



## JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

(Established by Andhra Pradesh Act No.30 of 2008)

Kukatpally, Hyderabad – 500 085, Andhra Pradesh (India)

### B.TECH. (ELECTRICAL & ELECTRONICS ENGINEERING)

#### IV YEAR I SEMESTER

Code	Subject	L	T/P/D	Credits
	Switch Gear and Protection	4	-	4
	Utilization of Electrical Energy	4	-	4
	Digital Signal Processing	4	-	4
	Power System Operation and Control	4	-	4
	<b>Elective-I</b> High Voltage Engineering VLSI Design Digital Control Systems <b>Data Structures</b>	4	-	4
	<b>Elective-II</b> Optimization Techniques Electrical Distribution Systems Electrical Estimation and Costing	4	-	4
	Microprocessors and Interfacing Devices Lab	-	3	2
	Electrical Measurements Lab	-	3	2
	<b>Total</b>	<b>24</b>	<b>6</b>	<b>28</b>

**Note:**All End Examinations (Theory and Practical) are of three hours duration.

**T-Tutorial      L – Theory      P – Practical/Drawing      C – Credits**

L	T/P/D	C
4	-/-	4

(A70231) SWITCH GEAR AND PROTECTION

**Objective:**

This course introduces all varieties of Circuit Breakers and Relays for protection of Generators, Transformers and feeder bus bars from over voltages and other hazards. It emphasis on Neutral grounding for overall protection.

**UNIT – I:**

**Circuit Breakers:** Circuit Breakers: Elementary principles of arc interruption, Recovery, Restriking Voltage and Recovery voltages.- Restriking Phenomenon, Average and Max. RRRV, Numerical Problems - Current Chopping and Resistance Switching - CB ratings and Specifications: Types and Numerical Problems. – Auto reclosures. Description and Operation of following types of circuit breakers: Minimum Oil Circuit breakers, Air Blast Circuit Breakers, Vacuum and SF6 circuit breakers.

**UNIT – II:**

**Electromagnetic and Static Relays:** Principle of Operation and Construction of Attracted armature, Balanced Beam, induction Disc and Induction Cup relays. **Relays Classification:** Instantaneous, DMT and IDMT types. Application of relays: Over current/ under voltage relays, Direction relays, Differential Relays and Percentage Differential Relays. Universal torque equation. **Distance relays:** Impedance, Reactance and Mho and Off-Set Mho relays, Characteristics of Distance Relays and Comparison. **Static Relays:** Static Relays verses Electromagnetic Relays.

**UNIT – III:**

**Generator & Transformer Protection : Protection of generators:** against Stator faults, Rotor faults, and Abnormal Conditions. Restricted Earth fault and Inter-turn fault Protection. Numerical Problems on % Winding Unprotected. **Protection of transformers:** Percentage Differential Protection, Numerical Problem on Design of CT s Ratio, Buchholtz relay Protection.

**UNIT-IV:**

**Feeder & Bus-Bar protection & Grounding: Protection of Lines:** Over Current, Carrier Current and Three-zone distance relay protection using Impedance relays. Translay Relay. Protection of Bus bars – Differential protection. **Neutral Grounding:** Grounded and Ungrounded Neutral Systems. - Effects of Ungrounded Neutral on system performance. Methods

of Neutral Grounding: Solid, Resistance, Reactance - Arcing Grounds and Grounding Practices.

**UNIT – V:**

**Protection Against Over Voltages:** Generation of Over Voltages in Power Systems.-Protection against Lightning Over Voltages - Valve type and Zinc-Oxide Lighting Arresters - Insulation Coordination -BIL, Impulse Ratio, Standard Impulse Test Wave, Volt-Time Characteristics.

**TEXT BOOKS:**

1. Switchgear and Protection, Sunil S Rao, Khanna Publishers.
2. Protection and Switchgear, Bhavesh Bhalja, R. P. Mahesheari, Nilesh G. Chothani, Oxford University Press.

**REFERENCE BOOKS:**

1. Electrical Power Systems, C.L.Wadhwa, New Age international (P) Limited, Publishers.
2. Power System Protection and Switchgear, Badari Ram, D.N Viswakarma, TMH Publications.
3. Electrical Power System Protection, C. Christopoulos and A. Wright, Springer International.
4. Electrical Power Systems, PSR. Murty, BS Publications.
5. Power system protection and switch gear by Bhuvanesh Oza, TMH,
6. A Text Book on Power System Engineering, M.L.Soni, P.V.Gupta, U.S.Bhatnagar, A.Chakrabarthy, Dhanpat Rai & Co Pvt. Ltd.
7. A Textbook of Power System Engineering, R. K. Rajput, Laxmi Publications (P) Limited.
8. Principles of Power Systems, V.K Mehta and Rohit Mehta S.Chand Company Pvt. Ltd.

