ACE
Engineering College

Ankushapur(V), Ghatkesar(M), R.R.Dist - 501 301

(An Autonomous Institution)

B.TECH. THIRD YEAR DEGREE COURSE

ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE STRUCTURE

(R20 Regulation)

III Year				I Semester			
S.No.	Course type	Course Code	Course Title	Periods per week			Credits
				L	T	P	
1	PCC	EE501PC	Power Electronics	3	1	0	4
2	PCC	EE502PC	Power System-II	3	1	0	4
3	PCC	EE503PC	Electrical Measurements And Instrumentation	3	1	0	4
4	PEC		Professional Elective-I	3	0	0	3
5	HSMC	SM504MS	Business Economics and Financial Analysis	3	0	0	3
6	PCC	EE505PC	Power System Lab-II	0	0	2	1
7	PCC	EE506PC	Power Electronics Lab	0	0	2	1
8	PCC	EE507PC	Electrical Measurements and Instrumentation Lab	0	0	2	1
9	HSMC	EN508HS	Advanced English Communication skills Lab	0	0	2	1
10	MC	MC509	Intellectual Property Rights	3	0	0	0
11	MC	MC511	Artificial Intelligence	3	0	0	0
Total				**21**	**3**	**8**	**22**

III Year				II Semester			
S. No.	Course type	Course Code	Course Title	Periods per week			Credits
				L	T	P	
1	ESC	EE601PC	Digital Signal Processing	3	0	0	3
2	ESC	EE602PC	Microprocessors and Microcontrollers	3	0	0	3
3	PCC	EE603PC	Power System Protection	3	1	0	4
4	PCC	EE604PC	Power System Operation and Control	3	0	0	3
5	PEC		Professional Elective-II	3	0	0	3
6	OEC		Open Elective-I	3	0	0	3
7	PCC	EE605PC	Electrical Systems Simulation Lab	0	0	2	1
8	ESC	EE606PC	Microprocessors and Microcontrollers Lab	0	0	2	1
9	ESC	EE607PC	Digital Signal Processing Lab	0	0	2	1
10	MC	MC610	Cyber Security	3	0	0	0
Total				**21**	**1**	**6**	**22**

Note: *MC = Satisfactory/Unsatisfactory

EE501PC: POWER ELECTRONICS

B.TECH. III YEAR I SEMESTER

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
EE501PC	PCC	3	1	0	4	30	70	100

Prerequisite: Analog Electronics(EE303PC), Digital Electronics (EE403PC)

Course Objectives:

1. To analyze the power electronic circuits.
2. To understand the principle of operation of different power conversion circuits.
3. To design suitable power converter for efficient control of power.
4. To design suitable power converter for efficient transmission and utilization of power in power system applications.

Course Outcomes: Upon completing this course, the student will be able to

1. Understand operation of different power electronics devices.
2. Explain workings of phase-controlled rectifier circuits.
3. Examine the operation of DC-DC converter
4. Compare different modes of operation of inverters
5. Judge the performance of ac voltage controller

UNIT: I	POWER SWITCHING DEVICES

Concept of power electronics, scope and applications, types of power converters; Power semiconductor switches and their V-I characteristics - Power Diodes, Power BJT, SCR, Power MOSFET, Power IGBT; Thyristor ratings and protection, methods of SCR commutation, UJT as a trigger source, gate drive circuits for BJT and MOSFETs

UNIT: II	AC-DC CONVERTERS

Principles of single-phase fully-controlled converter with R, RL, and RLE load, Principles of single-phase half-controlled converter with RL and RLE load, Principles of three-phase fully-controlled converter operation with RLE load, Effect of load and source inductances, General idea of gating circuits, Single phase and Three phase dual converters.

UNIT: III	DC-DC CONVERTERS

Introduction, elementary chopper with an active switch and diode, concepts of duty ratio, average inductor voltage, average capacitor current. Buck converter - Power circuit, analysis and waveforms at steady state, duty ratio control of output voltage. Boost converter - Power circuit, analysis and waveforms at steady state, relation between duty ratio and average output voltage. Buck-Boost converter - Power circuit, analysis and waveforms at steady state, relation between duty ratio and average output voltage.

Unit: IV	DC-AC CONVERTERS

: Introduction, principle of operation, performance parameters, single phase bridge inverters with R, RL loads, 3-phase bridge inverters - 120- and 180-degrees mode of operation, Voltage control of single-phase inverters –single pulse width modulation, multiple pulse width modulation, sinusoidal pulse width modulation.

UNIT: V	AC-AC CONVERTERS

Phase Controller (AC Voltage Regulator)-Introduction, principle of operation of single-phase voltage controllers for R, R-L loads and its applications. Cyclo-converter-Principle of operation of single phase cyclo-converters, relevant waveforms, circulating current mode of operation, Advantages and disadvantages.

TEXT BOOKS:

1. M. H. Rashid, "Power electronics: circuits, devices, and applications", Pearson Education India, 4th Edition, 2014.
2. N. Mohan and T. M. Undeland, "Power Electronics: Converters, Applications and Design", John Wiley & Sons, 3rd Edition , 2007.

REFERENCE BOOKS:

1. R. W. Erickson and D. Maksimovic, "Fundamentals of Power Electronics", 4th Edition Springer Science & Business Media, 2007.
2. L. Umanand, "Power Electronics: Essentials and Applications", Wiley India, 2009.

WEB REFERENCES:

1. https://nptel.ac.in/courses/108/105/108105066/
2. https://nptel.ac.in/courses/108/101/108101126/
3. https://nptel.ac.in/courses/108/101/108101038/

EE502PC: POWER SYSTEM – II

B.TECH. III YEAR I SEMESTER

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
EE502PC	PCC	3	1	0	4	30	70	100

Prerequisite: Power System-I(EE405PC)

Course Objectives:

1. To analyze the performance of transmission lines
2. To understand the voltage control and compensation methods
3. To understand the per unit representation of power systems
4. To understand the per unit representation of power systems

Course Outcomes: Upon completing this course, the student will be able to

1. Analyze transmission line performance
2. Apply load compensation techniques to control reactive power
3. Understand the application of per unit quantities
4. Design over voltage protection and insulation coordination
5. Determine the fault currents for symmetrical and unbalanced faults

UNIT: I PERFORMANCE OF LINES

Representation of lines, short transmission lines, medium length lines, nominal T and PI- representations, long transmission lines. The equivalent circuit representation of a long Line, A, B, C, D constants, Ferranti Effect, Power flow through a transmission line, receiving end power circle diagram.

UNIT: II VOLTAGE CONTROL

Introduction – methods of voltage control, shunt and series capacitors / Inductors, tap changing transformers, synchronous phase modifiers. Compensation In Power Systems: Introduction - Concepts of Load compensation – Load ability characteristics of overhead lines – Uncompensated transmission line – Symmetrical line – Radial line with asynchronous load – Compensation of lines.

UNIT: III PER UNIT REPRESENTATION OF POWER SYSTEMS

The one-line diagram, impedance and reactance diagrams, per unit quantities, changing the base of per unit quantities, advantages of per unit system. Travelling Waves on Transmission Lines: Production of travelling 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.

UNIT: IV OVERVOLTAGE PROTECTION AND INSULATION COORDINATION

Over voltage due to arcing ground and Peterson coil, lightning, horn gaps, surge diverters, rod gaps, expulsion type lightning arrester, valve type lightning arrester, ground wires, ground rods, counter poise, surge absorbers, insulation coordination, volt-time curves.

UNIT: V SYMMETRICAL COMPONENTS AND FAULT CALCULATIONS

Significance of positive, negative and zero sequence components, Average 3-phase power in terms of symmetrical components, sequence impedances and sequence networks, fault calculations, sequence network equations, single line to ground fault, line to line fault, double line to ground fault, three phase fault, faults on power systems, faults with fault impedance, reactors and their location, short circuit capacity of a bus.

TEXT BOOKS:

1. John J. Grainger & W.D. Stevenson, "Power System Analysis", Mc Graw Hill International, 2017.
2. C.L. Wadhwa, "Electrical Power Systems" – New Age International Pub. Co. Third Edition, 2016.

REFERENCE BOOKS:

1. D. P. Kothari;I. J. Nagrath, "Power System Engineering", McGraw-Hill; Third edition, 26 April 2019
2. A.N Kani, "Power System Analysis", CBS; Reprint edition, 2020
3. D.P. Kothari and I. J. Nagrath, "Modern Power System Analysis", Tata Mc Graw Hill Pub. Co., New Delhi, Fourth edition, 2011

WEB REFERENCES:

1. https://nptel.ac.in/courses/108/105/108105104/
2. https://nptel.ac.in/courses/108/105/108105067/

EE503PC: ELECTRICAL MEASUREMENTS AND INSTRUMENTATION

B.TECH. III YEAR I SEMESTER

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
EE503PC	PCC	3	1	0	4	30	70	100

Prerequisite: Basic Electrical Engineering (EE103ES), AnalogElectronics (EE303PC), ElectricalCircuits (EE302PC) & Electro Magnetic Fields (EE305PC).

Course Objectives:

1. To introduce the basic principles of all measuring instruments
2. To understand the constructional details and principle of operation of basic analog and digital measuring instruments.
3. To deal with the measurement of voltage, current, Power factor, power, energy and magnetic measurements.
4. To understand the basic concepts of smart and digital metering.

Course Outcomes: Upon completing this course, the student will be able to

1. Illustrate different types of measuring instruments, their construction, operation and characteristics
2. Identify the instruments suitable for typical measurements
3. Apply the knowledge about transducers and instrument transformers to use them effectively.
4. Analyze smart and digital metering for industrial applications.
5. Examine the operation of potentiometer for calibration of Instruments.

UNIT: I INTRODUCTION TO MEASURING INSTRUMENTS

Classification – deflecting, control and damping torques – Ammeters and Voltmeters – PMMC, moving iron type instruments – expression for the deflecting torque and control torque – Errors and compensations, extension of range using shunts and series resistance. Electrostatic Voltmeters electrometer type and attracted disc type – extension of range of E.S. Voltmeters.

UNIT: II POTENTIOMETERS & INSTRUMENT TRANSFORMERS

Principle and operation of D.C. Crompton"s potentiometer – standardization – Measurement of unknown resistance, current, voltage. A.C. Potentiometers: polar and coordinate type"s standardization – applications. CT and PT – Ratio and phase angle errors.

UNIT: III MEASUREMENT OF POWER & ENERGY

Single phase dynamometer wattmeter, LPF and UPF, Double element and three element dynamometer wattmeter, expression for deflecting and control torques – Extension of range of wattmeter using instrument transformers – Measurement of active and reactive powers in balanced and unbalanced systems. Single phase induction type energy meter – driving and braking torques – errors and compensations – testing by phantom loading using R.S.S. meter. Three phase energy meter – tri-vector meter, maximum demand meters.

