic Electrical Engineering, Network Analysis & Synthesis

Course Outcomes:

<table>
<thead>
<tr>
<th>Knowledge Level, KL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upon the completion of the course, the student will be able to:</td>
</tr>
</tbody>
</table>

**CO 1** Demonstrate the characteristics and triggering of IGBT, MOSFET, Power transistor and SCR.  
**CO 2** Analyze the performance of single phase fully controlled bridge rectifiers under different loading conditions.  
**CO 3** Develop simulation models of power electronic circuits.

KL - Bloom’s Knowledge Level (K₁, K₂, K₃, K₄, K₅, K₆)

K₁ – Remember  K₂ – Understand  K₃ – Apply  K₄ – Analyze  K₅ – Evaluate  K₆ – Create

Note: Minimum 10 experiments are to be performed from the following list:

1. To study triggering of (i) IGBT (ii) MOSFET (iii) power transistor
2. To study V-I characteristics of SCR and measure latching and holding currents.
3. To compare the R, RC & UJT trigger circuit for SCR.
4. To study the commutation circuit for SCR.
5. To study single phase fully controlled bridge rectifiers with resistive and inductive loads.
6. To study single phase fully controlled bridge rectifiers with DC motor load.
7. To study three-phase fully controlled bridge rectifier with resistive and inductive loads.
8. To study single-phase ac voltage regulator with resistive and inductive loads.
9. To study single phase cyclo-converter
10. To study the four quadrant operation of chopper circuit
11. To study MOSFET/IGBT based single-phase bridge inverter.

Software based experiments (Scilab/MATLAB or any equivalent open source software)

12. To obtain the simulation of single phase half wave controlled rectifier with R and RL load and plot load voltage and load current waveforms.
13. To obtain simulation of single phase fully controlled bridge rectifier and plot load voltage and load current waveform for inductive load.
14. To obtain simulation of single phase full wave ac voltage controller and draw load voltage and load current waveforms for inductive load.
15. To obtain simulation of step down dc chopper with L-C output filter for inductive load and determine steady-state values of output voltage ripples in output voltage and load current.

Text/Reference Books:
DEPARTMENTAL ELECTIVES
DEPARTMENT ELECTIVE-I
ROBOTICS

Pre-requisites of course: Basic Mathematics.

Course Outcomes:

<table>
<thead>
<tr>
<th>Knowledge Level, KL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upon the completion of the course, the student will be able to:</td>
</tr>
<tr>
<td>CO1 Learn the basic terminology used in robotics.</td>
</tr>
<tr>
<td>CO2 Conceptualize 3-D translation &amp; orientation of robot arm kinematics.</td>
</tr>
<tr>
<td>CO3 Understand different robotic actuators and power transmission systems.</td>
</tr>
<tr>
<td>CO4 Classify the types of robotic grippers used in automation industries.</td>
</tr>
<tr>
<td>CO5 Realization of robotic sensoric system and their interfacing with robot controller.</td>
</tr>
</tbody>
</table>

KL- Bloom’s Knowledge Level (K₁, K₂, K₃, K₄, K₅, K₆)
K₁ – Remember  K₂ – Understand  K₃ – Apply  K₄ – Analyze  K₅ – Evaluate  K₆ – Create

Detailed Syllabus:

UNIT I: INTRODUCTION
Classifications of robots, Flexible automation vs. Robotic technology, Robot components and degree of freedom, Robot joints, coordinates and reference frames, characteristics of robots, Robot workspace, role of robots in Industry 4.0; Robot safety and social robotics.

UNIT II: KINEMATICS OF ROBOT

UNIT III: ROBOT ACTUATORS AND POWER TRANSMISSION SYSTEMS
Characteristics of actuating systems, comparison of hydraulic, pneumatic and electrical actuating system, Mechanical transmission method (concept only) - Gear transmission, Belt drives, cables, Roller chains, Link-Rod systems, Rotary-to-Rotary motion conversion, Rotary-to-Linear motion conversion, Rack and Pinion drives, Lead screws, Ball Bearing screws.