**Outcome:**

After going through this course the student gets a thorough knowledge on, various types of protective devices (circuit breakers, relays etc..) and their co-ordination, protection of generators, transformers, feeders, bus-bars, through different types of protective devices, overvoltage protection, lightning, concept of earthing and grounding, with which he/she can able to apply the above conceptual things to real-world electrical and electronics problems and applications.

# JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

IV Year B.Tech. EEE-I Sem

L	T/P/D	C
4	-/-	4

## (A70232) UTILIZATION OF ELECTRICAL ENERGY

### Objective:

This subject deals with the fundamentals of illumination and its classification and the electric heating and welding. It gives the detailed study of all varieties of Electric drives and their application to electrical traction systems.

### UNIT – I:

**Electric Drives:** Type of electric drives, choice of motor, starting and running characteristics, speed control, temperature rise, particular applications of electric drives, types of industrial loads, continuous, intermittent and variable loads, load equalization.

### UNIT – II:

**Electric Heating & Welding:** Electric Heating: Advantages and methods of electric heating, resistance heating induction heating and dielectric heating.

**Electric welding:** resistance and arc welding, electric welding equipment, comparison between A.C. and D.C. Welding.

### UNIT – III:

**Illumination :** Introduction, terms used in illumination, laws of illumination, polar curves, photometry, integrating sphere, sources of light. Discharge lamps, MV and SV lamps – comparison between tungsten filament lamps and fluorescent tubes, Basic principles of light control, Types and design of lighting and flood lighting.

### UNIT – IV:

**Electric Traction-I :** System of electric traction and track electrification. Review of existing electric traction systems in India. Special features of traction motor, methods of electric braking-plugging rheostatic braking and regenerative braking. Mechanics of train movement. Speed-time curves for different services – trapezoidal and quadrilateral speed time curves.

### UNIT – VIII

**Electric Traction-II:** Calculations of tractive effort, power, specific energy consumption for given run, effect of varying acceleration and braking retardation, adhesive weight and braking retardation adhesive weight and coefficient of adhesion.

### TEXT BOOK:

1. Utilization of Electrical Power, Er. R. K. Rajput, Laxmi Publications.

2. Art & Science of Utilization of electrical Energy, Partab, Dhanpat Rai & Sons.

### REFERENCE BOOKS:

1. Utilization of Electric Energy, E. Openshaw Taylor, University press.
2. Generation, Distribution and Utilization of electrical Energy, C.L. Wadhwa, New Age International (P) Limited.
3. Utilization of Electrical Power including Electric drives and Electric traction, N.V.Suryanarayana, New Age International (P) Limited.
4. Utilization of Electric Energy, VVL Rao, University Press.

### Outcome:

After going through this course the student gets a thorough knowledge on, electric drives characteristics and their applicability in industry, nature of different types of loads and their characteristics, concept of electric heating welding, illumination, electric traction and utilization of electric energy by the above mentioned means, with which he/she can able to apply the above conceptual things to real-world electrical and electronics problems and applications.

**(A70421) DIGITAL SIGNAL PROCESSING**

**Objectives:**

This course is an essential course that provides design techniques for processing all type of signals in various fields. The main objectives are:

- To provide background and fundamental material for the analysis and processing of digital signals.
- To familiarize the relationships between continuous-time and discrete-time signals and systems.
- To study fundamentals of time, frequency and Z-plane analysis and to discuss the inter-relationships of these analytic method.
- To study the designs and structures of digital (IIR and FIR) filters from analysis to synthesis for a given specifications.
- The impetus is to introduce a few real-world signal processing applications.
- To acquaint in FFT algorithms, Multi-rate signal processing techniques and finite word length effects.

**UNIT -I:**

**Introduction:** Introduction to Digital Signal Processing: Discrete Time Signals & Sequences, Linear Shift Invariant Systems, Stability, and Causality, Linear Constant Coefficient Difference Equations, Frequency Domain Representation of Discrete Time Signals and Systems

**Realization of Digital Filters:** Applications of Z – Transforms, Solution of Difference Equations of Digital Filters, System Function, Stability Criterion, Frequency Response of Stable Systems, Realization of Digital Filters – Direct, Canonic, Cascade and Parallel Forms.

**UNIT -II:**

**Discrete Fourier series:** DFS Representation of Periodic Sequences, Properties of Discrete Fourier Series, Discrete Fourier Transforms: Properties of DFT, Linear Convolution of Sequences using DFT, Computation of DFT: Over-Lap Add Method, Over-Lap Save Method, Relation between DTFT, DFS, DFT and Z-Transform.

**Fast Fourier Transforms:** Fast Fourier Transforms (FFT) - Radix-2 Decimation-in-Time and Decimation-in-Frequency FFT Algorithms, Inverse FFT, and FFT with General Radix-N.