UNIT: IV DC & AC BRIDGES

Method of measuring low, medium and high resistance – sensitivity of Wheat-stone"s bridge – Carey Foster"s bridge, Kelvin"s double bridge for measuring low resistance, measurement of high resistance – loss of charge method. Measurement of inductance- Maxwell"s bridge, Hay"s bridge, Anderson"s bridge - Owen"s bridge. Measurement of capacitance and loss angle –Desaunty"s Bridge - Wien"s bridge – Schering Bridge.

UNIT: V TRANSDUCERS

Definition of transducers, Classification of transducers, Advantages of Electrical transducers, Characteristics and choice of transducers; Principle operation of LVDT and capacitor transducers; LVDT Applications, Strain gauge and its principle of operation, gauge factor, Thermistors, Thermocouples, Piezo electric transducers, photovoltaic, photo conductive cells, and photo diodes.

Introduction to Smart and Digital Metering: Digital Multi-meter, True RMS meters, Clamp-on meters, Digital Storage Oscilloscope

TEXT BOOKS:

1. G. K. Banerjee, "Electrical and Electronic Measurements", PHI Learning Pvt. Ltd., 2nd Edition, 2016
2. S. C. Bhargava, "Electrical Measuring Instruments and Measurements", BS Publications, 2013.

REFERENCE BOOKS:

1. A. K. Sawhney, "Electrical & Electronic Measurement & Instruments", Dhanpat Rai & Co. Publications, 2021.
2. R. K. Rajput, "Electrical & Electronic Measurement & Instrumentation", S. Chand and Company Ltd., 2016.

WEB REFERENCES:

1. https://nptel.ac.in/courses/108/105/108105153/
2. https://nptel.ac.in/noc/courses/noc19/SEM2/noc19-ee44/
3. https://www.classcentral.com/course/swayam-electrical-measurement-and-electronic-instruments-14032

EE511PE: COMPUTER ARCHITECTURE
(Professional Elective-I)

B.TECH. III YEAR I SEMESTER

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
EE511PE	PEC	3	0	0	3	30	70	100

Prerequisite: Digital Electronics(EE403PC)

Course Objectives:

1. To understand basic components of computers.
2. To understand the architecture of 8086 processor.
3. To understand the instruction sets, instruction formats and various addressing modes of 8086.
4. To understand the representation of data at the machine level and how computations are Performed at machine level.
5. To understand the memory organization and I/O organization.
6. To understand the parallelism both in terms of single and multiple processors.

Course Outcomes: Upon completing this course, the student will be able to

1. Understand the concepts of microprocessors, their principles and practices.
2. Write efficient programs in assembly language of the 8086 family of microprocessors.
3. Organize a modern computer system and be able to relate it to real examples.
4. Develop the programs in assembly language for 80286, 80386 and MIPS processors in real and protected modes.
5. Implement embedded applications using ATOM processor.

UNIT: I	INTRODUCTION TO COMPUTER ORGANIZATION

Architecture and function of general computer system, CISC Vs RISC, Data types, Integer Arithmetic - Multiplication, Division, Fixed and Floating-point representation and arithmetic, Control unit operation, Hardware implementation of CPU with Micro instruction, microprogramming, System buses, Multi-bus organization.

UNIT: II	MEMORY AND INPUT – OUTPUT ORGANIZATION

System memory, Cache memory - types and organization, Virtual memory and its implementation, Memory management unit, Magnetic Hard disks, Optical Disks.

Input – Output Organization Accessing I/O devices, Direct Memory Access and DMA controller, Interrupts and Interrupt Controllers, Arbitration, Multilevel Bus Architecture, Interface circuits - Parallel and serial port. Features of PCI and PCI Express bus.

UNIT: III	16 AND 32 MICROPROCESSORS

80x86 Architecture, IA – 32 and IA – 64, Programming model, Concurrent operation of EU and BIU, Real mode addressing, Segmentation, addressing modes of 80x86, Instruction set of 80x86, I/O addressing in 80x86

UNIT: IV	PIPELINING

Introduction to pipelining, Instruction level pipelining (ILP), compiler techniques for ILP,Data hazards, Dynamic scheduling, Dependability, Branch cost, Branch Prediction, Influence on

instruction set.

UNIT: V	DIFFERENT ARCHITECTURES

VLIW Architecture, DSP Architecture, SoC architecture, MIPS Processor and programming

TEXT BOOKS:

1. V. Carl, G. Zvonko and S. G. Zaky, "Computer organization", McGraw Hill, 1978.
2. B. Brey and C. R. Sarma, "The Intel microprocessors", Pearson Education, 2000.

REFERENCE BOOKS:

1. 1. J. L. Hennessy and D. A. Patterson, "Computer Architecture A Quantitative Approach", Morgan Kauffman, 2011.
2. W. Stallings, "Computer organization", PHI, 1987.
3. P. Barry and P. Crowley, "Modern Embedded Computing", Morgan Kaufmann, 2012.
4. N. Mathivanan, "Microprocessors, PC Hardware and Interfacing", Prentice Hall, 2004.
5. Y. C. Lieu and G. A. Gibson, "Microcomputer Systems: The 8086/8088 Family", Prentice Hall India, 1986.
6. J. Uffenbeck, "The 8086/8088 Design, Programming, Interfacing", Prentice Hall, 1987.
7. B. Govindarajalu, "IBM PC and Clones", Tata McGraw Hill, 1991.
8. P. Able, "8086 Assembly Language Programming", Prentice Hall India.

EE512PE: HIGH VOLTAGE ENGINEERING
(Professional Elective-I)

B.TECH. III YEAR I SEMESTER

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
EE512PE	PEC	3	0	0	3	30	70	100

Prerequisite: Power Systems – I (EE405PC), Electro Magnetic Fields (EE305PC)

Course Objectives:

7. To analyze breakdown phenomenon gaseous, liquids and solid dielectrics.
8. To inform about generation and measurement of high voltage and current.
9. To understand lightning surges and switching over-voltages.
10. To introduce high voltage testing methods.

Course Outcomes: Upon completing this course, the student will be able to

6. Understand breakdown incident in solid, liquid and gaseous insulating materials.
7. Differentiate the generation and measurement of D. C., A.C., & Impulse voltages.
8. Develop tests on H. V. equipment and insulating materials, as per the standards.
9. Analyze the generation of over-voltages in a power system.
10. Describe protection of over-voltages.

UNIT: I **FUNDAMENTALS OF INSULATING MATERIALS**

Ionization processes and de-ionization processes, Types of Discharge, Gases as insulating materials, Breakdown in Uniform gap, non-uniform gaps, Townsend"s theory, Streamer mechanism, Corona discharge. Breakdown in pure and commercial liquids, Solid dielectrics and composite dielectrics, intrinsic breakdown, electromechanical breakdown and thermal breakdown, Partial discharge, applications of insulating materials.

UNIT: II **GENERATION OF HIGH VOLTAGES**

Generation of high D. C. and A.C. voltages, generation of impulse voltages, generation of impulse currents, tripping and control of impulse generators.

UNIT: III **MEASUREMENTS OF HIGH VOLTAGES AND CURRENTS**

Peak voltage, impulse voltage and high direct current measurement method, cathode ray oscillo-graphs for impulse voltage and current measurement, measurement of dielectric constant and loss factor, partial discharge measurements.

UNIT: IV **LIGHTNING AND SWITCHING OVER-VOLTAGES**

Charge formation in clouds, stepped leader, Dart leader, Lightning Surges. Switching over-voltages, Protection against over-voltages, Surge diverters, and Surge modifiers.

UNIT: V **HIGH VOLTAGE TESTING OF ELECTRICAL COMPONENTS**

Various standards for HV Testing of electrical apparatus, IS, IEC standards, testing of insulators and bushings, testing of isolators and circuit breakers, testing of cables, power transformers and some high voltage equipment, High voltage laboratory layout, indoor and outdoor laboratories, testing facility requirements, safety precautions in H. V. Labs.

TEXT BOOKS:

3. "M. S. Naidu","V.Kamaraju", High Voltage Engineering, McGraw Hill Education, 2020 6th Edition
4. "C. L. Wadhwa", High Voltage Engineering, New Age Science, 2010

REFERENCE BOOKS:

9. "John Kuffel", High Voltage Engineering Fundamentals, Elsevier, 3rd Ed2012
10. "E. Kuffel", "W. S. Zaengl","J.Kuffel", "High Voltage Engineering Fundamentals", Newnes Publication, 2000.
11. "R. Arora","W.Mosch", "High Voltage and Electrical Insulation Engineering", John Wiley & Sons, 2011.

WEB REFERENCES:

1. https://nptel.ac.in/courses/108/104/108104048/
2. https://ietresearch.onlinelibrary.wiley.com/journal/23977264

EE513PE: SPECIAL ELECTRICAL MACHINES
(Professional Elective-I)

B.TECH. III YEAR I SEMESTER

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
EE513PE	PEC	3	0	0	3	30	70	100

Prerequisite: Electrical Machines-I(EE304PC), Electrical Machines-II(EE402PC)

Course Objectives:

1. To learnthe construction and operation of PMDC motor
2. To understand working and application of BLDC motor
3. To illustrate the application of special machines
4. To understand working principle of stepper motor

Course Outcomes: Upon the completion of this subject, the student will be able

1. Apply the working principle of PMDC motor.
2. Analyze the performance of a BLDC motor.
3. Derive emf equation of various special machines.
4. Develop controlling technique to PMSM motor.
5. Analyze the operation of stepper motor.

UNIT: I **SPECIAL PURPOSE DC MOTORS**

Permanent magnet DC Motor- PMDC Motors-construction-Principle of operation- characteristics and applications

Brushless DC motor- BLDC Motors-construction-Principle of operation- characteristics and applications

UNIT: II **PERMANENT MAGNET AC MOTORS**

Permanent magnet Synchronous Motor- PMSM Motors-construction-Principle of operation-characteristics, applications and control techniques.

UNIT: III **SWITCHED RELUCTANCE MOTOR**

Introduction-construction-operation-application – improvements in the design of conventional reluctance motors- Some distinctive differences between SR and conventional reluctance motors-principle of operation of SRM

UNIT: IV **STEPPER MOTORS**

Stepper Motors: Introduction-synchronous inductor (or hybrid stepper motor), Hybrid stepping motor, construction, principles of operation, Energization with two phase at a timeessential conditions for the satisfactory operation of a 2-phase hybrid step motor- very slow speed synchronous motor for servo control-different configurations for switching the phase windings-control circuits for stepping motors-an open-loop controller for a 2-phase stepping motor.

UNIT: V **SYNCHRONOUS RELUCTANCE MOTOR &LINER INDUCTION MOTORS**

Synchronous Reluctance Motor Construction, Working, Phasor Diagram, Torque Equation, Control - Direct Axis Current Control, Fast Torque Response Control, Advantages

Linear induction motors (LIM) Construction – Principle of operation – Double sided LIM from

rotating type Induction Motor – Schematic of LIM drive for traction – Development of one-sided LIM with back iron-equivalent circuit of LIM.