UNIT IV: ROBOT GRIPPERS
Classification of End effectors, Drive system for grippers - Mechanical adhesive vacuum-magnetic-grippers. Hooks & scoops, Active and passive grippers.

UNIT V: ROBOT SENSORS, CONTROL HARDWARE AND INTERFACING
TEXT BOOKS:


REFERENCES:

**SENSORS AND TRANSDUCERS**

**Pre-requisites of course:** Basic Electrical Engineering, Basic signals & systems

**Course Outcomes:**

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Knowledge Level, KL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upon the completion of the course, the student will be able to:</td>
<td></td>
</tr>
<tr>
<td><strong>CO 1</strong> Understand the working of commonly used sensors in industry for measurement of displacement, force and pressure.</td>
<td>K3</td>
</tr>
<tr>
<td><strong>CO2</strong> Recognize the working of commonly used sensors in industry for measurement of temperature, position, accelerometer, vibration sensor, flow and level.</td>
<td>K3</td>
</tr>
<tr>
<td><strong>CO3</strong> Identify the application of machine vision.</td>
<td>K2</td>
</tr>
<tr>
<td><strong>CO4</strong> Conceptualize signal conditioning and data acquisition methods.</td>
<td>K2</td>
</tr>
<tr>
<td><strong>CO5</strong> Comprehend smart sensors and their applications in automation systems.</td>
<td>K4</td>
</tr>
</tbody>
</table>

*KL- Bloom’s Knowledge Level (K₁, K₂, K₃, K₄, K₅, K₆)*

K₁ – Remember  K₂ – Understand  K₃ – Apply  K₄ – Analyze  K₅ – Evaluate  K₆ – Create

**Detailed Syllabus:**

**Unit- I:**

Sensors & Transducer: Definition, Classification of transducers, Advantages and Disadvantages of Electrical Transducers; Measurement of displacement using Potentiometer, LVDT & Optical Encoder; Measurement of force using strain gauges & load cells; Measurement of pressure using LVDT based diaphragm & piezoelectric sensor.

**Unit-II:**


**Unit -III:**

Machine Vision: Introduction to machine vision, Difference between machine vision and computer vision; Imaging Sensors: CCD and CMOS; sensing & digitizing function in machine vision, image processing and analysis, training the vision system in a pick and place robot.

**Unit-IV:**

Signal Conditioning: Introduction, Functions of signal conditioning equipment, need for amplification of signals, Types of amplifiers.
Data Acquisition Systems and Conversion: Introduction, Objectives & configuration of data acquisition system, Analog & Digital IO, Counters, Timers, need of data conversion.

Unit V:

Text Books:

Reference Books:
INDUSTRIAL AUTOMATION & CONTROL

Pre-requisites of course: Digital Electronics

Course Outcomes:

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Knowledge Level, KL</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1 Understand the concept of automation, its terminology and basic communication protocol.</td>
<td>K2</td>
</tr>
<tr>
<td>CO2 Apply Relay logic for automation.</td>
<td>K3</td>
</tr>
<tr>
<td>CO3 Learn about PLC, its operation and application in automation.</td>
<td>K3</td>
</tr>
<tr>
<td>CO4 Analyze the industrial sensors, its terminology and how one can interface with PLC.</td>
<td>K3</td>
</tr>
<tr>
<td>CO5 Demonstrate Pneumatic system and its application in industry.</td>
<td>K3</td>
</tr>
</tbody>
</table>

KL- Bloom’s Knowledge Level (K1, K2, K3, K4, K5, K6)
K1 – Remember K2 – Understand K3 – Apply K4 – Analyze K5 – Evaluate K6 – Create

Detailed Syllabus:

**Unit1: Introduction of Automation system**

Introduction to Industrial Automation, Requirement of automation systems, Application areas, Architecture of Industrial Automation system, Introduction of PLC and supervisory control and data acquisition (SCADA). Industrial communication protocols: modbus & profibus

