Counselling Code : VBIT

VIGNANA BHARATHI Institute of Technology ®

(A UGC Autonomous Institution, Approved by AICTE, Accredited by NBA & NAAC-A Grade, Affiliated to JNTUH)

DEPARTMENT OF ELECTRCAL AND ELECTRONICS ENGINEERING

R19 B. TECH III YEAR COURSE STRUCTURE AND SYLLABUS

III YEAR I SEMESTER

S.No	Course Code	Course Title	Category	L	T	P	Credits
1	19EE3111	Power Electronics	PC	3	1	-	4
2	19EE3112	Power Systems-II	PC	3	1	-	4
3	19EC3116	Signals and Systems	PC	3	-	-	3
4		**Open Elective –1**	OE	3	-	-	3
5		**Professional Elective – 1**	PE	3	-	-	3
	19EE3171	Power Systems Reliability					
	19EE3172	Renewable Energy Systems					
	19EE3173	Computer Architecture					
6	19EE3151	Electrical Machines-II Lab	PC	-	-	2	1
7	19HS3151	Advanced English Communication Skills Lab	HS	-	-	2	1
8	19EE3153	Electrical Simulation Lab	PC	-	-	2	1
9	19EC3154	Signals and Systems Lab	PC	-	-	2	1
10	19EE3181	Summer Internship	PW	-	-	2	1
11	19MC0005	Professional Ethics	MC	2	-	-	-
		Total		17	2	10	**22**

III YEAR II SEMESTER

S.No	Course Code	Course Title	Category	L	T	P	Credits
1	19EE3211	Power Systems Analysis	PC	3	1	-	4
2	19EE3212	Power System Protection & Switchgear	PC	3	-	-	3
3	19EC3216	Microprocessors and Microcontrollers	PC	3	-	-	3
4		**Open Elective-2**	OE	3	-	-	3
5		**Professional Elective-2**	PE	3	-	-	3
	19EE3271	Smart Grid Technologies					
	19EE3272	High Voltage Engineering					
	19EE3273	AI Techniques in Electrical Engineering					
6	19EC3254	Microprocessors and Microcontrollers lab	PC	-	-	2	1
7	19EE3251	Power Systems Lab	PC	-	-	2	1
8	19EE3252	Power Electronics Lab	PC	-	-	2	1
10	19EE3291	Technical Paper Presentation	PW	-	-	2	1
		Total		15	1	8	**20**

Course Code: 19EE3111

POWER ELECTRONICS

L	T	P	C
3	1	-	4

B. Tech.III Year I Semester

Prerequisite: Electrical Circuits and Analog Circuits

Course Objectives:

- To Design/develop suitable power converter for efficient control or conversion of power in drives applications.
- To Design / develop suitable power converter for efficient transmission and utilization of power in power system applications.
- Develop a suitable inverter for solar and fuel cell systems applications.

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

- Analyse switching characteristics for active power devices.
- Analyse the operation of Rectifiers.
- Analyse the operation of AC-AC converters.
- Analyse the operation of DC-DC choppers.
- Analyse the operation of voltage source inverters.

UNIT-I: POWER SEMICONDUCTOR SWITCHING DEVICES

Diode, Thyristor, MOSFET, IGBT, I-V Characteristics, Firing Circuits for Thyristor, Voltage and Current commutation of a Thyristor, Thyristor Protection, Series and Parallel operation of SCR, Gate drive circuits for MOSFET and IGBT.

UNIT-II2: PHASE CONTROLLED RECTIFIERS

Single-phase half-wave and full-wave rectifiers, Single-phase full-bridge thyristor rectifier with *R*-load and highly inductive load; Effect of freewheeling diode, Three-phase half and full controlled bridge thyristor rectifier with *R*-load and highly inductive load; Input current wave shape and power factor, Effect of source inductance, Single-phase dual converter, Numerical problems.

UNIT-III: DC-DC CONVERTERS

Elementary chopper with an active switch and diode, concepts of duty ratio and average voltage, Power circuit of a buck converter, boost converter, and buck-boost converter- analysis, waveforms at steady state, and duty ratio control of output voltage, Control strategies, Classifications of choppers, Numerical problems.