TEXT BOOKS:

1. K. Venkataratnam, Special electrical machines, university press, 2009
2. R. K. Rajput - Electrical machines, Laxmi Publications, 5th Edition 2016

REFERENCE BOOKS:

1. V.V. Athani - Stepper motor: Fundamentals, Applications and Design, New age International publishers, 1997
2. "E. G. Janardanan", Special electrical machines-PHI 2014.

WEB REFERENCES:

1. https://nptel.ac.in/courses/108/102/108102156/

EE514PE: LINEAR SYSTEMS ANALYSIS

(Professional Elective I)

B.TECH. III YEAR I SEMESTER

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
EE514PE	PEC	3	0	0	3	30	70	100

Prerequisite: Mathematics – II (MA201BS), Electrical Circuits(EE302PC)

Course Objectives:

1. To develop ability to analyze linear systems and signals
2. To develop critical understanding of mathematical methods to analyze linear systems and signals
3. To understand about Fourier Series and Fourier Transform representation
4. To understand, Laplace transform and its applications

Course Outcomes: Upon completing this course, the student will be able to

1. Understand State Variable Analysis
2. Apply mathematical modeling tools to represent linear systems
3. Employmathematical modeling tools to analyze linear systems
4. Understand the concepts of Fourier Series, Fourier Transform representation, Laplace transform
5. Know about sampling theorem.

UNIT: I STATE VARIABLE ANALYSIS

Choice of state variables in Electrical Networks-Formulation of state equations for Electrical networks Equivalent source method. Network topological method - Solution of state equations-Analysis of simple networks with state variable approach.

UNIT: II FOURIER SERIES AND FOURIER TRANSFORM REPRESENTATION AND APPLICATIONS

Introduction, Trigonometric form of Fourier series, Exponential form of Fourier series, Wave symmetry, Fourier integrals and transforms, Fourier transform of a periodic function ,Properties of Fourier Transform, Parseval"s theorem , Fourier transform of some common signals, Fourier transform relationship with Laplace Transform.

Introduction, Effective value, and average values of non sinusoidal periodic waves, currents, Power Factor, Effects of harmonics, Application in Circuit Analysis, Circuit Analysis using Fourier Series.

UNIT: III LAPLACE TRANSFORM APPLICATIONS AND NETWORK SYNTHESIS

Application of Laplace transform Methods of Analysis – Response of RL, RC, RLC Networks to Step, Ramp, and impulse functions, Shifting Theorem – Convolution Integral – Applications Testing of Polynomials: Elements of realisability - Hurwitz polynomials-positive real functions-Properties-Testing-Sturm"s Test, examples.

Synthesis of one port LC networks-Foster and Cauermethods-Synthesis of RL and RC one port networks-Foster and Cauer methods

UNIT: IV SAMPLING

Sampling theorem – Graphical and Analytical proof for Band Limited Signal impulse sampling, natural and Flat top Sampling, Reconstruction of signal from its samples, effect of under sampling – Aliasing, introduction to Band Pass sampling, Cross correlation and auto correlation of functions, properties of correlation function, Energy density spectrum, Power density spectrum, Relation between auto correlation function and Energy / Power spectral density function.

UNIT: V Z-TRANSFORMS

Fundamental difference between continuous and discrete time signals, discrete time complex, exponential and sinusoidal signals, periodicity of discrete time complex exponential, concept of Z Transform of a discrete sequence. Distinction between Laplace, Fourier, and Z-Transforms. Region of convergence in Z-Transforms, constraints on ROC for various classes of signals, Inverse Z-Transform properties of Z-Transforms.

TEXT BOOKS:

1. "B. P. Lathi", "Signals, Systems and Communications", BS Publications 2020.
2. "Umesh Sinha" "Network Analysis and Synthesis", Satya Prakashan Publications, 2013.

REFERENCE BOOKS:

1. "A. N. Tripathi", "Linear System Analysis", New Age International, 2nd Edition 2010.
2. "D. Roy Chowdhary", "Network and Systems", New Age International, 2013.
3. "Gopal G Bhise, Prem R. Chadha", Engineering Network Analysis and Filter Design, Umesh Publications 2012.

WEB REFERENCES:

1. https://nptel.ac.in/courses/108/106/108106162/
2. https://onlinecourses.nptel.ac.in/noc19_ee43

SM504MS: BUSINESS ECONOMICS AND FINANCIAL ANALYSIS

B.TECH. III YEAR I SEMESTER

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
SM504MS	HSMC	3	0	0	3	30	70	100

Prerequisite: Nil

Course Objectives:

1. To learn the basic business types, impact of the economy on Business and Firms specifically.
2. To analyze the Business from the Financial Perspective.

Course Outcomes: Upon completing this course, the student will be able to

1. Understand the various Forms of Business and the impact of economic variables on the Business. The Demand, Supply, Production, Cost, Market Structure, Pricing aspects are learnt.
2. The Students can study the firm's financial position by analysing the Financial Statements of a Company.

Unit: I	INTRODUCTION TO BUSINESS AND ECONOMICS

Structure of Business Firm, Theory of Firm, Types of Business Entities, Limited Liability Companies, Sources of Capital for a Company, Non-Conventional Sources of Finance. Economics: Significance of Economics, Micro and Macro Economic Concepts, Concepts and Importance of National Income, Inflation, Money Supply and Inflation, Business Cycle, Features and Phases of Business Cycle. Nature and Scope of Business Economics, Role of Business Economist, Multidisciplinary nature of Business Economics.

Unit: II	DEMAND AND SUPPLY ANALYSIS

Elasticity of Demand: Elasticity, Types of Elasticity, Law of Demand, Measurement and Significance of Elasticity of Demand, Factors affecting Elasticity of Demand, Elasticity of Demand in decision making, Demand Forecasting: Characteristics of Good Demand Forecasting, Steps in Demand Forecasting, Methods of Demand Forecasting. Supply Analysis: Determinants of Supply, Supply Function and Law of Supply.

Unit: III	PRODUCTION, COST, MARKET STRUCTURES AND PRICING

Production, Cost, Market Structures & Pricing Production Analysis: Factors of Production, Production Function, Production Function with one variable input, two variable inputs, Returns to Scale, Different Types of Production Functions. Cost analysis: Types of Costs, Short run and Long run Cost Functions. Market Structures: Nature of Competition, Features of Perfect competition, Monopoly, Oligopoly, Monopolistic Competition. Pricing: Types of Pricing, Product Life Cycle based Pricing, Break Even Analysis, Cost Volume Profit Analysis.

Unit: IV	FINANCIAL ACCOUNTING:

Accounting concepts and Conventions, Accounting Equation, Double-Entry system of Accounting, Rules for maintaining Books of Accounts, Journal, Posting to Ledger, Preparation of Trial Balance, Elements of Financial Statements, Preparation of Final Accounts.

UNIT-V	FINANCIAL ANALYSIS THROUGH RATIOS

Concept of Ratio Analysis, Importance, Liquidity Ratios, Turnover Ratios, Profitability Ratios, Proprietary Ratios, Solvency, Leverage Ratios – Analysis and Interpretation (simple problems).

TEXT BOOKS:

1. D. D. Chaturvedi, S. L. Gupta, Business Economics - Theory and Applications, International Book House Pvt. Ltd. 2013.
2. Dhanesh K Khatri, Financial Accounting, Tata Mc –Graw Hill, 2011.
3. Geethika Ghosh, Piyali Gosh, Purba Roy Choudhury, Managerial Economics, 2e,Tata Mc Graw Hill Education Pvt. Ltd. 2012.

REFERENCE BOOKS:

1. Paresh Shah, Financial Accounting for Management 2e, Oxford Press, 2015.
2. S. N. Maheshwari, Sunil K Maheshwari, Sharad K Maheshwari, Financial Accounting, 5e, Vikas Publications, 2013

WEB REFERENCES:

1. https:// www.slideshare.net/glory1988/managerial-economics-and- financial analysis.
2. https:// thenthata.web4kurd.net/mypdf/managerial-economics-and- financial analysis.

EE505PC: POWER SYSTEM LAB-II

B.TECH. III YEAR I SEMESTER

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
EE505PC	PCC	0	0	2	1	30	70	100

Prerequisite: Power System-I(EE405PC),Power System-II(EE502PC), Electrical Machines-I(EE304PC), Electrical Machines-II(EE402PC),

Course Objectives:

1. To find sequence impedances of 3-Φ synchronous machine
2. To find sequence impedances of 3-Φ Transformer
3. To find ABCD parameters of a transmission line
4. To perform fault analysis on Transmission line.

Course Outcomes: After completion of this lab, the student will be able to

1. Analyze IDMT over current relay
2. Understand differential protection of single-phase transformer
3. Analyze ABCD constants of a long transmission line.
4. Determine characteristics of under voltage and over voltage
5. Simulate shunt capacitor for under voltage control using MATLAB

List of Experiments:

1. Characteristics of IDMT Over-Current Relay
2. Differential protection of 1-Φ transformer
3. Characteristics of Micro Processor based Over Voltage/Under Voltage relay
4. A, B, C, D constants of a Long Transmission line
5. Finding the sequence impedances of 3-Φ synchronous machine.
6. Finding the sequence impedances of 3-Φ Transformer.
7. Simulation of LG, LL, LLG and LLL faults on a simple power system using PSCAD/MATLAB
8. Simulation of load compensation
9. Determination of Sequence components (Positive, Negative and Zero) of an Alternator
10. Determine ABCD parameters of short, medium and long Transmission lines using MATLAB.
11. Determine Characteristics of under voltage and over voltage using PSCAD/MATLAB
12. Simulation of a shunt capacitor for under voltage control using MATLAB.

WEB REFERENCES:

1. https://vp-dei.vlabs.ac.in/Dreamweaver/list.html

EE506PC: POWER ELECTRONICS LAB

B.TECH. III YEAR I SEMESTER

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
EE506PC	PCC	0	0	2	1	30	70	100

Prerequisite : Power Electronics(EE501PC)

Course Objectives:

1. Apply the concepts of power electronic converters for efficient conversion/control of power from source to load.
2. Design the power converter with suitable switches meeting a specific load requirement.
3. To make the students to design triggering circuits of SCR.
4. To perform the experiments on various converters.

Course Outcomes: Upon completing this course, the student will be able to

1. Understand the operating principles of various power electronic converters.
2. Analyze the characteristics of MOSFET, IGBT, SCR and SCR firing CKTs,
3. Develop the simulation model power converters.
4. Apply different commutation technique to turn off SCR
5. Examine output of inverter for different types of loads

List of Experiments:

1. Study of Characteristics of SCR, MOSFET & IGBT,
2. Gate firing circuits for SCR's
3. Single Phase AC Voltage Controller with R and RL Loads
4. Single Phase half controlled &fully controlled bridge converter with R and RL loads
5. Forced Commutation circuits (Class A, Class B, Class C, Class D & Class E)
6. Single Phase Cyclo-converter with R and RL loads
7. Single Phase series& parallel inverter with R and RL loads
8. Single Phase Bridge inverter with R and RL loads.
9. DC Jones chopper with R and RL Loads
10. Single Phase dual converter with RL loads

Following experiment are to be done by using suitable software.