**Unit2: Automation using relay logic**

Relay Circuits: Construction & Principle of Operation, Types of Relays, Relay as a memory element, Contactor Circuits, Advantages of Contactors over Relay, DOL circuit implementation using contactor, Automation problems based on relays, PLC Introduction: History & Current Trends, Basic Block Diagram of PLC, Classification of PLCs

**Unit3: Automation using PLC**

Types of PLC I/O: Analog and Digital, Sink and Source concept, PLC programming: Ladder diagram, Sequential flow chart, ladder programming, Timer instructions – On delay, Off delay, Cyclic and Retentive timers, Up/Down Counters, math instructions

**Unit4: Industrial sensors and its application**

Introduction to Industrial sensors: optical, inductive, capacitive Sensors, PNP and NPN sensor concept, interfacing of sensors with PLC, 4-20 ma current loops, HART protocol, modes of HART protocol

**Unit5: Basics of Pneumatics and its use in automation**

Introduction to Pneumatics, Role in industries, Laws: Boyel’s law, Charle’s Law Bernoulli Equation, Humidity (Absolute & Relative), Dew Point (ADP, PDP) Basic, Pneumatic System (Compressor, After coolers, Dryers, Air Tank, Service Unit (FRL), Actuators(singie acting, double acting), Valves: 2/2 & 3/2 Valves, Problems based on valves and actuator
Text Books:

1. Industrial Instrumentation and Control, by Singh, McGraw Hill.

Reference Books:

1. B. Pneumatic Systems-Principles and Maintenance Mazumdar S. R
Pre-requisites of course: Basic Electronics & Transducers

Course Outcomes:

<table>
<thead>
<tr>
<th>Knowledge Level, KL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upon the completion of the course, the student will be able to:</td>
</tr>
</tbody>
</table>

| CO1 | Understand the physiological system of the body and also an understanding on the generation of various bioelectric signals like ECG, EEG and EMG, their characteristic features and concepts of transduction. | K2 |
| CO2 | Remember the various techniques and clinical instruments available for the measurement of various physiological parameters. | K2 |
| CO3 | Apply the various techniques and clinical instruments available for the measurement of various Nervous system parameters | K3 |
| CO4 | Evaluate fundamentals of medical instrumentation along with their working principle. | K4 |
| CO5 | Differentiate patient monitoring system, their types and safety hazards | K3 |

KL- Bloom’s Knowledge Level (K1, K2, K3, K4, K5, K6)
K1 – Remember K2 – Understand K3 – Apply K4 – Analyze K5 – Evaluate K6 – Create

Detailed Syllabus:

Unit-I: Introduction to Biomedical Instrumentation: Problems encountered in measurements of living systems, Block diagram of Biomedical Instrumentation System & its components and Biomaterials for medical instrument applications. Transducers use for biomedical applications. Bioelectric potential: Genesis, Propagation and Distribution (ECG, EEG and EMG).

Unit-II: Bio-potential Electrodes: Basic types: Micro, Skin surface and needle electrodes and Biochemical transducers: Blood gas, PH and specific ions electrodes. The cardiovascular system and measurements: Heart and cardiovascular system and its block diagram, Blood pressure, Blood flow & Heart sound characteristics and their measurements. Electrocardiography, ECG leads configurations and recordings of ECG.


Unit-V: Patient care monitoring: Elements of intensive care unit, Organization of the Hospital for patient-care monitoring, Pace-maker systems, their types and modes, Defibrillators and their types. Shock hazards from electrical equipment and safety measures. Bio-telemetry and its applications in patient care and sports.
Text Book:


Reference Book:

DEPARTMENT ELECTIVE-II
OPTIMIZATION TECHNIQUES

Pre-requisites of course: Basic mathematics

<table>
<thead>
<tr>
<th>Course Outcomes:</th>
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</thead>
<tbody>
<tr>
<td>Upon the completion of the course, the student will be able to:</td>
<td></td>
</tr>
<tr>
<td>CO 1 Understand the importance of optimization techniques in engineering applications</td>
<td>K2</td>
</tr>
<tr>
<td>CO2 Learn optimization methods for solving linear programming problems</td>
<td>K3</td>
</tr>
<tr>
<td>CO3 Learn optimization methods for solving nonlinear programming problems</td>
<td>K3</td>
</tr>
<tr>
<td>CO4 Be aware of the concept of simulation and modern methods of optimization</td>
<td>K3</td>
</tr>
<tr>
<td>CO5 Apply optimization techniques to electrical engineering problems</td>
<td>K4</td>
</tr>
</tbody>
</table>

KL- Bloom’s Knowledge Level (K1, K2, K3, K4, K5, K6)
K1 – Remember K2 – Understand K3 – Apply K4 – Analyze K5 – Evaluate K6 – Create

Detailed syllabus:

Unit I

Unit II

Unit III
Non-Linear Programming: Standard form of non-linear programming, One-Dimensional Minimization Methods - Unimodal function, Dichotomous search, interval halving method; Unconstrained Optimization Techniques - Univariate method, Steepest descent method; Constrained Optimization Techniques - Interior Penalty function method, Exterior penalty function method.

Unit IV
Simulation: Definition, types of simulation, General process of simulation, advantages & disadvantages of simulation.
Project Management Techniques: PERT and CPM

Unit V
Case study (algorithm only): Economic load scheduling of power plant (without considering losses), maintenance scheduling of machines in manufacturing industry, fuzzy logic based speed control of DC machines.

Text Books:

Reference Books:
NEURAL NETWORKS & FUZZY SYSTEMS

Course Outcomes:

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Knowledge Level, KL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upon the completion of the course, the student will be able to:</td>
<td></td>
</tr>
<tr>
<td>CO 1 Apply the concepts of feed forward neural networks and their learning techniques.</td>
<td>K3</td>
</tr>
<tr>
<td>CO2 Comprehend the architecture, develop algorithms and apply the concepts of back propagation networks.</td>
<td>K5</td>
</tr>
<tr>
<td>CO3 Differentiate between the fuzzy and the crisp sets, apply the concepts of fuzziness and the fuzzy set theory.</td>
<td>K4</td>
</tr>
<tr>
<td>CO4 Select the membership functions, write rules and develop the fuzzy controller for Industrial applications.</td>
<td>K5</td>
</tr>
<tr>
<td>CO5 Demonstrate the working of fuzzy neural networks and identify its applications.</td>
<td>K3</td>
</tr>
</tbody>
</table>

KL- Bloom’s Knowledge Level (K1, K2, K3, K4, K5, K6)
K1 – Remember K2 – Understand K3 – Apply K4 – Analyze K5 – Evaluate K6 – Create

Detailed syllabus:

Unit-I: Neural Networks-1 (Introduction & Architecture):

Unit-II: Neural Networks-II (Back propagation networks):
Architecture: perceptron model, solution, single layer artificial neural network, multilayer perception model; back propagation learning methods, effect of learning rule co-efficient; back propagation algorithm, factors affecting back propagation training, applications.

Unit-III: Fuzzy Logic-I (Introduction):
Basic concepts of fuzzy logic, Fuzzy sets and Crisp sets, Fuzzy set theory and operations, Properties of fuzzy sets, Fuzzy and Crisp relations, Fuzzy to Crisp conversion.

Unit-IV: Fuzzy Logic –II (Fuzzy Membership, Rules):
Membership functions, interference in fuzzy logic, fuzzy if-then rules, Fuzzy implications and Fuzzy algorithms, Fuzzyfications & Defuzzificataions, Fuzzy Controller, Industrial applications.

Unit-V: Fuzzy Neural Networks:
L-R Type fuzzy numbers, fuzzy neutron, fuzzy back propogation (BP), architecture, learning in fuzzy BP, inference by fuzzy BP, applications.