UNIT-IV: AC-AC CONVERTERS

AC voltage controllers – Single-phase two SCRs in anti-parallel with *R* and *R-L* loads, modes of operation of TRIAC – TRIAC with *R* and *R-L* loads – Derivation of RMS load voltage, current and power factor- wave forms, Numerical problems- Single-phase and three-phase Cycloconverters (principle of operation only).

UNIT-V: INVERTERS

Power circuit of single-phase voltage source inverters, switch states and instantaneous output voltage, square wave operation of the inverter, concept of average voltage over a switching cycle, Power circuit of a three-phase voltage source inverter, switch states, instantaneous output voltages, average output voltages over a sub-cycle, voltage control techniques, pulse-width modulation

techniques-single-pulse width, multiple pulse width and sinusoidal pulse width modulations, Series inverter, parallel inverter, McMurray-Bedford Inverters, Numerical problems.

TEXT/REFERENCES:

1. P. S. Bimbhra, "*Power Electronics*", Khanna Publications, 4th edition, 2006.
2. M. D. Singh and K. B. Kanchandhani, "*Power Electronics*", Tata McGraw – Hill Publishing Company, 1998.
3. N. Mohan and T. M. Undeland, "*Power Electronics: Converters, Applications and Design*", John Wiley & Sons, 2007.
4. P. C. Sen, "*Power Electronics*", Tata McGraw-Hill Publishing, 2001.
5. M. H. Rashid, "*Power Electronics: Circuits, Devices, and Applications*", Pearson Education India, 2009.

Course Code: 19EE3112

POWER SYSTEMS-II

L	T	P	C
3	1	-	4

B. Tech. III Year I Semester

Prerequisite: Power Systems –I and Electromagnetic Field Theory.

Course Objectives:

- To analyze the performance of transmission lines.
- To calculate the sag and tension of transmission lines.
- To examine the performance of travelling waves.
- To understand the power factor improvement and voltage control methods.
- To understand the per-unit representation of the power system.
- To know the symmetrical components and fault current calculation analysis.

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

- To analyze the performance of transmission lines in terms of voltage regulation and efficiency.
- To understand the concept of corona and sag calculation.
- To understand the transient phenomenon of transmission lines.
- To explain the importance of power factor and different types of voltage control methods.
- To analyze the fault currents for symmetrical and unsymmetrical faults with and without fault impedance.

UNIT-I: PERFORMANCE OF SHORT AND MEDIUM LENGTH TRANSMISSION LINES
Classification of Transmission Lines - Short, medium and long line and their model representations - Nominal-T, Nominal-Pie and A, B, C, D Constants for symmetrical & Asymmetrical Networks, Numerical Problems. Mathematical Solutions to estimate regulation and efficiency of all types of lines - Numerical Problems.
Long Transmission Lines: Long Transmission Line - Rigorous Solution, Evaluation of A, B, C, D Constants

UNIT-II: VARIOUS FACTORS GOVERNING THE PERFORMANCE OF TRANSMISSION LINE: Skin and Proximity effects - Description and effect on Resistance of Solid Conductors - Ferranti effect – charging Current - Effect on Regulation of the Transmission Line. Corona - Description of the phenomenon, factors affecting corona, critical voltages and power loss, Radio Interference.
Sag and Tension Calculations: Sag and Tension Calculations with equal and unequal heights of towers, Effect of Wind and Ice on weight of Conductor, Numerical Problems - Stringing chart and sag template and its applications.

UNIT-III: TRAVELING WAVES ON TRANSMISSION LINE
Interpretation of the Long Line Equations, Incident, Reflected and Refracted Waves -Surge Impedance and SIL of Long Lines, Wave Length and Velocity of Propagation of Waves - Representation of Long Lines - Equivalent-T and Equivalent Pie network models (numerical problems). Production of travelling waves, open circuited line, short circuited line, Line terminated through a resistance, line connected to a cable, reflection and refraction coefficients at a T-junction, Line terminated through a capacitance, attenuators of travelling waves.

UNIT-IV: POWER FACTOR AND VOLTAGE CONTROL

Causes of low power factor, methods of improving the power factor –phase advancing and generation of reactive KVAR using static capacitors – most economical power factor for constant KW load and constant KVA loads, numerical problems. Dependency of voltage on reactive power flow – methods of voltage control-shunt capacitors, series capacitors, synchronous capacitors, tap-changing and booster transformers.