11. (a) Simulation of single-phase Half wave converter using R and RL loads
    (b) Simulation of single-phase full converter using R, RL and RLE loads
    (c) Simulation of single-phase Semi converter using R, RL and RLE loads
12. (a) Simulation of Single-phase AC voltage controller using R and RL loads
    (b)Simulation of Single phase Cyclo-converter with R and RL-loads
13. Simulation of Buck chopper
14. Simulation of single-phase Inverter with PWM control
15. Simulation of three phase fully controlled converter with R and RL loads, with and without Freewheeling diode. Observation of waveforms for Continuous and Discontinuous modes of Operation.
16. Study of PWM techniques

Virtual Lab

http://vlabs.iitb.ac.in/vlabs-dev/labs/mit_bootcamp/power_electronics/labs/index.php

EE507PC: ELECTRICAL MEASUREMENTS AND INSTRUMENTATION LAB

B.TECH. III YEAR I SEMESTER

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
EE507PC	PCC	0	0	2	1	30	70	100

Prerequisite: Electrical Measurements and Instrumentation (EE503PC)

Course Objectives:

1. To calibrate LPF Watt Meter, energy meter, P. F Meter using electro dynamo meter type instrument as the standard instrument
2. To determine unknown inductance, resistance, capacitance by performing experiments on D.C Bridges & A. C Bridges
3. To determine three phase active & reactive powers using single wattmeter method practically
4. To determine the ratio and phase angle errors of current transformer and potential transformer.

Course Outcomes: Upon completing this course, the student will be able to

1. To select instruments
2. Analyze anyelectrical instrument
3. Find the accuracy of any instrument by performing experiment.
4. Calibrate PMMC instrument using D.C potentiometer.
5. Estimate the Strength of Dielectric oil

List of 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 displacement with the help of LVDT.
9. Calibration LPF wattmeter – by Phantom testing.
10. Measurement of 3-phase power with single watt meter and two CTs.
11. C.T. testing using mutual Inductor – Measurement of % ratio error and phase angle of given CT by Null method.
12. PT testing by comparison – V. G. as Null detector – Measurement of % ratio error and phase angle of the given PT
13. Resistance strain gauge – strain measurements and Calibration.
14. Transformer turns ratio measurement using AC bridges.
15. Measurement of % ratio error and phase angle of given CT by comparison.

WEB REFERENCES:

1. http://vlabs.iitkgp.ernet.in/asnm/exp10/index.html
2. http://vlabs.iitkgp.ernet.in/asnm/exp23/index.html
3. http://vlabs.iitkgp.ernet.in/asnm/exp21/index.html
4. https://vp-dei.vlabs.ac.in/Dreamweaver/exp4.html
5. http://vlabs.iitkgp.ernet.in/asnm/exp7/index.html

EN508HS: ADVANCED ENGLISH COMMUNICATION SKILLS LAB

B.TECH. III YEAR I SEMESTER

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
EN508HS	HSMC	0	0	2	1	30	70	100

Prerequisite: Knowledge of functional English, basics in grammar, understanding of LSRW skills

Course Objectives:

1. To improve the students' fluency in English, through a well-developed vocabulary and enable them to listen to English spoken at normal conversational speed by educated English speakers and respond appropriately in different socio-cultural and professional contexts.
2. Further, they would be required to communicate their ideas relevantly and coherently in writing.
3. To prepare all the students for their placements.

Course Outcomes: Upon completing this course, the student will be able to

1. Better understanding of nuances of English language through audio- visual experience and group activities
2. Neutralization of accent for intelligibility
3. Speaking skills with clarity and confidence which in turn enhances their employability skills

SYLLABUS

1. Activities on Fundamentals of Inter-personal Communication and Building Vocabulary - Starting a conversation – responding appropriately and relevantly – using the right body language – Role Play in different situations & Discourse Skills- using visuals - Synonyms and antonyms, word roots, one-word substitutes, prefixes and suffixes, study of word origin, business vocabulary, analogy, idioms and phrases, collocations & usage of vocabulary.

2. Activities on Reading Comprehension –General Vs Local comprehension, reading for facts, guessing meanings from context, scanning, skimming, inferring meaning, critical reading& effective googling.

3. Activities on Writing Skills – Structure and presentation of different types of writing – letter writing/Resume writing/ e-correspondence/Technical report writing/ – planning for writing – improving one's writing.

4. Activities on Presentation Skills – Oral presentations (individual and group) through JAM sessions/seminars/PPTs and written presentations through posters/projects/reports/ emails/assignments etc.

5. Activities on Group Discussion and Interview Skills – Dynamics of group discussion, intervention, summarizing, modulation of voice, body language, relevance, fluency and organization of ideas and rubrics for evaluation- Concept and process, pre-interview planning, opening strategies, answering strategies, interview through tele-conference & video-conference and Mock Interviews.

MINIMUM REQUIREMENT:

The Advanced English Communication Skills (AECS) Laboratory shall have the following infrastructural facilities to accommodate at least 35 students in the lab:

- Spacious room with appropriate acoustics.

- Round Tables with movable chairs
- Audio-visual aids
- LCD Projector
- Public Address system
- P – IV Processor, Hard Disk – 80 GB, RAM–512 MB Minimum, Speed – 2.8 GHZ
- T. V, a digital stereo & Camcorder
- Headphones of High quality

SUGGESTED SOFTWARE: The software consisting of the prescribed topics elaborated above should be procured and used.

- Oxford Advanced Learner's Compass, 7th Edition
- DELTA's key to the Next Generation TOEFL Test: Advanced Skill Practice.
- Lingua TOEFL CBT Insider, by Dream tech
- TOEFL & GRE (KAPLAN, AARCO & BARRONS, USA, Cracking GRE by CLIFFS)

TEXT BOOKS:

1. Effective Technical Communication by M Asharaf Rizvi. McGraw Hill Education (India) Pvt. Ltd. 2 nd Edition

2. Academic Writing: A Handbook for International Students by Stephen Bailey, Routledge, 5th Edition.

References:

1. Learn Correct English – A Book of Grammar, Usage and Composition by Shiv K. Kumar and HemalathaNagarajan. Pearson 2007

2. Professional Communication by ArunaKoneru, McGraw Hill Education (India) Pvt. Ltd, 2016.

3. Technical Communication by Meenakshi Raman &Sangeeta Sharma, Oxford University Press 2009.

4. Technical Communication by Paul V. Anderson. 2007. Cengage Learning pvt. Ltd. New Delhi.

5. English Vocabulary in Use series, Cambridge University Press 2008.

6. Handbook for Technical Communication by David A. McMurrey& Joanne Buckley. 2012. Cengage Learning.

7. Communication Skills by Leena Sen, PHI Learning Pvt Ltd., New Delhi, 2009.

8. Job Hunting by ColmDownes, Cambridge University Press 2008.

9. English for Technical Communication for Engineering Students, AyshaVishwamohan, Tata Mc Graw-Hill 2009.

MC509: INTELLECTUAL PROPERTY RIGHTS

B.TECH. III YEAR I SEMESTER

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
MC509	MC	3	0	0	0	100	0	100

UNIT: I

Introduction to Intellectual property: Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights.

UNIT: II

Trade Marks: Purpose and function of trademarks, acquisition of trade mark rights, protectable matter, selecting, and evaluating trade mark, trade mark registration processes.

UNIT: III

Law of copy rights: Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law. Law of patents: Foundation of patent law, patent searching process, ownership rights and transfer

UNIT: IV

Trade Secrets: Trade secret law, determination of trade secrete status, liability for misappropriations of trade secrets, protection for submission, trade secrete litigation. Unfair competition: Misappropriation right of Publicity, false advertising.

UNIT: V

New development of intellectual property: new developments in trade mark law; copy right law, patent law, intellectual property audits. International overview on intellectual property, international – trade mark law, copy right law, international patent law, and international development in trade secrets law.

TEXT BOOKS & REFERENCE BOOKS:

1. Intellectual property right, Deborah. E. Bouchoux, Cengage learning.
2. Intellectual property right – Unleashing the knowledge economy, prabuddha ganguli, Tata McGraw Hill Publishing company ltd.

MC511: ARTIFICIAL INTELLIGENCE

B.TECH. III YEAR I SEMESTER

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
MC511	MC	3	0	0	0	100	0	100

Prerequisite: Nil

Course Objectives:

1. To train the students to understand different types of AI agents, various AI search algorithms, fundamentals of knowledge representation, building of simple knowledge-based systems and to apply knowledge representation, reasoning. Study of Markov Models enable the student ready to step into applied AI.

UNIT: I

Introduction: AI problems, Agents and Environments, Structure of Agents, Problem Solving Agents Basic Search Strategies: Problem Spaces, Uninformed Search (Breadth-First, Depth-First Search, Depth-first with Iterative Deepening), Heuristic Search (Hill Climbing, Generic Best-First, A*), Constraint Satisfaction (Backtracking, Local Search)

UNIT: II

Advanced Search: Constructing Search Trees, Stochastic Search, A* Search Implementation, Minimax Search, Alpha-Beta Pruning Basic Knowledge Representation and Reasoning: Propositional Logic, First-Order Logic, Forward Chaining and Backward Chaining, Introduction to Probabilistic Reasoning, Bayes Theorem

UNIT: III

Advanced Knowledge Representation and Reasoning: Knowledge Representation Issues, Nonmonotonic Reasoning, Other Knowledge Representation Schemes Reasoning Under Uncertainty: Basic probability, Acting Under Uncertainty, Bayes' Rule, Representing Knowledge in an Uncertain Domain, Bayesian Networks

UNIT: IV

Learning: What Is Learning? Rote Learning, Learning by Taking Advice, Learning in Problem Solving, Learning from Examples, Winston's Learning Program, Decision Trees.

UNIT: V

Expert Systems: Representing and Using Domain Knowledge, Shell, Explanation, Knowledge Acquisition.

TEXT BOOKS:

1. Russell, S. and Norvig, P, Artificial Intelligence: A Modern Approach, Third Edition, PrenticeHall, 2010.

REFERENCE BOOKS:

1. Artificial Intelligence, Elaine Rich, Kevin Knight, Shivasankar B. Nair, The McGraw Hill publications, Third Edition, 2009.

2. George F. Luger, Artificial Intelligence: Structures and Strategies for Complex Problem Solving, Pearson Education, 6th ed., 2009.

EE601PC: DIGITAL SIGNAL PROCESSING

B.TECH. III YEAR II SEMESTER

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
EE601PC	ESC	3	0	0	3	30	70	100

Prerequisite: Nil

Course Objectives:

1. This gives the basics of Signals and Systems required for all Electrical Engineering related courses
2. To understand the behavior of signal in time and frequency domain
3. To understand the characteristics of LTI systems
4. This gives concepts of Signals and Systems and its analysis using different transform techniques.
5. To study the designs and structures of digital (IIR and FIR) filters and analyze and synthesize for a given specifications.