Text Books:
1. Kumar Satish, “Neural Networks” McGraw Hill

Reference Books:
1. Siman Haykin, “Neural Networks” Prentice Hall of India
2. Timothy J. Ross, “Fuzzy Logic with Engineering Applications” Wiley India
DIGITAL SIGNAL PROCESSING

Pre-requisites of course: Basic Signals & System, Network Analysis & Synthesis.

<table>
<thead>
<tr>
<th>Course Outcomes:</th>
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<tr>
<td>Upon the completion of the course, the student will be able to:</td>
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</tr>
<tr>
<td>CO 1</td>
<td>Represent discrete sequence and LTI systems, frequency domain of discrete sequence. Compute Fourier transform. Draw structure of systems based on System type-IIR &amp; FIR Systems.</td>
</tr>
<tr>
<td>CO2</td>
<td>Describe sampling of signal and its reconstruction, processing of continuous time and discrete time signals. Sampling rate variation and application of multirate signal processing. Sampling effect in A/D and D/A conversion.</td>
</tr>
<tr>
<td>CO3</td>
<td>Evaluate the response of LTI system and rational system function. Drive linear phase systems. Compute discrete Fourier transform (DFT) and calculate linear and circular convolution.</td>
</tr>
<tr>
<td>CO4</td>
<td>Design IIR &amp; FIR filters with the desired specification with the help of impulse invariant and bilinear transformation method for IIR, with the help of window techniques for FIR. Design Butterworth and Chebyshev filter response.</td>
</tr>
<tr>
<td>CO5</td>
<td>Compute DFT using efficient algorithm like FFT in decimation in time and decimation in frequency both, using convolution property and Goertzel algorithm. Comparison between wavelet and Fourier transform. Application of WCT &amp; DCT.</td>
</tr>
</tbody>
</table>

KL- Bloom’s Knowledge Level (K₁, K₂, K₃, K₄, K₅, K₆)
K₁ – Remember  K₂ – Understand  K₃ – Apply  K₄ – Analyze  K₅ – Evaluate  K₆ – Create

Detailed syllabus:

Unit-I:
Discrete-Time Signals and Systems:
Sequences, discrete time systems, LTI systems, frequency domain representation of discrete time signals and systems, discrete time signals and frequency domain representation, Fourier Transform.

Realization of Digital Linear Systems:
IIR Filter Realization: Direct form, cascade realization, parallel form realization, Ladder structures- continued fraction expansion of H(z). FIR Filter Realization: Direct, Cascade, FIR Linear Phase Realization

Unit-II:
Sampling of Continuous Time Signals:
Sampling and reconstruction of signals, frequency domain representation of sampling, discrete time processing of continuous time signals, continuous time processing of discrete time signals, changing the sampling rate using discrete time processing, multi rate signal processing, digital processing of analog signals, over sampling and noise shaping in A/D and D/A conversion.
Unit-III:
Transform Analysis of LTI Systems:
Frequency response of LTI systems, system functions, frequency response for rational system functions, magnitude-phase relationship, all pass systems, minimum phase systems, and linear systems with generalized linear phase

Discrete Fourier Transform:
Concept and relations for DFT/IDFT, Twiddle factors and their properties, computational burden on direct DFT, DFT/IDFT as linear transformations, DFT/IDFT matrices, computation of DFT/IDFT by matrix method, multiplication of DFTs, circular convolution, computation of circular convolution by graphical, DFT/IDFT and matrix methods, linear filtering using DFT, aliasing error, filtering of long data sequences – Overlap-Save and Overlap-Add methods with example

Unit-IV:
Filter Design Techniques:

Unit-V:
Fast Fourier Transform:
Radix-2 algorithm, decimation-in-time, decimation-in-frequency algorithms, signal flow graphs, Butterflies, computations in one place, bit reversal, examples for DIT & DIF FFT Butterfly computations with examples.

Introduction to Wavelet transform:
Wavelet comparison with Fourier transforms, Applications of Wavelet cosine transform, Discrete cosine transform (DCT).