UNIT-V: 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.

Symmetrical Components and Fault Calculations: Significance of positive, negative, zero sequence components, Average 3-phase power in terms of symmetrical components. Sequence impedances and sequence networks for fault calculations, single line to ground (LG) fault, LL fault, LLG fault, LLLG fault, reactors and their location, short circuit capacity of a bus.

TEXT BOOKS:

1. C. L. Wadhwa, *Electrical power systems*, New Age International (P) Limited Publishers, 1998.
2. Grainger and Stevenson, *Power Systems Analysis*, McGraw-Hill, 1st Edition 2003.
3. M. L. Soni, P. V. Gupta, U.S. Bhatnagar and A. Chakrabarthy, *Power System Engineering*,Dhanpat Rai & Co Pvt. Ltd, 2009.

REFERENCE BOOKS:

1. I. J. Nagarath& D. P Kothari, *Power System Engineering*, TMH, 2nd Edition, 2010.
2. B. R. Gupta, *Power System Analysis and Design*, Wheeler Publishing, 1998.
3. Abhijit Chakrabarti and Sunitha Halder, *Power System Analysis Operation and control*, PHI,3rd Edition, 2010.

Course Code: 19EC3116

SIGNALS AND SYSTEMS

L	T	P	C
3	-	-	3

B. Tech III Year I Semester

Prerequisite: Control Systems, Laplace Transforms, Numerical Methods and Complex variables

Course Objectives:

- To develop ability to analyze linear systems and signals
- To develop critical understanding of mathematical methods to analyze linear systems and signals
- To know the various transform techniques
- To analyze sampling principles

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

- Analyze linear systems and signals
- Discuss the concepts of continuous time and discrete time systems.
- Analyze systems using Fourier Transforms
- Analyze systems using Laplace and Z- Transforms
- Discuss sampling theorem and it implications.

UNIT-I: INTRODUCTION TO SIGNALS AND SYSTEMS

Signals and systems as seen in everyday life, and in various branches of engineering and science. **Signal properties:** periodicity, absolute integrability, determinism and stochastic character.

Some special signals of importance: the unit step, the unit impulse, the sinusoid, the complex exponential, some special time-limited signals; continuous and discrete time signals, continuous and discrete amplitude signals.

System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, reliability. Examples.

UNIT-II: BEHAVIOR OF CONTINUOUS AND DISCRETE-TIME LTI SYSTEMS

Impulse response and step response, convolution, input-output behavior with aperiodic convergent inputs, cascade interconnections. Characterization of causality and stability of LTI systems. System representation through differential equations and difference equations. State-space Representation of systems. State-Space Analysis, Multi-input, multi-output representation. State Transition Matrix and its Role. Periodic inputs to an LTI system, the notion of a frequency response and its relation to the impulse response

UNIT-III: FOURIER TRANSFORMS

Fourier series representation of periodic signals, Waveform Symmetries, Calculation of Fourier Coefficients. Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. The Discrete Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem.

UNIT-IV: **LAPLACE AND Z-TRANSFORMS**

Review of the Laplace Transform for continuous time signals and systems, system functions, poles and zeros of system functions and signals, Laplace domain analysis, solution to differential equations and system behavior. The z-Transform for discrete time signals and systems, system functions, poles and zeros of systems and sequences, z-domain analysis.

UNIT-V: SAMPLING AND RECONSTRUCTION

The Sampling Theorem and its implications. Spectra of sampled signals.

Reconstruction: ideal interpolator, zero-order hold, first-order hold. Aliasing and its effects. Relation between continuous and discrete time systems.

Introduction to the applications of signal and system theory: modulation for communication, filtering, feedback control systems.

TEXTBOOKS:

1. A. V. Oppenheim, A. S. Willsky and S. H. Nawab, "*Signals and Systems*", Prentice Hall India, 1997.
2. J. G. Proakis and D. G. Manolakis, *"Digital Signal Processing: Principles, Algorithms, and Applications"*, Pearson, 2006.