Course Outcomes: Upon completing this course, the student will be able to

1. Differentiate various signal functions.
2. Represent any arbitrary signal in time and frequency domain.
3. Understand the characteristics of linear time invariant systems.
4. Analyze the signals with different transform technique.
5. Design a digital filter for a given specification.

UNIT: I SIGNAL ANALYSIS, FOURIER SERIES, FOURIER TRANSFORMS

Classification of Signals and systems, Exponential and Sinusoidal signals, Concepts of Impulse function, Unit Step function, Signum function.

Fourier series: Representation of Fourier series, Continuous time periodic signals, Properties of Fourier Series, Dirichlet's conditions, Trigonometric Fourier Series and Exponential Fourier Series, Complex Fourier spectrum.

Fourier Transforms: Deriving Fourier Transform from Fourier series, Fourier Transform of arbitrary signal, Fourier Transform of standard signals, Fourier Transform of Periodic Signals, Properties of Fourier Transform, Fourier Transforms involving Impulse function and Signum function.

Frequency Domain Representation of Discrete Time Signals and Systems

UNIT: II SIGNAL TRANSMISSION THROUGH LINEAR SYSTEMS, SAMPLING THEOREM

Signal Transmission through Linear Systems:

Linear System, Impulse response, Response of a Linear System, Linear Time Invariant(LTI) System, Linear Time Variant (LTV) System, Transfer function of a LTI System, Filter characteristic of Linear System, Concept of convolution in Time domain and Frequency domain

Sampling theorem: Graphical and analytical proof for Band Limited Signals, Impulse Sampling, Natural and Flat top Sampling, Reconstruction of signal from its samples, Effect of under sampling – Aliasing,

UNIT: III LAPLACE TRANSFORMS, Z–TRANSFORMS

Laplace Transforms: Laplace Transforms (L.T), Inverse Laplace Transform, Concept of Region of Convergence (ROC) for Laplace Transforms, Properties of L.T, Relation between L.T and F.T of a signal, Laplace Transform of certain signals using waveform synthesis.

Z–Transforms: Concept of Z- Transform of a Discrete Sequence, Distinction between Laplace, Fourier and Z Transforms, Region of Convergence in Z-Transform, Constraints on ROC for various classes of signals, Inverse Z-transform, Properties of Z-transforms.

UNIT: IV IIR DIGITAL FILTERS AND REALIZATION OF DIGITAL FILTERS

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.
Realization of Digital Filters: Realization of Digital Filters – Direct, Canonic, Cascade and Parallel Forms.

UNIT: V	FIR DIGITAL FILTERS

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

TEXT BOOKS:

1. Signals, Systems & Communications - B.P. Lathi, 2013, BSP.
2. Signals and Systems - A.V. Oppenheim, A.S. Willsky and S.H. Nawabi, 2 Ed.
3. Discrete Time Signal Processing – A. V. Oppenheim and R.W. Schaffer, PHI, 2009
4. Digital Signal Processing, Principles, Algorithms, and Applications: John G. Proakis, Dimitris G. Manolakis, Pearson Education / PHI, 2007.

REFERENCE BOOKS:

1. Signals and Systems – Simon Haykin and Van Veen, Wiley 2 Ed.,
2. Signals and Systems – A. Rama Krishna Rao, 2008, TMH
3. Fundamentals of Signals and Systems - Michel J. Robert, 2008, MGH International Edition.
4. Signals, Systems and Transforms - C. L. Philips, J.M.Parr and Eve A.Riskin, 3 Ed., 2004, PE.
5. Signals and Systems – K. Deergha Rao, Birkhauser, 2018.
6. Digital Signal Processing – Fundamentals and Applications – Li Tan, Elsevier, 2008
7. Fundamentals of Digital Signal Processing using MATLAB – Robert J. Schilling, Sandra L. Harris, Thomson, 2007
8. Digital Signal Processing – S. Salivahanan, A. Vallavaraj and C. Gnanapriya, TMH, 2009
9. Digital Signal Processing - A Practical approach, Emmanuel C. Ifeachor and Barrie W. Jervis, 2nd Edition, Pearson Education, 2009

WEB REFERENCES:

1. https://nptel.ac.in/courses/108/106/108106151/
2. https://nptel.ac.in/courses/108/101/108101174/
3. https://nptel.ac.in/courses/117/101/117101055/

EE602PC: MICROPROCESSORS AND MICROCONTROLLERS

B.TECH. III YEAR II SEMESTER

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
EE602PC	ESC	3	0	0	3	30	70	100

Prerequisite: Digital System Design, Computer Organization, Basics of VLSI, Basic Programming Knowledge

Course Objectives:

1. To develop an understanding of the functionality of microprocessors; Assembly language programming and interfacing techniques.
2. To provide knowledge on functionality of microcontrollers; Assembly language programming and interfacing techniques.
3. To develop an understanding of the operations and Programming of ARM Processor
4. To study the basic concepts of Advanced ARM processors (A, R, M profile) and their applications.

Course Outcomes: Upon completing this course, the student will be able to

1. Understand the 8086μp architecture, its operation and apply the knowledge of instruction set& assembler directives to write Programs using MASM.
2. Understand the 8051μc architecture, its operation and apply the knowledge of instruction setto design applications.
3. Apply the knowledge of 8051μc and Communication protocols to interface I/O devices.
4. Understand the ARM processor internal architecture; apply the knowledge of instruction set todesign applications.
5. Understand the ARM CORTEX and OMAP Processor architecture and architecture and theirapplications.

UNIT: I 8086 MICROPROCESSOR ARCHITECTURE & INSTRUCTION SET

8086 Architecture: 8086 Architecture-Functional diagram, Register Organization, Memory Segmentation, Programming Model, Memory addresses, Physical Memory Organization, Architecture of 8086, Signal descriptions of 8086, interrupts of 8086.

Instruction Set and Assembly Language Programming of 8086: Instruction formats, Addressing modes, Instruction Set, Assembler Directives, Macros, and Simple Programs involving Logical, Branch and Call Instructions, Sorting, String Manipulations.

UNIT: II 8051 MICROCONTROLLER ARCHITECTURE & REAL TIME CONTROL

Introduction to Microcontrollers: Overview of 8051 Microcontroller, Architecture, I/O Ports, Memory Organization, Addressing Modes and Instruction set of 8051.

8051 Real Time Control: Programming Timer Interrupts, Programming External Hardware Interrupts, Programming the Serial Communication Interrupts, Programming 8051 Timers and Counters

UNIT: III I/O, MEMORY & SERIAL BUS INTERFACE

I/O and Memory Interface: LCD, Keyboard, External Memory RAM, ROM Interface, ADC, DAC Interface to 8051.

Serial Communication and Bus Interface: Serial Communication Standards, Serial Data Transfer Scheme, On board Communication Interfaces-I2C Bus, SPI Bus, UART; External Communication Interfaces-RS232,USB.

UNIT: IV ARM ARCHITECTURE

ARM Processor fundamentals, ARM Architecture – Register, CPSR, Pipeline, exceptions and interrupts interrupt vector table, ARM instruction set – Data processing, Branch instructions, load store instructions, Software interrupt instructions, Program status register instructions, loading constants, Conditional execution, Introduction to Thumb instructions.

UNIT: V	ADVANCED ARM PROCESSORS

Introduction to CORTEX Processor and its architecture, OMAP Processor and its Architecture.

TEXT BOOKS:

1. Advanced Microprocessors and Peripherals – A. K. Ray and K.M. Bhurchandani, MHE, 2ndEdition 2006.
2. The 8051 Microcontroller, Kenneth. J. Ayala, Cengage Learning, 3rd Ed.
3. ARM System Developers guide, Andrew N SLOSS, Dominic SYMES, ChrisWRIGHT, Elsevier, 2012

REFERENCE BOOKS:

1. Microprocessors and Interfacing, D. V. Hall, MGH, 2nd Edition 2006.
2. Introduction to Embedded Systems, Shibu K.V, MHE, 2009
3. The 8051Microcontrollers, Architecture and Programming and Applications -K.UmaRao, Andhe Pallavi, Pearson, 2009.

WEB REFERENCES:

1. https://www.arm.com/
2. https://www.intel.com/content/www/us/en/homepage.html
3. https://onlinecourses.nptel.ac.in/noc20_ee42/preview
4. https://ict.iitk.ac.in/courses/microprocessors-and-microcontrollers/
5. https://en.wikipedia.org/wiki/Microcontroller
6. https://nptel.ac.in/courses/108/103/108103157/
7. https://nptel.ac.in/courses/106/105/106105193/

EE603PC: POWER SYSTEM PROTECTION

B.TECH. III YEAR II SEMESTER

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
EE603PC	PCC	3	1	0	4	30	70	100

Prerequisite: Power System-I(EE405PC), Power System-II(EE502PC)

Course Objectives:

2. To introduce all kinds of circuit breakers and relays
3. To explain the voltage control and compensation methods
4. To understand the phenomenon of Over Voltages and its classification
5. To study Microprocessor Based Relays

Course Outcomes: Upon completing this course, the student will be able to

1. Compare electromagnetic, static and microprocessor-based relays
2. Apply technology to protect power system components
3. Interpret relay settings of over current and distance relays
4. Evaluate quenching mechanisms used in air, oil and vacuum circuit breakers
5. Analyze the testing of circuit breakers

UNIT: I	PROTECTIVE RELAYS

Introduction, Need for power system protection, effects of faults, evolution of protective relays, zones of protection, primary and backup protection, essential qualities of protection, classification of protective relays and schemes, current transformers, potential transformers, basic relay terminology. Operating Principles and Relay Construction: Electromagnetic relays, thermal relays, static relays, microprocessor based protective relays.

UNIT: II	OVER-CURRENT PROTECTION DISTANCE PROTECTION

Time-current characteristics, current setting, over current protective schemes, directional relay, protection of parallel feeders, protection of ring mains, Phase fault and earth fault protection, Combined earth fault and phase fault protective scheme, Directional earth fault relay. Distance Protection: Impedance relay, reactance relay, MHO relay, input quantities for various types of distance relays, Effect of arc resistance, Effect of power swings, effect of line length and source impedance on the performance of distance relays, selection of distance relays, MHO relay with blinders, Reduction of measuring units, switched distance schemes, auto re-closing.

UNIT: III	PILOT RELAYING SCHEMES AC MACHINES AND BUS ZONE PROTECTION

Wire Pilot protection, Carrier current protection. AC Machines and Bus Zone Protection: Protection of Generators, Protection of transformers, Buszone protection, frame leakage protection.

UNIT: IV	STATIC RELAYS MICROPROCESSOR BASED RELAYS

Amplitude and Phase comparators, Duality between AC and PC, Static amplitude comparator, integrating and instantaneous comparators, static phase comparators, coincidence type of phase comparator, static over current relays, static directional relay, static differential relay, static distance relays, Multi input comparators, concept of Quadrilateral and Elliptical relay characteristics. Microprocessor Based Relays: Advantages, over current relays, directional relays, distance relays.