**UNIT -III:**

**IIR Digital Filters:** Analog filter approximations – Butterworth and Chebyshev, Design of IIR Digital Filters from Analog Filters, Step and Impulse Invariant Techniques, Bilinear Transformation Method, Spectral Transformations.

**UNIT -IV:**

**FIR Digital Filters:** Characteristics of FIR Digital Filters, Frequency Response, Design of FIR Filters: Fourier Method, Digital Filters using Window Techniques, Frequency Sampling Technique, Comparison of IIR & FIR filters.

**UNIT -V:**

**Multirate Digital Signal Processing:** Introduction, Down Sampling, Decimation, Upsampling, Interpolation, Sampling Rate Conversion.

**Finite Word Length Effects:** Limit cycles, Overflow Oscillations, Round-off Noise in IIR Digital Filters, Computational Output Round-off Noise, Methods to Prevent Overflow, Trade Off Between Round Off and Overflow Noise, Dead Band Effects.

**TEXT BOOKS:**

1. Digital Signal Processing, Principles, Algorithms, and Applications: John G. Proakis, Dimitris G. Manolakis, Pearson Education / PHI, 2007.
2. Discrete Time Signal Processing – A. V. Oppenheim and R.W. Schaffer, PHI, 2009
3. Fundamentals of Digital Signal Processing – Loney Ludeman, John Wiley, 2009

**REFERENCE BOOKS:**

1. Digital Signal Processing – Fundamentals and Applications – Li Tan, Elsevier, 2008
2. Fundamentals of Digital Signal Processing using MATLAB – Robert J. Schilling, Sandra L. Harris, Thomson, 2007
3. Digital Signal Processing – S.Salivahanan, A.Vallavaraj and C.Gnanapriya, TMH, 2009
4. Discrete Systems and Digital Signal Processing with MATLAB – Taan S. ElAli, CRC press, 2009.
5. *Digital Signal Processing - A Practical approach*, Emmanuel C. Ifeachor and Barrie W. Jervis, 2<sup>nd</sup> Edition, Pearson Education, 2009.
6. Digital Signal Processing - Nagoor Khani, TMG, 2012

**Course Outcomes:**

On completion of this subject, the student should be able to:

- Perform time, frequency and Z -transform analysis on signals and systems.

- Understand the inter-relationship between DFT and various transforms.
- Understand the significance of various filter structures and effects of roundoff errors.
- Design a digital filter for a given specifications.
- Understand the fast computation of DFT and appreciate the FFT processing.
- Understand the tradeoffs between normal and multi rate DSP techniques and finite length word effects.

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**(A70230) POWER SYSTEM OPERATION AND CONTROL**

**Objective:**

This subject deals with Economic operation of Power Systems, Hydrothermal scheduling and modeling of turbines, generators and automatic controllers. It emphasizes on single area and two area load frequency control and reactive power control.

**UNIT – I:**

**Economic Operation of Power Systems:** Optimal operation of Generators in Thermal Power Stations, - heat rate Curve – Cost Curve – Incremental fuel and Production costs, input-output characteristics, Optimum generation allocation with line losses neglected. Optimum generation allocation including the effect of transmission line losses – Loss Coefficients, General transmission line loss formula.

**UNIT – II:**

**Hydrothermal Scheduling:** Optimal scheduling of Hydrothermal System: Hydroelectric power plant models, scheduling problems-Short term hydrothermal scheduling problem.

**UNIT – III:**

**Modeling:** Modeling of Turbine: First order Turbine model, Block Diagram representation of Steam Turbines and Approximate Linear Models.

**Modeling of Governor:** Mathematical Modeling of Speed Governing System – Derivation of small signal transfer function.

**Modeling of Excitation System:** Fundamental Characteristics of an Excitation system, Transfer function, Block Diagram Representation of IEEE Type-1 Model.

**UNIT – IV:**

**Single Area & Two-Area Load Frequency Control :** Necessity of keeping frequency constant. Definitions of Control area – Single area control – Block diagram representation of an isolated power system – Steady state analysis – Dynamic response – Uncontrolled case.

**Load frequency control of 2-area system:** Uncontrolled case and controlled case, tie-line bias control.

**Load Frequency Controllers:** Proportional plus Integral control of single area and its block diagram representation, steady state response – Load Frequency Control and Economic dispatch control.

**UNIT – V:**

**Reactive Power Control:** Overview of Reactive Power control – Reactive Power compensation in transmission systems – advantages and disadvantages of different types of compensating equipment for transmission systems. Load compensation: Specifications of load compensator, Uncompensated and compensated transmission lines: shunt and Series Compensation. (Qualitative treatment)

**TEXT BOOKS:**

1. Power System Operation and Control, Dr. K. Uma Rao, Wiley India Pvt. Ltd.
2. Power Systems Analysis, operation and control, Abhijit Chakrabarti, Sunitha Halder, PHI.