REFERENCES:

1. H. P. Hsu,*" Signals and Systems"*, Schaum's series, McGraw Hill Education,2010.
2. S. Haykinand B. V. Veen, *"Signals and Systems*", John Wiley and Sons, 2007.
3. A. V. Oppenheim and R. W. Schafer, "*Discrete-Time Signal Processing*", Prentice Hall, 2009.
4. M. J. Robert "*Fundamentals of Signals and Systems*", McGraw Hill Education, 2007.
5. B. P. Lathi, "*Linear Systems and Signals*", Oxford University Press, 2009.

Course Code: 19EE3171

POWER SYSTEMS RELIABILITY

L	T	P	C
3	-	-	3

B. Tech III Year I Semester

Prerequisite: Reliability Engineering, Power Systems, and Power System Operation and Control.

Course Objectives:

- To describe the generation system model.
- To describe recursive relation for capacitive model building.
- To explain the equivalent transitional rates, cumulative probability and cumulative frequency.
- To develop the understanding of risk, system and load point reliability indices.
- To explain the basic and performance reliability indices.

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

- Estimate loss of load and energy indices for generation systems model.
- Describe merging generation and load models.
- Evaluate cumulative probability and cumulative frequency of non-identical generating units.
- Apply various indices for distribution systems.
- Evaluate reliability of interconnected systems.

UNIT-I: BASIC PROBABILITY THEORY

Elements of probability, probability distributions, Random variables, Density and Distribution Functions-Binomial distribution- Expected value and standard deviation - Binomial distribution, Poisson distribution, normal distribution, exponential distribution, Weibull distribution.

Definition Of Reliability: Definition of terms used in reliability, Component reliability, Hazard rate, derivation of the reliability function in terms of the hazard rate. Hazard models - Bath tub curve, Effect of preventive maintenance. Measures of reliability: Mean Time to Failure and Mean Time between Failures.

UNIT-II: GENERATING SYSTEM RELIABILITY ANALYSIS

Generation system model – capacity outage probability tables – Recursive relation for capacitive model building – sequential addition method – unit removal – Evaluation of loss of load and energy indices – Examples. Frequency and Duration methods – Evaluation of equivalent transitional rates of identical and non-identical units – Evaluation of cumulative probability and cumulative frequency of non-identical generating units – 2-level daily load representation - merging generation and load models – Examples.

UNIT-III: OPERATING RESERVE EVALUATION

Basic concepts - risk indices – PJM methods – security function approach – rapid start and hot reserve units – Modeling using STPM approach.

Bulk Power System Reliability Evaluation: Basic configuration – conditional probability approach – system and load point reliability indices – weather effects on transmission lines – Weighted average rate and Markov model – Common mode failures.

Inter Connected System Reliability Analysis: Probability array method – Two inter connected systems with independent loads – effects of limited and unlimited tie capacity - imperfect tie – Two connected Systems with correlated loads – Expression for cumulative probability and cumulative frequency.

UNIT-IV: DISTRIBUTION SYSTEM RELIABILITY ANALYSIS

Basic Techniques – Radial networks –Evaluation of Basic reliability indices, performance indices – load point and system reliability indices – customer oriented, loss and energy-oriented indices – Examples. Basic concepts of parallel distribution system reliability

UNIT-V: SUBSTATIONS AND SWITCHING STATIONS

Effects of short-circuits - breaker operation – Open and Short-circuit failures – Active and Passive failures – switching after faults – circuit breaker model – preventive maintenance– exponential maintenance times.

TEXT BOOKS:

1. R. Billinton, and R.N. Allan, *Reliability Evaluation of Power systems*, BS Publications, 2019.
2. J. Endrenyi, *Reliability Modeling in Electric Power Systems*, John Wiley and Sons,2014.

REFERENCE BOOKS:

1. Alessandro Birolini, *Reliability Engineering: Theory and Practice*, 8th edition, Springer, 2017.
2. Charles Ebeling, *An Introduction to Reliability and Maintainability Engineering*, McGraw Hill Education, 1996.
3. E. Balaguruswamy, *Reliability Engineering*,McGraw Hill Education, 2017.

Course Code: 19EE3172

RENEWABLE ENERGY SYSTEMS

L	T	P	C
3	-	-	3

B. Tech III Year I Semester

Prerequisites: Power Systems.