UNIT: V	CIRCUIT BREAKERS FUSES

Introduction, arcing in circuit breakers, arc interruption theories, re-striking and recovery voltage, resistance switching, current chopping, interruption of capacitive current, oil circuit breaker, air blast circuit breakers, SF6 circuit breaker, operating mechanism, selection of circuit breakers, high voltage d.c. breakers, ratings of circuit breakers, testing of circuit breakers. FUSES: Introduction, fuse characteristics, types of fuses, application of HRC fuses, discrimination.

TEXT BOOKS:

1. "Badriram"," D.N. Vishwakarma", Power System Protection and Switchgear, McGraw Hill Education; 2nd edition, 2017
2. "Sunil S.Rao", Switchgear Protection And Power Systems", Khanna Publishers, 14th edition, 2019

REFERENCE BOOKS:

1. "U.A.Bakshi", "M.V.Bakshi",Switchgear and Protection, Technical Publications, 1st edition 2021
2. "J.B. Gupta", Fundamentals of Switchgear and Protection, S.K. Kataria& Sons; 2013 edition, 2013
3. "D.P. Kothari","I. J. Nagrath", Modern Power System Analysis - Tata Mc Graw Hill Pub. Co., New Delhi, Fourth edition, 2011

WEB REFERENCES:

1. https://nptel.ac.in/courses/108/101/108101039/
2. https://nptel.ac.in/courses/108/105/108105167/

EE604PC: POWER SYSTEM OPERATION AND CONTROL

B.TECH. III YEAR II SEMESTER

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
EE604PC	PCC	3	0	0	3	30	70	100

Prerequisite: Power System-I(EE405PC), Power System-II(EE502PC)

Course Objectives:

1. To understand real power control and operation
2. To know the importance of frequency control
3. To analyze different methods to control reactive power
4. To analyze different methods to control reactive power

Course Outcomes: Upon completing this course, the student will be able to

1. Analyze the optimal scheduling of power plants
2. Analyze the steady state behavior of the power system for voltage and frequency fluctuations
3. Describe reactive power control of a power system
4. Design suitable controller to dampen the frequency and voltage steady state oscillations
5. Analyze SCADA and EMS functions

UNIT: I	LOAD –FREQUENCY CONTROL

Basics of speed governing mechanism and modeling – speed load characteristics – load sharing between two synchronous machines in parallel. Control area concept LFC control of a single-area system. Static and dynamic analysis of uncontrolled and controlled cases. Integration of economic dispatch control with LFC. Two area system – modeling - static analysis of uncontrolled case - tie line with frequency bias control of two-area system - state variable model.

UNIT: II	REACTIVE POWER – VOLTAGE CONTROL

Basics of reactive power control. Excitation systems – modeling. Static and dynamic analysis - stability compensation - generation and absorption of reactive power. Relation between voltage, power and reactive power at a node - method of voltage control - tap-changing transformer. System level control using generator voltage magnitude setting, tap setting of OLTC transformer and MVAR injection of switched capacitors to maintain acceptable voltage profile and to minimize transmission loss.

UNIT: III	ECONOMIC LOAD DISPATCH

Statement of economic dispatch problem – cost of generation – incremental cost curve - co-ordination equations without loss and with loss, solution by direct method and λ-iteration method.

UNIT: IV	UNIT COMMITMENT

Statement of Unit Commitment problem – constraints; spinning reserve, thermal unit constraints, hydro constraints, fuel constraints and other constraints. Solution methods - Priority-list methods - forward dynamic programming approach. Numerical problems on priority-list method using full-load average production cost and Forward DP method.

UNIT: V	COMPUTER CONTROL OF POWER SYSTEMS

Need of computer control of power systems. Concept of energy control centre (or) load dispatch centre and the functions - system monitoring - data acquisition and control. System hardware configuration – SCADA and EMS functions. Network topology – Importance of Load Forecasting and simple techniques of forecasting.

TEXT BOOKS:

1. "D. P. Kothari"," I. J. Nagrath", Modern Power System Analysis, 4th Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2011

2. "Olle. I. Elgerd", Electric Energy Systems Theory – An Introduction, Tata McGraw Hill Publishing Company Ltd, New Delhi, 2nd edition, 2017

REFERENCE BOOKS:

1. "Chakrabarti &Haldar", Power System Analysis: Operation and Control, Prentice Hall of India, Third edition. January 2010
2. "C.L. Wadhwa", Electrical Power Systems – New Age International Pub. Co. Third Edition, 2016
3. "Sivanagaraju", Power System Operation and Control, Pearson Education India; 1st edition 2010

WEB REFERENCES:

1. https://nptel.ac.in/courses/108/101/108101040/
2. https://nptel.ac.in/courses/108/104/108104052/

EE611PE: OPTIMIZATION TECHNIQUES

(Professional Elective II)

B.TECH. III YEAR II SEMESTER

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
EE611PE	PEC	3	0	0	3	30	70	100

Prerequisite: Mathematics –I(MA101BS) & Mathematics –II(MA201BS)

Course Objectives:

1. To introduce various optimization techniques like classical, linear programming, transportation problem, simplex algorithm, dynamic programming
2. Constrained and unconstrained optimization techniques for solving and optimizing an electrical and electronic engineering circuits design problems in real world situations
3. To learn characteristics of constrained problems
4. To explain the concept of Dynamic programming and its applications to project implementation

Course Outcomes: After completion of this course, the student will be able to

1. Explain the need of optimization of engineering systems
2. Understand optimization of electrical and electronics engineering problems
3. Apply classical optimization techniques, linear programming, simplex algorithm, transportation problem
4. Compare and contrast different unconstrained optimization methods
5. Develop algorithm using constrained non-linear programming anddynamic programming

UNIT: I **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– multivariable 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 condition.

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.

Transportation Problem: 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.

UNIT: III **UNCONSTRAINED OPTIMIZATION TECHNIQUES**

One dimensional minimization methods, Classification, Fibonacci method and Quadratic interpolation method**:** Univariant method, Powell"s method and steepest descent method.

UNIT: IV	CONSTRAINED NONLINEAR PROGRAMMING

Characteristics of constrained problem -classification - Basic approach of Penalty Function method –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 indynamic programming – examples illustrating the calculus method of solution –examplesillustrating the tabular method of solution

TEXT BOOKS:

1. Singiresu S. Rao, Engineering Optimization: Theory and Practice by John Wiley and Sons, 4th edition, 2009.
2. H. S. Kasene& K. D. Kumar, Introductory Operations Research, Springer (India), Pvt. Ltd., 4th edition ,2004

REFERENCE BOOKS:

1. "George Bernard Dantzig", "Mukund Narain Thapa", Linear programming, Springer series in operations research 3rd edition, 2003.
2. "H.A. Taha", Operations Research: An Introduction, 8th Edition, Pearson/Prentice Hall, 2007.
3. "KalyanmoyDeb",Optimization for Engineering Design – Algorithms and Examples, PHI Learning Pvt. Ltd, New Delhi, 2005.

WEB REFERENCES:

1. https://nptel.ac.in/courses/111/105/111105039/

EE612PE: WIND AND SOLAR ENERGY SYSTEMS

(Professional Elective II)

B.TECH. III YEAR II SEMESTER

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
EE612PE	PEC	3	0	0	3	30	70	100

Prerequisite: Nil

Course Objectives:

1. To study the physics of wind power and energy
2. To understand the principle of operation of wind generators
3. To know the solar power resources
4. To analyze the solar photo-voltaic cells
5. To discuss the solar thermal power generation

Course Outcomes: Upon completing this course, the student will be able to

1. Understand the energy scenario and the consequent growths of the power generate renewable energy sources.
2. Identify the basic physics of wind and solar power generation.
3. Apply the power electronic interfaces for wind and solar generation.
4. Understand the issues related to the grid-integration of solar and wind energy systems.
5. Identify the network integration issues.

UNIT: I	PHYSICS OF WIND POWER

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

UNIT: II	WIND GENERATOR TOPOLOGIES

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

UNIT: III	SOLAR ENERGY TECHNOLOGIES

Introduction, solar radiation spectra, solar geometry, Earth Sun angles, observer Sun angles, solar day length, Estimation of solar energy availability.
Technologies-Amorphous, mono-crystalline, polycrystalline; V-I characteristics of a PV cell, PV module, array, Power Electronic Converters for Solar Systems, Maximum Power point Tracking (MPPT) algorithms. Converter Control.

UNIT: IV	NETWORK INTEGRATION ISSUES

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

UNIT: V	SOLAR THERMAL POWER GENERATION

Technologies, Parabolic trough, central receivers, parabolic dish, Fresnel, solar pond, elementary analysis. System Thermal Calculations: Component Models, Collector Heat Exchanger Factor, Duct and Pipe Loss Factors,Controls,Collector Arrays: Series Connections, Performance of Partially Shaded Collectors, Series Arrays with Sections Having Different Orientations.

TEXT BOOKS:

1. "T. Ackermann", Wind Power in Power Systems, John Wiley and Sons Ltd., 2012.
2. "G. M. Masters", Renewable and Efficient Electric Power Systems, John Wiley and Sons, 2013.

REFERENCE BOOKS:

1. "S. P. Sukhatme", Solar Energy: Principles of Thermal Collection and Storage, McGraw Hill, 2008.
2. "H. Siegfried"," R. Waddington", "Grid integration of wind energy conversion systems" John Wiley and Sons Ltd., 2006.
3. "J. A. Duffie","W. A. Beckman", Solar Engineering of Thermal Processes, John Wiley & Sons, 2013.

WEB REFERENCES:

1. https://nptel.ac.in/noc/courses/noc21/SEM1/noc21-ch11/
2. https://nptel.ac.in/courses/103/103/103103206/

EE613PE: DIGITAL CONTROL SYSTEMS

(Professional Elective-II)

B.TECH. III YEAR II SEMESTER

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
EE613PE	PEC	3	0	0	3	30	70	100

Prerequisite: Control Systems(EE404PC)

Course Objectives:

1. To understand the fundamentals of digital control systems representations, z-transforms and discrete complex domain.
2. To understand the concepts of state variables analysis for discrete LTIV systems.
3. To understand the concepts of controllability and observability of discrete time systems
4. To get exposed the design aspects of controllers and for discrete time systems
5. To understand the concepts of the stability for discrete LTIV systems

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Obtain discrete representation of LTI systems.
2. Find the state space analysis of discrete time systems.
3. Test and analyze the controllability and observability for discrete time systems
4. Analyze stability of discrete time systems using various methods
5. Design state feedback controllers and observers.

UNIT: I REPRESENTATION OF DISCRETE TIME SYSTEMS

Basics of Digital Control Systems. Discrete representation of continuous systems. Sample and hold circuit. Mathematical Modeling of sample and hold circuit. Effects of Sampling and Quantization. Choice of sampling frequency. ZOH equivalent.

Z-Transforms, Mapping from s-plane to z plane, Properties of Z-Transforms and Inverse Z Transforms. Pulse Transfer function: Pulse transfer function of closed loop systems. Solution of Discrete time systems. Time response of discrete time system, Steady State errors.