**REFERENCE BOOKS:**

1. Operation and Control in Power Systems, PSR Murthy, BS Publications.
2. Power systems stability and control, Prabha Kundur, The McGraw – Hill companies.
3. Power System Analysis, C.L.Wadhwa, Newage International.
4. Modern Power System Analysis, I.J.Nagrath & D.P.Kothari Tata McGraw – Hill Publishing Company Ltd.
5. Power System Analysis and Design, J.Duncan Glover and M.S.Sarma, Cengage Learning.
6. Power System Analysis, Grainger and Stevenson, Tata McGraw Hill.

**Outcome:**

After going through this course the student gets a thorough knowledge on, economic operation of power systems, scheduling of hydro-thermal power plants, modeling of the power system components like turbine, governor and excitation systems, necessity of keeping the frequency of the power system constant, load frequency control in single and two area systems, operation of load frequency controllers, reactive power control, uncompensated transmission line and compensation in transmission systems through shunt and series compensations, with which he/she can able to apply the above conceptual things to real-world electrical and electronics problems and applications.

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**(A70228) HIGH VOLTAGE ENGINEERING****(Elective-I)****Objective:**

This subject deals with the detailed analysis of Breakdown occurring in gaseous, liquids and solid dielectrics. Information about generation and measurement of High voltage and current. In addition High voltage testing methods are also discussed.

**UNIT- I:**

**Introduction to High Voltage Engineering:** Electric Field Stresses, Gas / Vacuum as Insulator, Liquid Dielectrics, Solids and Composites, Estimation and Control of Electric Stress, Numerical methods for electric field computation, Surge voltages, their distribution and control, Applications of insulating materials in transformers, rotating machines, circuit breakers, cable power capacitors and bushings.

**UNIT- II:**

**Break Down in Dielectric Materials:** Gases as insulating media, collision process, Ionization process, Townsend's criteria of breakdown in gases, Paschen's law. Liquid as Insulator, pure and commercial liquids, breakdown in pure and commercial liquids. Intrinsic breakdown, electromechanical breakdown, thermal breakdown, breakdown of solid dielectrics in practice, Breakdown in composite dielectrics, solid dielectrics used in practice.

**UNIT-III:**

**Generation & Measurement of High Voltages & Currents :** Generation of High Direct Current Voltages, Generation of High alternating voltages, Generation of Impulse Voltages, Generation of Impulse currents, Tripping and control of impulse generators. Measurement of High Direct Current voltages, Measurement of High Voltages alternating and impulse, Measurement of High Currents-direct, alternating and Impulse, Oscilloscope for impulse voltage and current measurements.

**UNIT-IV:**

**Over Voltages & Insulation Co-Ordination:** Natural causes for over voltages – Lightning phenomenon, Overvoltage due to switching surges, system faults and other abnormal conditions, Principles of Insulation Coordination on High voltage and Extra High Voltage power systems.

**UNIT- V:**

**Testing Of Materials & Electrical Apparatus:** Measurement of D.C

Resistivity, Measurement of Dielectric Constant and loss factor, Partial discharge measurements. Testing of Insulators and bushings, Testing of Isolators and circuit breakers, testing of cables, Testing of Transformers, Testing of Surge Arresters, and Radio Interference measurements.

#### TEXT BOOKS:

1. High Voltage Engineering, M.S.Naidu and V. Kamaraju, TMH Publications.
2. High Voltage Engineering, C.L.Wadhwa, New Age Internationals (P) Limited.

#### REFERENCE BOOKS:

1. High Voltage Engineering: Fundamentals, E.Kuffel, W.S.Zaengl, J.Kuffel by Elsevier.
2. High Voltage Insulation Engineering, Ravindra Arora, Wolfgang Mosch, New Age International (P) Limited.
3. High Voltage Engineering, Theory and Practice, Mazen Abdel Salam, Hussein Anis, Ahdan El-Morshedy, Roshdy Radwan, Marcel Dekker

#### Outcome:

After going through this course the student gets a thorough knowledge on, basics of high voltage engineering, break-down phenomenon in different types of dielectrics, generation and measurement of high voltages and currents, the phenomenon of over-voltages, concept of insulation coordination, testing of various materials and electrical apparatus used in high voltage engineering, with which he/she can able to apply the above conceptual things to real-world electrical and electronics problems and applications.

## JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

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(A70432) VLSI DESIGN

(Elective-I)

#### Course Objectives:

The objectives of the course are to:

- Give exposure to different steps involved in the fabrication of ICs using MOS transistor, CMOS/BICMOS transistors and passive components.
- Explain electrical properties of MOS and BiCMOS devices to analyze the behavior of inverters designed with various loads.
- Give exposure to the design rules to be followed to draw the layout of any logic circuit.
- Provide concept to design different types of logic gates using CMOS inverter and analyze their transfer characteristics.
- Provide design concepts to design building blocks of data path of any system using gates.
- Understand basic programmable logic devices and testing of CMOS circuits.

#### UNIT –I:

**Introduction:** Introduction to IC Technology – MOS, PMOS, NMOS, CMOS & BiCMOS

**Basic Electrical Properties:** Basic Electrical Properties of MOS and BiCMOS Circuits: I -V relationships, MOS transistor threshold Voltage,  $g_m$ ,  $g_{ds}$ , Figure of merit  $\mu_0^{\text{ds}}$ ,  $P_{\text{ds}}$  transistor, NMOS Inverter, Various pull ups, CMOS<sup>ds</sup>Inverter analysis and design, Bi-CMOS Inverters.

#### UNIT -II:

**VLSI Circuit Design Processes:** VLSI Design Flow, MOS Layers, Stick Diagrams, Design Rules and Layout, 2  $\mu\text{m}$  CMOS Design rules for wires, Contacts and Transistors Layout Diagrams for NMOS and CMOS Inverters and Gates, Scaling of MOS circuits.

#### UNIT –III:

**Gate Level Design:** Logic Gates and Other complex gates, Switch logic, Alternate gate circuits, Time delays, Driving large capacitive loads, Wiring capacitance, Fan – in, Fan – out, Choice of layers.

#### UNIT -IV:

**Data Path Subsystems:** Subsystem Design, Shifters, Adders, ALUs, Multipliers, Parity generators, Comparators, Zero/One Detectors, Counters.

**Array Subsystems:** SRAM, DRAM, ROM, Serial Access Memories.

#### UNIT -V:

**Programmable Logic Devices:** PLAs, FPGAs, CPLDs, Standard Cells, Programmable Array Logic, Design Approach, Parameters influencing low power design.

**CMOS Testing:** CMOS Testing, Need for testing, Test Principles, Design Strategies for test, Chip level Test Techniques.

#### TEXT BOOKS:

1. Essentials of VLSI Circuits and Systems – Kamran Eshraghian, Eshraghian Douglas and A. Pucknell, PHI, 2005 Edition.
2. CMOS VLSI Design – A Circuits and Systems Perspective, Neil H. E Weste, David Harris, Ayan Banerjee, 3<sup>rd</sup> Ed, Pearson, 2009.

#### REFERENCE BOOKS:

1. Introduction to VLSI Systems: A Logic, Circuit and System Perspective – Ming-BO Lin, CRC Press, 2011
2. CMOS logic circuit Design - John .P. Uyemura, Springer, 2007.
3. Modern VLSI Design - Wayne Wolf, Pearson Education, 3<sup>rd</sup> Edition, 1997.
4. VLSI Design- K. Lal Kishore, V. S. V. Prabhakar, I.K International, 2009.
5. Introduction to VLSI – Mead & Convey, BS Publications, 2010.

#### Course Outcomes:

Upon successfully completing the course, the student should be able to:

- Acquire qualitative knowledge about the fabrication process of integrated circuit using MOS transistors.
- Choose an appropriate inverter depending on specifications required for a circuit
- Draw the layout of any logic circuit which helps to understand and estimate parasitics of any logic circuit
- Design different types of logic gates using CMOS inverter and analyze their transfer characteristics

- Provide design concepts required to design building blocks of data path using gates.
- Design simple memories using MOS transistors and can understand Design of large memories.
- design simple logic circuit using PLA, PAL, FPGA and CPLD.
- Understand different types of faults that can occur in a system and learn the concept of testing and adding extra hardware to improve testability of system.



(A70435) DIGITAL CONTROL SYSTEMS

(Elective-I)

**Objective:**

This course gives fundamentals digital control systems, z-transforms, state space representation of the control systems, concepts of controllability and observability, estimation of stability in different domains, design of discrete time control systems, compensators, state feedback controllers, state observers through various transformations.

**UNIT – I:**

**Introduction :** Introduction, Examples of Data control systems – Digital to Analog conversion and Analog to Digital conversion, sample and hold operations.

**Z – TRANSFORMS:** Introduction, Linear difference equations, pulse response, Z – transforms, Theorems of Z – Transforms, the inverse Z – transforms, Modified Z- Transforms. Z-Transform method for solving difference equations; Pulse transforms function, block diagram analysis of sampled – data systems, mapping between s-plane and z-plane.

**UNIT – II:**

**State Space Analysis:** State Space Representation of discrete time systems, Pulse Transfer Function Matrix solving discrete time state space equations, State transition matrix and its Properties, Methods for Computation of State Transition Matrix, Discretization of continuous time state – space equations. Concepts of Controllability and Observability, Tests for controllability and Observability. Duality between Controllability and Observability, Controllability and Observability conditions for Pulse Transfer Function.