Course Objectives

- To study the concepts of Non-renewable and renewable energy systems.
- To outline utilization of renewable energy sources for both domestic and industrial applications.
- To understand the environmental and cost economics of renewable energy sources in comparison with fossil fuels.
- To study the characteristics of photo voltaic cells.

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

- Understand the energy scenario and the consequent growth of the power generation from renewable energy sources.
- Differentiate between fixed and variable speed wind turbines
- Analyze the basic physics of wind and solar power generation.
- Understand the power electronic interfaces for wind and solar generation.
- Analyze the issues related to the grid-integration of solar and wind energy systems.

UNIT-I: INTRODUCTION TO RENEWABLE ENERGY SOURCES

Introduction to Wind energy, solar energy, geo thermal energy, bio-mass, Ocean Energy, MHD Generation -Indian and Global statistics.

UNIT-II: WIND GENERATOR TOPOLOGIES

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

UNIT-III: THE SOLAR RESOURCE

Introduction, solar radiation spectra, solar geometry, Earth Sun angles, observer Sun angles, solar day length, Estimation of solar energy availability. Technologies, Parabolic trough, central receivers, parabolic dish, Fresnel, solar pond, elementary analysis.

UNIT-IV: SOLAR PHOTOVOLTAIC

Technologies-Amorphous, Mon 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-V: 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.

TEXT BOOKS:

1. T. Ackermann, "*Wind Power in Power Systems*", John Wiley and Sons Ltd., 2005.
2. G. M. Masters, "*Renewable and Efficient Electric Power Systems***",** John Wiley and Sons, 2004.

REFERENCES:

1. G. D. Rai, "*Non-Conventional Energy Sources*", Khanna Publishers, 2011.
2. S. P. Sukhatme, "*Solar Energy: Principles of Thermal Collection and Storage*", McGrawHill,1984.
3. H. Siegfried and R. Waddington, "*Grid integration of wind energy conversion systems*" JohnWileyand Sons Ltd., 2006.
4. G. N. Tiwari and M. K. Ghosal, "*Renewable Energy Applications*", Narosa Publications, 2004.
5. J. A. Duffie and W. A. Beckman, "*Solar Engineering of Thermal Processes*", John Wiley& Sons,1991.

Course Code: 19EE3173

COMPUTER ARCHITECTURE

L	T	P	C
3	-	-	3

B. Tech III Year I Semester

Prerequisite: Digital Electronics

Course Objectives:

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

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

- Understand the concepts of micro processors, their principles and practices.
- Write efficient programs in assembly language of the 8086 family of micro processors.
- Organize a modern computer system and be able to relate it to real examples.
- Develop the programs in assembly language for 80286, 80386 and MIPS processors in real and protected modes.
- 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, Hard ware implementation of CPU with Micro instruction, micro programming, System buses, Multi-bus organization.

UNIT-II: MEMORY 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 MICRO PROCESSORS

80x86 Architecture, IA–32 andIA–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: PIPE LINING

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

TEXTBOOKS:

1. V. Carl, G.ZvonkoandS.G.Zaky, "*Computer organization*", McGrawHill, 1978.
2. B. Brey and C. R. Sarma, "*The Intel microprocessors*", Pearson Education, 2000.

REFERENCES:

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. Barryand P. Crowley, "*Modern Embedded Computing*", Morgan Kaufmann, 2012.
4. N. Mathivanan, "Micro processors, *P C Hardware and Interfacing*", Prentice Hall, 2004.
5. Y.C.Lieu and G.A.Gibson, "*Micro computer Systems: The 8086/8088Family*", Prentice Hall India, 1986.
6. J. Uffenbeck, "*The 8086/8088 Design, Programming, Interfacing",* Prentice Hall, 1987.
7. B. Govindarajalu, "*IBMP C and Clones*", TataMcGrawHill, 1991.
8. P.Able,"*8086 Assembly Language Programming*", Prentice Hall India.