Text Books:

Reference Books:
**ANALOG & DIGITAL COMMUNICATION**

**Pre-requisites of course:** Basic Signals & Systems.

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<tr>
<td>Upon the completion of the course, the student will be able to:</td>
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</tr>
<tr>
<td>CO 1  Understand the Amplitude Modulation in communication system.</td>
<td>K₂</td>
</tr>
<tr>
<td>CO 2  Comprehend the Frequency &amp; Phase modulation.</td>
<td>K₂</td>
</tr>
<tr>
<td>CO 3  Realize the Pulse Modulation Techniques.</td>
<td>K₂</td>
</tr>
<tr>
<td>CO 4  Get the Digital Modulation Techniques and their use in communication system.</td>
<td>K₂</td>
</tr>
<tr>
<td>CO 5  Apply the concept of Information Theory in Communication Engineering.</td>
<td>K₃</td>
</tr>
</tbody>
</table>

**Detailed Syllabus:**

**UNIT I**

Elements of communication system and its limitations, Amplitude modulation and detection, Generation and detection of DSB-SC, SSB and vestigial side band modulation, carrier acquisition AM transmitters and receivers, Superheterodyne Receiver, IF amplifiers, AGC circuits, Frequency Division multiplexing.

**Unit II**

Angle Modulation: Basic definition, Narrow-Band and wideband frequency modulation, transmission bandwidth of FM signals, Generation and detection of frequency modulation, Generation and detection of Phase Modulation.

Noise: External noise, internal noise, noise calculations, signal to noise ratio.

**Unit III**

Pulse Modulation: Introduction, sampling process, Analog Pulse Modulation Systems, Pulse Amplitude Modulation (PAM), Pulse width modulation (PWM) and Pulse Position Modulation (PPM).


**Unit IV**

Digital Modulation Techniques: Types of digital modulation, waveforms for amplitude, frequency and phase shift keying, coherent and non-coherent methods for the generation of ASK, FSK and PSK. Comparisons of above digital modulation techniques.

**Unit V**

Time Division Multiplexing: Fundamentals, Electronic Commutator, Bit/byte interleaving, TI carrier system, synchronization and signaling of TI, TDM and PCM hierarchy, synchronization techniques.

Introduction to Information Theory: Measure of information, Entropy & Information rate, channel capacity, Hartley Shannan law, Huffman coding, shannan Fano coding.
Text Books:

Reference Books:
DEPARTMENT ELECTIVE-III
SPECIAL ELECTRICAL MACHINES

Pre-requisites of course: Electrical Machines-I & Electrical Machines-II.

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<tr>
<td>Upon the completion of the course, the student will be able to:</td>
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</tr>
<tr>
<td>CO 1 Describe the working principle, Constructional Features of different types of electrical machines including the fractional kilowatt machines.</td>
<td>K2</td>
</tr>
<tr>
<td>CO2 Analyse torque-speed characteristics of different electrical machines and interpret their performance and identify the suitable machine for an operation.</td>
<td>K4</td>
</tr>
<tr>
<td>CO3 Study different types of control techniques for a machine and identify the best control strategy based upon different constraints.</td>
<td>K4</td>
</tr>
<tr>
<td>CO4 Illustrate the use of stepper, BLDCs, SRM, and other special machines in the area of the various industrial and domestic as well as commercial applications of various fractional kilowatt machines.</td>
<td>K3</td>
</tr>
</tbody>
</table>

KL- Bloom’s Knowledge Level (K₁, K₂, K₃, K₄, K₅, K₆)
K₁ – Remember  K₂ – Understand  K₃ – Apply  K₄ – Analyze  K₅ – Evaluate  K₆ – Create

Detailed Syllabus:

**Unit-I: Induction Machines**: Concept of constant torque and constant power controls, SEIG, DFIG: Operating Principle, Equivalent Circuit, Characteristics, Applications, Linear Induction Motors. Construction, principle of operation, Linear force, and applications.