UNIT: II DISCRETE TIME STATE SPACE ANALYSIS

State space representation of discrete time systems, Conversion of pulse transfer function to state space models and vice-versa, Solving discrete time state space equations, State Transition Matrix, Pulse Transfer Function Matrix. Discretization of continuous time state space equations. Concept of Controllability, stabilizability, observability, reachability – Controllability and observability tests. Effect of pole zero cancellation on the controllability & observability.

UNIT: III STABILITY ANALYSIS OF DISCRETE TIME SYSTEM

Concept of stability in z-domain, Stability analysis discrete time system: by Jury test, using bilinear transformation. Stability Analysis of discrete time systems using Lyapunov methods.

UNIT: IV	DESIGN OF DIGITAL CONTROL SYSTEM BY CONVENTIONAL METHODS

Design and realization of digital PID Controller, Design of discrete time controllers with bilinear transformation, Design of digital control system with dead beat response, Practical issues with dead beat response design.

UNIT: V	DEISGN STATE FEEDBACK CONTROLLERS AND OBSERVERS

Design of discrete state feedback controllers through pole placement, Design of Discrete Observer for LTI System: Design of full order and reduced observers, Design of observer-based controllers.

TEXT BOOKS:

1. "K. Ogata",Digital Control Engineering, Prentice Hall, Englewood Cliffs, 1995.
2. "M. Gopal", Digital Control Engineering, Wiley Eastern, 1988.
3. "V, I, George"."C. P. Kurian", Digital Control Systems, CENGAGE Learning, 2012

REFERENCE BOOKS:

1. "G. F. Franklin", "J. D. Powell","M. L. Workman", Digital Control of Dynamic Systems, Addison-Wesley, 1998.
2. "B.C. Kuo", Digital Control System, Holt, Rinehart and Winston, 1980.

WEB REFERENCES:

1. https://nptel.ac.in/courses/108/103/108103008/

EE614PE: VLSI DESIGN

(Professional Elective II)

B.Tech III year II semester

Course Code	Category	Hours/Week			Credits	Max Marks		
		L	T	P	C	CIA	SEE	Total
EE614PE	PEC	3	0	0	3	30	70	100

Prerequisite : Digital Electronics(EE403PC)

Course Objectives :

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

Course Outcomes : Upon successful completion of the course, students will be able to:

1. Acquire qualitative knowledge about the fabrication process of integrated circuits using MOS transistors.
2. Draw the layout of any logic circuit which helps to understand and estimate parasitic of any logic circuit
3. Design different types of logic gates using CMOS inverter and analyze their transfer characteristics
4. Design building blocks of data path subsystems and memories using basic digital logic devices.
5. Design simple logic circuits using PLA,PAL, FPGA and CPLD
6. Understand different types of faults that can occur in a system and learn the concept of testing.

UNIT- I	INTRODUCTION

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

Basic Electrical Properties of MOS and BiCMOS Circuits: Ids-Vdsrelationships,MOS transistor threshold Voltage, gm, gds, Figure of merit;Pass transistor,NMOS Inverter, Various pull ups, CMOS Inverter analysis and design, Bi-CMOS Inverters.

UNIT- II	VLSI CIRCUIT DESIGN PROCESSES

VLSI Circuit Design Processes:VLSI Design Flow, MOS Layers, Stick Diagrams, Design Rules and Layout,Transistors Layout Diagrams for NMOS and CMOS Inverters and Gates, Scaling of MOS circuits.

UNIT- III	GATE LEVEL DESIGN

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 & ARRAY SUBSYSTEMS

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 & CMOS TESTING

Programmable Logic Devices: Design Approach – PLA, PAL, Standard Cells, FPGAs, CPLDs.

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

Text Books :

1. Essentials of VLSI circuits and systems – Kamran Eshraghian, EshraghianDougles and A.Pucknell, PHI, 2005.
2. CMOS VLSI Design – A Circuits and Systems Perspective, Neil H. E Weste, David Harris,Ayan Banerjee, 3rd 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, 3rd Ed., 1997.

Web References :

1. https://nptel.ac.in/courses/117/101/117101058/
2. https://nptel.ac.in/courses/108/107/108107129/
3. http://www.vlsi-expert.com/p/vlsi-basic.html

E-text Books :

1. https://www.phindia.com/Books/ShoweBooks/MTMzMA/MTE2NA/VLSI-Design
2. http://www.cmosvlsi.com/
3. https://www.springer.com/gp/book/9781402084461
4. https://books.google.co.in/books?id=CO8zq6_vcr8C&printsec=frontcover

EE605PC: ELECTRICAL SYSTEMS SIMULATION LAB

B.TECH. III YEAR II SEMESTER

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
EE605PC	PCC	0	0	2	1	30	70	100

Prerequisite: Power System-I(EE405PC), Power System-II(EE502PC),
Softwares Required: MATLAB/PSCAD/PSPICE/PSIM

Course Objectives:

1. To perform voltage distributions across insulator strings
2. To understand the high frequency transients
3. To perform parameter estimation and fault analysis on Transmission lines
4. To perform parameter estimation and fault analysis on Transmission lines

Course Outcomes: Upon completing this course, the student will be able to

1. Analyze various transmission line calculations
2. Determine time constants for RL, RC and RLC circuits
3. analyze the Voltage distribution across insulator string
4. Determine fault currents of transmission line
5. Analyze the experimental data and draw the conclusions

List of Experiments:

1. Generation of high frequency transients through RLC circuit
2. Voltage distribution across insulator string
3. Comparison of lumped and distributed transmission lines
4. Calculation of fault currents of transmission line
5. Time constant calculation of RL circuit
6. Time constant calculation of RC circuit
7. Time constant calculation of RLC circuit
8. Simulation of Resonance circuit
9. Calculation of R, L, C, Zs of 3-phase Transmission Line
10. Estimation of TARIFF based on load curve

EE606PC: MICROPROCESSORS AND MICROCONTROLLERS LAB

B.TECH. III YEAR II SEMESTER

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
EE606PC	ESC	0	0	2	1	30	70	100

Prerequisite: Digital Electronics(EE403PC)

Course Objectives:

1. To develop an understanding of the Assembly language programming on 8086Microprocessor.
2. To develop an understanding of the interfacing techniques with 8086 Microprocessor.
3. To develop an understanding of the Assembly language programming using Keil IDE on 8051µc.
4. To develop an understanding of the interfacing techniques with 8051 Microcontroller.

Course Outcomes: Upon completing this course, the student will be able to

1. Understand and apply the knowledge of addressing modes, instruction set & assembler directives of 8086 to perform arithmetic operations, sorting& String programs using MASM.
2. Design & test the function of Stepper motor and 8255by interfacing with 8086.
3. Understand and apply the knowledge of addressing modes, instruction set of 8051 to perform arithmetic, logical & bit manipulation programs using Keil.
4. Able to verify the operation of timer/counter/UART/interrupt handler in 8051.

List of Experiments:

Cycle 1: Using 8086 Processor Kits and/or Assembler (6 Weeks)

1. Assembly Language Programs to perform Arithmetic, Logical, and String Operations.
2. Assembly Language Programs to perform Rotate, Shift, Swap and Branch Operations.
3. Interfacing stepper motor, ADC & DAC to 8086.

Cycle 2: Using Keil IDE**- (5 weeks)-**

1. Assembly Language Programs to Perform Arithmetic, Logical Operations.
2. Assembly Language Programs to perform Rotate, Shift, Swapand Branch Instructions
3. Time delay Generation Using Timers of 8051.
4. UART operation (Serial communication) in 8051.
5. Program and verify interrupt handling in 8051.

Cycle 3: Interfacing I/O Devices to 8051 (5 Weeks)

1. Interfacing LCD to 8051
2. Interfacing Matrix Keyboard to 8051
3. Interfacing 8-bit ADC to 8051.
4. Interfacing DAC to 8051.

List of Equipment/Software (with Specifications or Range) Required:

1. Computer Systems(Intel) with Windows 7 or higher Operating System
2. MASM 611 Software (Open source)
3. Keil µVision IDE Software (Open Source)
4. 8086 µp kits, stepper motor interfacing module,8051µc kits, LCD interfacing module,Matrix Keyboard interfacing module, ADC interfacing module, DAC interfacing module.

EE607PC: DIGITAL SIGNAL PROCESSING LAB

B.TECH. III YEAR II SEMESTER

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
EE607PC	ESC	0	0	2	1	30	70	100

Prerequisite: Nil

Course Objectives:

1. To Generate and characterize various continuous and discrete time signals
2. Find frequency response of systems
3. Design of digital IIR and FIR filters
4. To implement Laplace transform on a given signal

Course Outcomes: Upon completing this course, the student will be able to

1.Understand basics of MATLAB syntax, functions and programming
2. Generate and characterize various continuous and discrete time signals.
3. Analyze the spectral characteristics of signals using Fourier analysis.
4. Analyze the systems using Laplace transform and Z-transform.
5.Design and simulate Digital IIR and FIR filter using MATLAB
6.Analyse frequency response for the given system

List of Experiments:

1. Basic Operations on Matrices.
2. Generation of Various Signals and Sequences (Periodic and Aperiodic), such as Unit Impulse,Unit Step, Square, Saw tooth, Triangular, Sinusoidal, Ramp, Sinc.
3. Operations on Signals and Sequences such as Addition, Multiplication, Scaling, Shifting,Folding, Computation of Energy and Average Power.
4. Finding the Even and Odd parts of Signal/Sequence and Real and Imaginary parts of Signal.
5. Convolution for Signals and sequences.
6. Verification of Linearity and Time Invariance Properties of a given Continuous/DiscreteSystem.
7. Finding the Fourier Transform of a given signal and plotting its magnitude and phase spectrum.
8. Waveform Synthesis using Laplace Transform.
9. Locating the Zeros and Poles and plotting the Pole-Zero maps in S-plane and Z-Plane for thegiven transfer function.
10. Verification of Sampling Theorem.
11. To find Frequency Response of a given System given in Transfer Function/ Differentialequation form.
12. Implementation of LP FIR Filter for a given Sequence/Signal.
13. Implementation of HP IIR Filter for a given Sequence/Signal
14. Impulse Response of First order and Second Order Systems.

List of Equipment/Software(with Specifications or Range) Required:

The Programs shall be implemented in Software (Using MATLAB / Lab View / C Programming/ Equivalent)

MC610: CYBER SECURITY

B.TECH. III YEAR I SEMESTER

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
MC610	MC	3	0	0	0	100	0	100

Prerequisite: NIL

Course Objectives:

1. To familiarize various types of cyber-attacks and cyber-crimes
2. To give an overview of the cyber laws
3. To study the defensive techniques against these attacks

Course Outcomes: After completion of this course the student is able to

1. Cyber-attacks, types of cybercrimes, cyber laws and also how to protect them self and ultimately the entire Internet community from such attacks.