Course Code: 19EE3151

ELECTRICAL MACHINES- II LAB

L	T	P	C
-	-	2	1

B. Tech. III Year I Semester

Prerequisites: Electrical Machines I and Electrical Machines II

Course Objectives:

- To understand the performance of single phase Transformer
- To understand the analysis of performance of a synchronous machine
- To understand the equivalent of a single phase induction motor
- To understand the circuit diagram of an induction motor by conducting no load and blocked rotor test of an induction motor
- To determine of Xd and Xq of a salient pole synchronous machine

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

- Perform the no load and blocked rotor test on three phase squirrel cage induction motor
- Perform the no load and blocked rotor test single phase induction motors to obtain the equivalent circuit
- Determine the Regulation of a three-phase alternator by different methods
- Convert three phase supply to two supply using Scott connection of transformers
- Determine of Xd and Xq of a salient pole synchronous machine

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

Part - A

1. O.C. & S.C. Tests on Single phase Transformer
2. Sumpner's test on a pair of single phase transformers
3. No-load & Blocked rotor tests on three phase induction motor
4. Regulation of a three-phase alternator by synchronous impedance and m.m.f. methods
5. V and inverted V curves of a three-phase synchronous motor
6. Equivalent circuit of a single phase induction motor
7. Determination of Xd and Xq of a salient pole synchronous machine
8. Load test on three phase induction motor

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

Part - B

9. Separation of core losses of a single phase transformer
10. Efficiency of a three phase alternator.
11. Parallel operation of single phase transformer
12. Regulation of three phase alternator by using Z.P.F and A.S.A methods
13 Heat run test on a bank of 3 Nos. of single phase Delta-connected transformers
14 Measurement of sequence impedance of a three phase Alternator
15 Vector grouping of three phase transformer
16 Scott connection of transformer

TEXT BOOKS:

1. "Generalized Machine Theory", Bhimbra, Khanna publishers, 5th edition.
2. "Electrical Machines", I. J. Nagarath & D. P. Kothari., Tata McGraw Hill, 4th edition.
3. "Performance and Design of AC Machines", M. G. Say, Pitman, ELBS.

REFERENCE BOOKS:

1. 'General Theory of Electrical Machines', Adkins; Chapman & Hall, 1979.
2. 'Electrical Machinery', Fitzgerald A.E. & Kingsley; McGraw-Hill, 6th edition.
3. 'Theory of AC Machinery', Langsdorf A.S.; Tata McGraw-Hill, 2001
4. 'Alternating Current Machines', Puchestein, Lloyd & Cenrad, Asia Publishing House, 1968
5. 'Electric Machinery Fundamentals', Chapman S.J.; McGraw-Hill, 1991

Course Code: 19HS3151

ADVANCED ENGLISH COMMUNICATION SKILLS LAB

L	T	P	C
-	-	2	1

B. Tech. III Year I Semester

Course Objectives: This Lab focuses on using multi-media instruction for language development to meet the following targets:

- To improve students' fluency in spoken English
- To enable them to listen to English spoken at normal conversational speed
- To help students develop their vocabulary
- To read and comprehend texts in different contexts
- To communicate their ideas relevantly and coherently in writing
- To make students industry-ready
- To help students acquire behavioral skills for their personal and professional life
- To respond appropriately in different socio-cultural and professional contexts

Course Outcomes: By the end of the course, students will be able to

- Acquire vocabulary and use it contextually
- Listen and speak effectively
- Develop proficiency in academic reading and writing
- Increase possibilities of job prospects
- Communicate confidently in formal and informal contexts

The following course activities will be conducted as part of the Advanced English Communication Skills Lab:

- Inter-personal Communication and Building Vocabulary – Starting a Conversation – Responding Appropriately and Relevantly – Using Appropriate Body Language – Role Play in Different Situations – Synonyms and Antonyms, One-word Substitutes, Prefixes and Suffixes, Idioms and Phrases and Collocations.
- Reading Comprehension - General Vs Local Comprehension, Reading for Facts, Guessing Meanings from Context, , Skimming, Scanning, Inferring Meaning.
- Writing Skills – Structure and Presentation of Different Types of Writing – Letter Writing/Resume Writing/ e-correspondence/ Technical Report Writing.
- Presentation Skills – Oral Presentations (individual or group) through JAM Sessions/Seminars/PPTs and Written Presentations through Posters/Projects/Reports/ Emails /Assignments… etc.,
- Group Discussion and Interview Skills – Dynamics of Group Discussion, Intervention, Summarizing, Modulation of Voice, Body Language, Relevance, Fluency and Organization of Ideas and Rubrics of Evaluation- Concept and Process, Pre-interview Planning, Opening Strategies, Answering Strategies, Interview through Tele-conference & Video-conference and Mock Interviews.