**Two Phase AC Servomotors**: Construction, torque-speed characteristics, performance and applications.

**Unit-II: Stepper Motors**: Constructional features, Principle of operation, Variable reluctance motor, Hybrid motor, Single and multistack configurations, Torque equations, Characteristics, Drive circuits, Microprocessor control of stepper motors, Closed loop control, Applications.

**Unit-III: Switched Reluctance Motors**: Constructional features, Rotary and Linear SRM, Principle of operation, Torque production, performance characteristics, Methods of Rotor position sensing, Sensor less operation, Closed loop control and Applications

**UNIT-IV: Permanent Magnet Machines**: Permanent Magnet synchronous generator Operating Principle, Equivalent Circuit, Characteristics, Permanent magnet DC motors, sinusoidal PMAC motors, their important features and applications, PCB motors,

**Permanent Magnet Brushless D.C. Motors**: Principle of operation, Types, Magnetic circuit analysis, EMF and torque equations, Commutation, Motor characteristics and control, Applications.

**UNIT-V: Single phase synchronous motor**: construction, operating principle and characteristics of reluctance and hysteresis motors;

**Single Phase Commutator Motors**: Construction, principle of operation, characteristics of universal and repulsion motors;
TEXT BOOKS:


Reference Books:

LINEAR INTEGRATED CIRCUITS

Pre-requisites of course: Electronics Engineering and Network Analysis & Synthesis

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<tr>
<td>Upon the completion of the course, the student will be able to:</td>
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</tr>
<tr>
<td>CO 1 Analyze integrated circuit designed by BJT.</td>
<td>K4</td>
</tr>
<tr>
<td>CO2 Design the higher order filters with Op-Amp.</td>
<td>K3</td>
</tr>
<tr>
<td>CO3 Use the CMOS to make digital integrated circuits</td>
<td>K3</td>
</tr>
<tr>
<td>CO4 Comprehend the non-linear application of Op-Amp.</td>
<td>K3</td>
</tr>
<tr>
<td>CO5 Understand the 555 Timer and PLL.</td>
<td>K2</td>
</tr>
</tbody>
</table>

KL- Bloom’s Knowledge Level (K₁, K₂, K₃, K₄, K₅, K₆)
K₁ – Remember K₂ – Understand K₃ – Apply K₄ – Analyze K₅ – Evaluate K₆ – Create

Detailed Syllabus:

UNIT I
The 741 IC Op-Amp: Basic Circuit and device parameters; DC analysis of 741, small signal analysis of input stage, output stage; Gain, Frequency response of 741; a simplified model, Slew rate.

Unit II
Filters: First and second order LP, HP, BP BS and All pass active filters, KHN.

Unit III
Digital Integrated Circuit Design- An Overview: CMOS Logic Gate Circuits: Basic Structure CMOS realization of Inverters, AND, OR, NAND and NOR Gates

Unit IV

Unit V
D/A and A/D converters Integrated Circuit Timer: The 555 Circuit, Implementing a Mono stable Multivibrator Using the 555 IC, Astable Multi vibrator Using the 555 IC.
Phase locked loops (PLL): Ex-OR Gates and multipliers as phase detectors, Block Diagram of IC PLL, Working of PLL and Applications of PLL.
Text Books:

Reference Books:
3. Mark N. Horenstein, “Microelectronic Circuits and Devices”, PHI.
DIGITAL CONTROL SYSTEM

Pre-requisites of course: Control System

<table>
<thead>
<tr>
<th>Course Outcome</th>
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<tbody>
<tr>
<td>Upon the completion of the course, the student will be able to:</td>
<td></td>
</tr>
<tr>
<td>CO 1 Represent discrete time systems under the form of z-domain transfer functions and state-space models.</td>
<td>K3</td>
</tr>
<tr>
<td>CO 2 Obtain the model of discrete-time systems by pulse transfer function.</td>
<td>K4</td>
</tr>
<tr>
<td>CO 3 Analyze stability, transient response and steady state behaviour of linear discrete-time systems, analytically and numerically using tools such as MATLAB and Simulink</td>
<td>K4</td>
</tr>
<tr>
<td>CO 4 Design sampled data control systems.</td>
<td>K5</td>
</tr>
<tr>
<td>CO 5 Describe Discrete state space model and test controllability and observability of systems.</td>
<td>K5</td>
</tr>
</tbody>
</table>