**UNIT –III:**

**Stability Analysis:** Mapping between the S-Plane and the Z-Plane – Primary strips and Complementary Strips – Constant frequency loci, Constant damping ratio loci, Stability Analysis of closed loop systems in the Z-Plane.

Jury stability test – Stability Analysis by use of the Bilinear Transformation and Routh Stability criterion.

**UNIT-IV:**

**Design of Discrete Time Control System :** Transient and steady – State response Analysis – Design based on the frequency response method – Bilinear Transformation and Design procedure in the w-plane, Lead, Lag and Lead-Lag compensators and digital PID controllers.

**UNIT – V:**

**State Feedback Controllers & Observers:** Design of state feedback controller through pole placement – Necessary and sufficient conditions, Ackerman's formula.

State Observers – Full order and Reduced order observers.

**TEXT BOOK:**

1. Discrete-Time Control systems - K. Ogata, Pearson Education/PHI, 2<sup>nd</sup> Edition.
2. Digital Control Systems , V. I. George, C. P. Kurian, Cengage Learning

**REFERENCE BOOKS:**

1. Digital Control Systems, Kuo, Oxford University Press, 2<sup>nd</sup> Edition, 2003. Digital Control and State Variable Methods by M.Gopal, TMH .
2. Digital Control Engineering Analysis and Design M. Sami Fadali Antonio Visioli, AP Academic Press.

**Outcome:**

After going through this course the student gets a thorough knowledge on, basics of digital control systems, z-transforms, mapping between S-plane and Z-plane, state-space analysis, concept of controllability and observability, derivation of pulse-transfer function, stability analysis in S-domain and Z-domains, stability through jury-stability test, stability through bilinear transformation and R-H criteria, design of discrete-time control systems, design of lag, lead, lead-lag compensators, design of PID controllers and design of state feedback controllers and observers, with which he/she can able to apply the above conceptual things to real-world electrical and electronics problems and applications.

(A70229) OPTIMIZATION TECHNIQUES

(Elective-II)

**Objective:**

This course introduces various optimization techniques i.e classical, linear programming, transportation problem, simplex algorithm, dynamic programming, constrained and unconstrained optimization techniques for solving and optimizing an electrical and electronic engineering circuits design problems in real world situations.

**UNIT – I:**

**Introduction & Classical Optimization Techniques:** Statement of an Optimization problem – design vector – design constraints – constraint surface – objective function – objective function surfaces – classification of Optimization problems Single variable Optimization – multi variable Optimization without constraints – necessary and sufficient conditions for minimum/maximum – multivariable Optimization with equality constraints. Solution by method of Lagrange multipliers – multivariable Optimization with inequality constraints – Kuhn – Tucker conditions.

**UNIT – II:**

**Linear Programming:** Standard form of a linear programming problem – geometry of linear programming problems – definitions and theorems – solution of a system of linear simultaneous equations – pivotal reduction of a general system of equations – motivation to the simplex method – simplex algorithm.

**UNIT – III:**

**Transportation Problem & Unconstrained Optimization:** Finding initial basic feasible solution by north – west corner rule, least cost method and Vogel's approximation method – testing for optimality of balanced transportation problems.

One – dimensional minimization methods: Classification, Fibonacci method and Quadratic interpolation method. Univariate method, Powell's method and steepest descent method.

**UNIT – IV:**

**Constrained Nonlinear Programming:** Characteristics of a constrained problem, Classification, Basic approach of Penalty Function method; Basic approaches of Interior and Exterior penalty function methods. Introduction to convex Programming Problem.

**UNIT – V:**

**Dynamic Programming:** Dynamic programming multistage decision processes – types – concept of sub optimization and the principle of optimality – computational procedure in dynamic programming – examples illustrating the calculus method of solution - examples illustrating the tabular method of solution.

**TEXT BOOKS:**

1. Engineering optimization: Theory and practice", S. S.Rao, New Age International (P) Limited.
2. Optimization Methods in Operations Research and systems Analysis, K.V. Mittal and C. Mohan, New Age International (P) Limited.

**REFERENCE BOOKS:**

1. Operations Research, Dr. S.D.Sharma.
2. Introductory Operations Research, H.S. Kasene & K.D. Kumar, Springer (India), Pvt .LTd.
3. Operations Research: An Introduction, H.A.Taha, Pearson Pvt. Ltd.
4. Operations Research, Richard Bronson, Govindasami Naadimuthu, Tata Mc Graw – Hill Company Limited.