Minimum Hardware Requirement: Soft Skills Laboratory shall have the following infrastructural facilities to accommodate at least 35 students in the lab:

- Spacious room with appropriate acoustics
- Eight round tables with five movable chairs for each table.
- Audio-visual aids
- LCD Projector
- Public Address system
- Computer with suitable configuration.

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

TEXTBOOKS:

1. Oxford Advanced Learner's Compass, 8th Edition.
2. DELTA's key to the Next Generation TOEFL Test: Advanced Skill Practice.

REFERENCES:

1. Kumar, Sanjay and Pushp Lata. English for Effective Communication, Oxford University Press, 2015.
2. Konar, Nira. English Language Laboratories – A Comprehensive Manual, PHI Learning Pvt. Ltd., 2011

Course Code: 19EE3153

ELECTRICAL SIMULATION LAB

L	T	P	C
-	-	2	1

B. Tech. III Year I Semester

Prerequisite: Basic Electrical and Electronics Engineering, Network Theory and Control Systems

Course Objectives:

- To develop the simulation Skills.
- To perform the analysis of electrical networks
- To understand the operating principles of various power electronic converters.
- To perform the transient analysis.

Course outcome: After going through this lab the student will be able to

- Apply the simulation skills to analyze the different networks.
- Analyze the behavior of different power electronic converters.
- Apply techniques to calculate different parameters of the circuit using simulation.
- Analyze the Circuit and measure the real and reactive power through simulation
- Analyze the practical behavior of the circuits in simulation environment.

The following experiments are required to be conducted compulsory experiments:

1. Basic Operations of Matrices.
2. Mesh and Nodal Analysis of Electrical circuits.
3. Application of Network Theorems to Electrical Networks.
4. Simulation of DC circuits.
5. Transient analysis.
6. (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.

7. 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.
8. Simulation of Buck chopper.

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

9. (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.
10. Study of PWM techniques.
11. Simulation of single-phase Inverter with PWM control.
12. Design of Lead-Lag compensator for the given system and with specification using suitable software.

13. Measurement of active power of three phase circuit for balanced and unbalanced load.
14. Harmonic analysis of non-sinusoidal waveforms.
15. Design of Low Pass and High Pass filters.

TEXT BOOKS:

1. M. H. Rashid, Simulation of Electric and Electronic circuits using PSPICE – by M/s PHIPublications.
2. "A. K. Sawhney", "Electrical & Electronic Measurement & Instruments", Dhanpat Rai & Co. Publications, 2005.
3. M. Gopal, "Control Systems: Principles and Design", McGraw Hill Education, 1997.
4. C. K. Alexander and M. N. O. Sadiku, "Electric Circuits", McGraw Hill Education, 2004.

REFERENCE BOOKS:

1. Reference guides of related software's
2. Rashid, Spice for power electronics and electric power, CRC Press

Course Code: 19EC3154

SIGNALS AND SYSTEMS LAB

L	T	P	C
-	-	2	1

B. Tech. III Year I Semester

Prerequisites: Signals and Systems

Course Objectives:

- To develop ability to analyze linear systems and signals
- To develop critical understanding of mathematical methods to analyze linear systems and signals
- To know the various transform techniques
- To analyze sampling principles

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

- Understand the concepts of continuous time and discrete time systems.
- Analyze systems in complex frequency domain.
- Understand sampling theorem and its implications.