KL- Bloom’s Knowledge Level (K1, K2, K3, K4, K5, K6)
K1 – Remember K2 – Understand K3 – Apply K4 – Analyze K5 – Evaluate K6 – Create

Detailed syllabus:

Unit 1: Introduction to digital control
Introduction, Discrete time system representation, Mathematical modelling of sampling process, Data reconstruction.

Unit 2: Modelling discrete-time systems by pulse transfer function
Revisiting Z-transform, Mapping of s-plane to z-plane, Pulse transfer function, Pulse transfer function of closed loop system, Sampled signal flow graph.

Unit 3: Stability analysis of discrete time systems

Unit 4: Design of sampled data control systems:
Root locus method, Controller design using root locus, Root locus-based controller design using MATLAB, Nyquist stability criteria, bode plot, Lead compensator design using Bode plot, Lag compensator design using Bode plot, Lag-lead compensator design in frequency domain.

Unit 5: Discrete state space model

Text and References Books:

EMBEDDED SYSTEMS

Pre-requisites of course: Basics of Microprocessor

Course Outcomes:

<table>
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<th>Knowledge Level, KL</th>
<th>Upon the completion of the course, the student will be able to:</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>Understand various Embedded system related concepts, Memory classification, 8051 architecture and its Instructions</td>
</tr>
<tr>
<td>CO2</td>
<td>Demonstrate the programming of I/O, Timers, Serial communication and Interrupt of 8051.</td>
</tr>
<tr>
<td>CO3</td>
<td>Differentiate types of embedded processor and there use in embedded system.</td>
</tr>
<tr>
<td>CO4</td>
<td>Remember the application of RTOS and its various services in embedded system such as Semaphores, Mailbox. Architecture of high end processor.</td>
</tr>
<tr>
<td>CO5</td>
<td>Learn various Communication protocol and demonstrate interfacing of microcontroller with various components such as LCD, motor, stepper motor and pushbuttons.</td>
</tr>
</tbody>
</table>

KL- Bloom’s Knowledge Level (K1, K2, K3, K4, K5, K6)
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Detailed Syllabus:

Unit1: Basic Terms in Embedded system:
Introduction to Microcontrollers and Microprocessors, Embedded versus external memory devices, CISC and RISC processors, Harvard and Von Neumann Architecture, 8051 microcontrollers-Assembly language, Architecture of 8051, Registers, Addressing Modes, Instruction Set

Unit2: 8051 internal architecture and programming:
I/O ports, memory organization, Programs showing use of I/O Pins, Interrupts, Interrupt Programming, Timer and counters, Serial Communication, Programming of serial communication.

Unit3: Introduction to advanced concept in embedded system:

Unit4: Introduction to operating system and basics of higher embedded system:
Introduction to RTOS, Tasks, Data, Semaphores and shared data, Operating system services, Message queues, Mailboxes, Advanced processor (Only architecture), 80386, 80486, ARM (References)

Unit5: Communication basics and interfacing of various devices the microcontroller:
Microprocessor interfacing I/O addressing, direct memory access (DMA), Arbitration, multilevel bus architecture, serial protocol, parallel protocols and wireless protocol, Real world interfacing: LCD, Stepping motor, ADC, DAC, LED, Pushbuttons, Keyboard, Latch connection, PPI
Text Books:
1. Embedded system Design-Frank Vahid/ Tony Givargis. John Willey
3. An Embedded Software Primer-David E.Simon, Pearson Education

Reference Books:
1. The 8051 Microcontroller and embedded systems-Muhammad Ali Mazidi and Janice Gillispie.