**Outcome:**

After going through this course the student gets a thorough knowledge on, Optimization of electrical and electronics engineering problems through classical optimization techniques, linear programming, simplex algorithm, transportation problem, unconstrained optimization, constrained non-linear programming and dynamic programming, with which he/she can able to apply the above conceptual things to real world electrical and electronics problems and applications.

(A70226) ELECTRICAL DISTRIBUTION SYSTEMS

(Elective-II)

**Objective:**

This course gives the complete knowledge of electrical distribution systems, the design of feeders, substations. It also gives conceptual knowledge on how to determine the performance of a distribution system through its important parameters i.e. voltage drops and power losses and the very important thing that protection of the system by means of protective devices and their co-ordination during the several fault conditions. It also specifies how to improve the voltage profiles and power factor of the system to better value using various voltage control and compensation techniques.

**UNIT – I:**

**Introduction & General Concepts:** Introduction to distribution systems: Load modeling and characteristics. Coincidence factor, contribution factor loss factor - Relationship between the load factor and loss factor.

**Classification of loads:** Residential, commercial, Agricultural and Industrial loads and their characteristics.

**UNIT – II:**

**Distribution Feeders & Substations: Design Considerations of Distribution Feeders:** Radial and loop types of primary feeders, voltage levels, feeder loading; basic design practice of the secondary distribution system. **Substations:** Rating of distribution substation, service area within primary feeders. Benefits derived through optimal location of substations.

**UNIT – III:**

**Distribution System Analysis: Voltage drop and power-loss calculations:** Derivation for voltage drop and power loss in lines, manual methods of solution for radial networks, three phase balanced primary lines.

**UNIT – IV:**

**Protective Devices & Co-Ordination:** Objectives of distribution system protection, types of common faults and procedure for fault calculations.

**Protective Devices:** Principle of operation of Fuses, Circuit Reclosures, and line sectionalizers, and circuit breakers.

**Coordination of Protective Devices:** General coordination procedure.

**UNIT – V:**

**Voltage Control & P.F Improvement:** Equipment for voltage control, effect

of series capacitors, line drop Compensation, effect of AVB/AVR. Power-factor control using different types of power capacitors, shunt and series capacitors, effect of shunt capacitors (Fixed and Switched), capacitor allocation - Economic justification –Procedure to determine the best capacitor location.

**TEXT BOOK:**

1. Electrical Power Distribution Systems, V. Kamaraju, TMH.
2. Electrical Distribution Systems, Dr. S. Siva naga raj, Dr. K. Shankar. Danapathi Rai Publications.

**REFERENCE BOOK:**

1. Electric Power Distribution System Engineering, Turan Gonen, CRC Press.
2. Electric Power Generation, Transmission and Distribution, SN. Singh, PHI Publishers.

**Outcome:**

After going through this course the student gets a thorough knowledge on, general aspects of electrical distribution systems, design and analysis of distribution feeders and substations, distribution systems analysis through voltage-drop and power loss calculations, operation of protective devices used in distribution systems and their co-ordination, voltage control and power factor improvement through capacitor compensation and distribution system-faults analysis, with which he/she can able to apply the above conceptual things to real-world electrical and electronics problems and applications.

**(A70227) ELECTRICAL ESTIMATING AND COSTING**

**(Elective-II)**

**Objective:**

Emphasize the estimating and costing aspects of all electrical equipment, installation and designs to analyze the cost viability. Exposure to design and estimation of wiring, design of overhead and underground distribution lines, substations and illuminations design. These techniques should help the students to successfully estimate costing of the products / projects that are part of our every day usage.

**UNIT-I:**

**Design Considerations of Electrical Installations:** Electric Supply System, Three phase four wire distribution system, Protection of Electric Installation against over load, short circuit and Earth fault, Earthing, General requirements of electrical installations, testing of installations, Indian Electricity rules, Neutral and Earth wire, Types of loads, Systems of wiring, Service connections , Service Mains, Sub-Circuits, Location of Outlets, Location of Control Switches, Location of Main Board and Distribution board, Guide lines for Installation of Fittings, Load Assessment, Permissible voltage drops and sizes of wires, estimating and costing of Electric installations.

**UNI -II:**

**Electrical Installation for Different Types of Buildings and Small Industries:** Electrical installations for residential buildings – estimating and costing of material, Electrical installations for commercial buildings, Electrical installations for small industries.

**UNIT-III:**

**Overhead and Underground Transmission and Distribution Lines:** Introduction, Supports for transmission lines, Distribution lines – Materials used, Underground cables, Mechanical Design of overhead lines, Design of underground cables.

**UNIT-IV:**

**Substations:** Introduction, Types of substations, Outdoor substation – Pole mounted type, Indoor substations – Floor mounted type.

**UNIT-V:**

**Design of Illumination Schemes:** Introduction, Terminology in illumination, laws of illumination, various types of light sources, Practical lighting schemes.