UNIT: I	INTRODUCTION TO CYBER SECURITY

Basic Cyber Security Concepts, layers of security, Vulnerability, threat, Harmful acts, Internet Governance – Challenges and Constraints, Computer Criminals, CIA Triad, Assets and Threat, motive of attackers, active attacks, passive attacks, Software attacks, hardware attacks, Spectrum of attacks, Taxonomy of various attacks, IP spoofing, Methods of defense, Security Models, risk management, Cyber Threats-Cyber Warfare, Cyber Crime, Cyber terrorism, Cyber Espionage, etc., Comprehensive Cyber Security Policy.

UNIT: II	CYBERSPACE AND THE LAW & CYBER FORENSICS

Introduction, Cyber Security Regulations, Roles of International Law. The INDIAN Cyberspace, National Cyber Security Policy. Introduction, Historical background of Cyber forensics, Digital Forensics Science, The Need for Computer Forensics, Cyber Forensics and Digital evidence, Forensics Analysis of Email, Digital Forensics Lifecycle, Forensics Investigation, Challenges in Computer Forensics, Special Techniques for Forensics Auditing.

UNIT: III	CYBERCRIME

Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Organizational Security Policies and Measures in Mobile Computing Era, Laptops.

UNIT: IV	CYBER SECURITY

Introduction, Single-Variable Optimization, Multivariable Optimization with No Constraints, Multivariable Optimization with Equality Constraints, Multivariable Optimization with Inequality Constraints, Convex Programming Problem.

UNIT: II	LINEAR PROGRAMMING:

Introduction, Revised Simplex Method, Duality in Linear Programming, Decomposition Principle, Sensitivity or Postoptimality Analysis, Transportation Problem, Karmarkar"s Method, Quadratic Programming

UNIT: III	NON-LINEAR PROGRAMMING

Introduction, Unimodal Function, Unrestricted Search, Exhaustive Search, Dichotomous Search, Interval Halving Method, Fibonacci Method, Golden Section Method, Comparison of Elimination Methods, Quadratic Interpolation Method, Cubic Interpolation Method, Direct Root Methods, Rate of convergence, Design variables, Random search methods, Chrivariate methods, Powell"s method, Newton"s method, Marquard Method, Test function.

Unit: IV	GEOMETRIC PROGRAMMING

Introduction, Posynomial, Unconstrained Minimization Problem, Primal-Dual Relationship and Sufficiency Conditions in the Unconstrained Case,Constrained Minimization, Primal and Dual Programs in the Case of Less-Than Inequalities, Geometric Programming with Mixed Inequality Constraints, Complementary Geometric Programming, Applications of Geometric Programming.

Unit: V	DYNAMIC PROGRAMMING

Introduction, Multistage Decision Processes, Concept of Sub optimization and the Principle of Optimality, Computational Procedure in Dynamic Programming, The Calculus Method of Solution, The Tabular Method of Solution, Conversion of a Final Value Problem into an Initial Value Problem, Linear Programming as a Case of Dynamic Programming, Continuous Dynamic Programming, Applications.

TEXT BOOKS:

1. "C B Gupta" , Optimization Techniques in Operations Research, 1st Edition, I K International Publications, New Delhi, 2013.
2. "Singireshel S Rao", Engineering Optimizations, 4th Edition, Elsevier Butterworth, Heineman, USA, 2011.

REFERENCE BOOKS:

1. "Jasibir Arora", Introduction to Optimum Design, 4th Edition, Academic press in an Imprint of Elsevier, USA,2016.
2. "N V S Raju", Optimization Methods for Engineering, 1st edition, PHI Publications, New Delhi, 2014
3. "Edwin K", "P Chang", "Stanislaw H. Zak", An Introduction to Optimization, 3rd Edition, Jhon Wiley, New York, 2013

WEB REFERENCES:

1. https://nptel.ac.in/courses/111/105/111105039/
2. https://www.udemy.com/course/optimization-for-engineering-students

EE600OE: RENEWABLE ENERGY SOURCES
(Open Elective-I)

B.TECH. III YEAR II SEMESTER

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
EE600OE	OEC	3	0	0	3	30	70	100

Prerequisite: NIL

Course Objectives:

1. To develop the awareness of energy conservation
2. To identify the use of renewable energy sources for electrical power generation
3. To classify different energy storage methods.
4. To explain about environmental effects of energy conversion.

Course Outcomes: Upon completing this course, the student will be able to

1. Understand the principles of wind power and solar photovoltaic power generation, fuel cells.
2. Assess the cost of generation for conventional and renewable energy plants
3. Design suitable power controller for wind and solar applications
4. Analyze the issues involved in the integration of renewable energy sources to the grid
5. Discuss the various energy storage methods.

UNIT: I ECONOMICS RENEWABLE ENERGY

Grid-Supplied Electricity-Distributed Generation-Renewable Energy Economics-Calculation of Electricity Generation Costs –Demand side Management Options –Supply side Management Options-Modern Electronic Controls of Power Systems.

Wind Power Plants: Appropriate Location -Evaluation of Wind Intensity -Topography - Purpose of the Energy Generated - General Classification of Wind Turbines-Rotor Turbines-Multiple-Blade Turbines Drag Turbines -Lifting Turbines-Generators and Speed Control used in Wind Power Energy Analysis of
Small Generating Systems.

UNIT: II PHOTOVOLTAIC POWER PLANTS AND FUEL CELLS

Solar Energy-Generation of Electricity by Photovoltaic Effect -Dependence of a PV Cell Characteristic on Temperature-Solar cell Output Characteristics-Equivalent Models and Parameters for Photovoltaic Panels- Photovoltaic Systems-Applications of Photovoltaic Solar Energy-Economical Analysis of Solar Energy.

The Fuel Cell-Low and High Temperature Fuel Cells-Commercial and Manufacturing Issues Constructional Features of Proton Exchange-Membrane Fuel Cells –Reformers-Electro-lyzer Systems and Related Precautions-Advantages and Disadvantages of Fuel Cells-Fuel Cell Equivalent
Practical Determination of the Equivalent Model Parameters -Aspects of Hydrogen as Fuel.

UNIT: III INDUCTION GENERATORS

Principles of Operation-Representation of Steady-State Operation-Power and Losses Generated-Self Excited Induction Generator-Magnetizing Curves and Self-Excitation Mathematical Description of the Self-Excitation Process-Interconnected and Stand-alone operation -Speed and Voltage Control -
Economical Aspects.

UNIT: IV STORAGE SYSTEMS

Energy Storage Parameters-Lead–Acid Batteries-Ultra Capacitors-Flywheels –Superconducting Magnetic Storage System-Pumped Hydroelectric Energy Storage - Compressed Air Energy Storage - Storage Heat -Energy Storage as an Economic Resource.

UNIT: V	INTEGRATION OF ALTERNATIVE SOURCES OF ENERGY:

Principles of Power Injection-Instantaneous Active and Reactive Power Control Approach Integration of Multiple Renewable Energy Sources-Islanding and Interconnection Control-DG Control and Power Injection.**Interconnection of Alternative Energy Sources with the Grid:** Interconnection Technologies - Standards and Codes for Interconnection - Interconnection Considerations - Interconnection Examples for Alternative Energy Sources.

TEXT BOOKS:

1. "John Twidell" ,"Tony Weir", Renewable Energy Resources, Routledge,2015
2. "Mehmet Kanoglu","YunusA.Cengel","JohnM.Cimbala", Fundamentals and Applications of Renewable Energy,McGraw-Hill Education,2020

REFERENCE BOOKS:

1. "S.C. Bhatia", "R.K. Gupta" , Renewable Energy, Woodhead,2018
2. "Mehmet Kanoglu", "Yunus A. Cengel", "John M. Cimbala" ,Fundamentals and Applications of Renewable Energy | Indian Edition -2020
3. "Anand Tembulkar", "S.P. Meher, Kataria",Non-Conventional Energy Sources,2013

WEB REFERENCES:

1. https://www.eia.gov/energyexplained/renewable-sources/
2. https://nptel.ac.in/courses/103/103/103103206/

EE601OE: RELIABILITY ENGINEERING

(Open Elective-I)

B.TECH. III YEAR II SEMESTER

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
EE601OE	OEC	3	0	0	3	30	70	100

Prerequisite: Laplace Transforms, Numerical Methods and Complex variables (MA401BS)

Course Objectives:

1. To understand the basic concepts of reliability, various models of reliability
2. To analyze reliability of various systems
3. To discuss the concept of Discrete Markov Chains
4. To explain the techniques of frequency and duration for reliability evaluation of repairable Systems

Course Outcomes: Upon completing this course, the student will be able to

1. Discuss various systems of reliability networks
2. Evaluate the reliability of simple and complex systems
3. Estimate the limiting state probabilities of repairable systems
4. Apply various distribution functions for reliability evaluation.
5. Apply various mathematical models for evaluating reliability of irreparable systems

UNIT: I BASIC PROBABILITY THEORY

Elements of probability, probability distributions, Random variables, Density and Distribution functions- Mathematical expected – variance and standard deviation Binomial Distribution: Concepts, properties, engineering applications.

UNIT: II NETWORK MODELING AND EVALUATION OF SIMPLE SYSTEMS

Basic concepts- Evaluation of network Reliability / Unreliability - Series systems, Parallel systems - Series-Parallel systems- Partially redundant systems- Examples. Conditional probability method- tie set, Cut-set approach- Event tree and reduced event tree methods Relationships between tie and cut-sets- Examples

UNIT: III PROBABILITY DISTRIBUTIONS IN RELIABILITY EVALUATION

Distribution concepts, Terminology of distributions, General reliability functions, Evaluation of the reliability functions, shape of reliability functions –Poisson distribution – normal distribution, exponential distribution, Weibull distribution.

Network Reliability Evaluation Using Probability Distributions:

Reliability Evaluation of Series systems, Parallel systems – Partially redundant systems- determination of reliability measure- MTTF for series and parallel systems – Examples.

UNIT: IV DISCRETE MARKOV CHAINS

Basic concepts- Stochastic transitional probability matrix- time dependent probability evaluation- Limiting State Probability evaluation- Absorbing states – Application.

Continuous Markov Processes: Modeling concepts- State space diagrams- Unreliability evaluation of single and two component repairable systems

UNIT: V FREQUENCY AND DURATION TECHNIQUES

Frequency and duration concepts, application to multi state problems, Frequency balance approach.

Approximate System Reliability Evaluation: Series systems – Parallel systems- Network reduction techniques- Cut set approach- Common mode failures modeling and evaluation techniques- Examples.

TEXT BOOKS:

1. "Roy Billinton", " Ronald N Allan", Reliability Evaluation of Engineering Systems, Plenum Press 2013.
2. "E. Balagurusamy", Reliability Engineering by Tata McGraw-Hill Publishing Company Limited 2017

REFERENCE BOOKS:

1. "Alessandro Birolini", Reliability Engineering: Theory and Practice Springer Publications-2018
2. "Charles Ebeling", An Introduction to Reliability and Maintainability Engineering, TMH Publications 2017.
3. "Elsayed A", Reliability Engineering , Third Edition ,John Wiley and Sons Ltd 2021

WEB REFERENCES:

1. https://nptel.ac.in/courses/111/101/111101004/
2. https://nptel.ac.in/courses/105/108/105108128/