**TEXT BOOKS:**

1. Electrical Design Estimating and Costing, K. B. Raina, S. K. BhattAcharya, New Age International Publisher.
2. Design of Electrical Installations, Er. V. K. Jain, Er. Amitabh Bajaj, University Science Press.
3. Electricity Pricing Engineering Principles and Methodologies, Lawrence J. Vogt, P. E., CRC Press.

**REFERENCE BOOKS:**

1. Code of practice for Electrical wiring installations,(System voltage not exceeding 650 volts), Indian Standard Institution, IS: 732-1983.
2. Guide for Electrical layout in residential buildings, Indian Standard Institution, IS: 4648-1968.
3. Electrical Installation buildings Indian Standard Institution, IS: 2032.
4. Code of Practice for selection, Installation of Maintenance of fuse (voltage not exceeding 650V), Indian Standard Institution, IS: 3106-1966.
5. Code of Practice for earthing, Indian Standard Institution, IS:3043-1966.
6. Code of Practice for Installation and Maintenance of induction motors, Indian Standard Institution, IS: 900-1965.
7. Code of Practice for electrical wiring, Installations (system voltage not exceeding 650 Volts), Indian Standard Institution, IS: 2274-1963.
8. Electrical Installation, estimating and costing, Gupta J. B., Katson, Ludhiana.

**Outcome:**

After going through this course the student gets a thorough knowledge on, estimating and costing aspects of all electrical equipment, installation and designs to analyze the cost viability, exposure to design and estimation of wiring, design of overhead and underground distribution lines, substations and illuminations, with which he/she can able to apply the above conceptual things to real-world electrical and electronics problems and applications.

**(A70498) MICROPROCESSORS AND INTERFACING DEVICES LAB**

**8086 Microprocessor:**

1. Arithmetic operations(Addition, Subtraction, Multiplication and Division)
2. Addition of two BCD numbers.
3. Ascending order/Descending order of an array of numbers.
4. Finding Largest/Smallest number in an array of numbers.
5. Generation of Fibonacci series.
6. Hexadecimal to Decimal conversion.
7. ASCII to Decimal conversion.
8. Program for sorting an array for 8086.
9. Program for searching for a number or character in a string for 8086.
10. Program for string manipulations for 8086.

**MASM Programming:**

1. Arithmetic operations(Addition, Subtraction, Multiplication and Division)
2. Addition of two BCD numbers.
3. Ascending order/Descending order of an array of numbers.
4. Finding Largest/Smallest number in an array of numbers.
5. Generation of Fibonacci series.
6. Hexadecimal to Decimal conversion.

**8051 Microcontroller:**

1. Arithmetic operations(Addition, Subtraction, Multiplication and Division)
2. Addition of two BCD numbers.
3. Ascending order/Descending order of an array of numbers.
4. Finding Largest/Smallest number in an array of numbers.
5. Generation of Fibonacci series.
6. Masking of Bits.
7. Hexadecimal to Decimal conversion.

**Interfacing with 8086 Microprocessor:**

1. Stepper motor interfacing to 8086.
2. Traffic Light Controller interfacing to 8086.
3. Elevator simulator interfacing to 8086.
4. Seven-segment Display interfacing to 8086.
5. Tone Generator interfacing to 8086.
6. Interfacing ADC and DAC to 8086.
7. SRAM and DRAM interfacing to 8086.
8. Digit Key - interfacing to 8086.

Note: Minimum of 12 experiments to be conducted.

**(A70293) ELECTRICAL MEASUREMENTS LAB**

The following experiments are required to be conducted as compulsory experiments:

1. Calibration and Testing of single phase energy Meter
2. Calibration of dynamometer power factor meter
3. Crompton D.C. Potentiometer – Calibration of PMMC ammeter and PMMC voltmeter
4. Kelvin's double Bridge – Measurement of resistance – Determination of Tolerance.
5. Dielectric oil testing using H.T. testing Kit
6. Schering bridge & Anderson bridge.
7. Measurement of 3-phase reactive power with single-phase wattmeter.
8. Measurement of parameters of a choke coil using 3 voltmeter and 3 ammeter methods.

In addition to the above eight experiments, at-least any two of the experiments from the following list are required to be conducted:

9. Calibration LPF wattmeter – by Phantom testing
10. Measurement of 3 phase power with single watt meter and 2 No's of C.T.
11. C.T. testing using mutual Inductor – Measurement of % ratio error and phase angle of given C.T. by Null method.
12. P.T. testing by comparison – V.G. as Null detector – Measurement of % ratio error and phase angle of the given P.T.
13. LVDT and capacitance pickup – characteristics and Calibration
14. Resistance strain gauge – strain measurements and Calibration
15. Transformer turns ratio measurement using a.c. bridge
16. Measurement of % ratio error and phase angle of given C.T. by comparison.