Any twelve experiments are mandatory:

1. Basic Operation on Matrices
2. Generation of Various Signals and Sequences, such as Unit Impulse, Unit step, Square, Saw tooth, Triangular, Sinusoidal, Ramp, Sinc
3. Operation on Signals and Sequences such as Addition, Multiplication, Scaling, Shifting, Folding, Computation of Energy and Power
4. Finding the Even and Odd Parts of Signal/Sequence and Real and Imaginary Parts of Signal
5. Convolution of Signals and Sequences
6. Auto Correlation and Cross Correlation for Signals and Sequences
7. Verification of Linearity and Time Invariance Properties of a Given System
8. Computation of Unit Sample, Unit step and Sinusoidal response of the given LTI system and verifying its physical realiazability and stability properties
9. Gibbs Phenomenon Simulation
10. Finding the Fourier Transform of a given signal and plotting its magnitude and phase spectrum.
11. Waveform Synthesis using Laplace Transform
12. Locating the Zeros and Poles and Plotting the Pole-Zero Maps in S-Plane and Z-Plane for the given transfer function
13. Generation of Gaussian noise, Computation of its mean, Mean Square, Skew, Kurtosis and PSD Probability Distribution Function
14. Verification of Sampling Theorem
15. Verification of Weiner-Khinchine Relation.

TEXT BOOKS:

1. A. V. Oppenheim, A. S. Willsky and S. H. Nawab, “Signals and systems”, Prentice Hall India, 1997.
2. J. G. Proakis and D. G. Manolakis, “Digital Signal Processing: Principles, Algorithms, and Applications”, Pearson, 2006.

REFERENCES:

1. H. P. Hsu, “Signals and systems”, Schaum’s series, McGraw Hill Education, 2010.
2. S. Haykin and B. V. Veen, “Signals and Systems”, John Wiley and Sons, 2007.
3. A. V. Oppenheim and R. W. Schafer, “Discrete-Time Signal Processing”, Prentice Hall, 2009.
4. M. J. Robert “Fundamentals of Signals and Systems”, McGraw Hill Education, 2007.
5. B. P. Lathi, “Linear Systems and Signals”, Oxford University Press, 2009.

Course Code: 19MC0005

PROFESSIONAL ETHICS

L	T	P	C
2	-	-	-

B. Tech III Year I Semester

Course Objective:
To enable the students to imbibe and internalize the Values and Ethical Behavior in the personal and Professional lives.

Course Outcome:
The students will understand the importance of Values and Ethics in their personal lives and professional careers. The students will learn the rights and responsibilities as an employee, team member and a global citizen.

UNIT - I
Introduction to Professional Ethics: Basic Concepts, Governing Ethics, Personal &Professional Ethics, Ethical Dilemmas, Life Skills, Emotional Intelligence, Thoughts of Ethics, Value Education, Dimensions of Ethics, Profession and professionalism, Professional Associations, Professional Risks, Professional Accountabilities, Professional Success, Ethics and Profession.

UNIT - II
Basic Theories: Basic Ethical Principles, Moral Developments, Deontology, Utilitarianism, Virtue Theory, Rights Theory, Casuist Theory, Moral Absolution, Moral Rationalism, Moral Pluralism, Ethical Egoism, Feminist Consequentialism, Moral Issues, Moral Dilemmas, Moral Autonomy.

UNIT - III
Professional Practices in Engineering: Professions and Norms of Professional Conduct, Norms of Professional Conduct vs. Profession; Responsibilities, Obligations and Moral Values in Professional Ethics, Professional codes of ethics, the limits of predictability and responsibilities of the engineering profession. Central Responsibilities of Engineers - The Centrality of Responsibilities of Professional Ethics; lessons from 1979 American Airlines DC-10 Crash and Kansas City Hyatt Regency Walk away Collapse.

UNIT - IV
Work Place Rights & Responsibilities, Ethics in changing domains of Research, Engineers and Managers; Organizational Complaint Procedure, difference of Professional Judgment within the Nuclear Regulatory Commission (NRC), the Hanford Nuclear Reservation. Ethics in changing domains of research - The US government wide definition of research misconduct, research misconduct distinguished from mistakes and errors, recent history of attention to research misconduct, the emerging emphasis on understanding and fostering responsible conduct, responsible authorship, reviewing & editing.
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UNIT - V

Global issues in Professional Ethics: Introduction – Current Scenario, Technology Globalization of MNCs, International Trade, World Summits, Issues, Business Ethics and Corporate Governance, Sustainable Development Ecosystem, Energy Concerns, Ozone Deflection, Pollution, Ethics in Manufacturing and Marketing, Media Ethics; War Ethics; Bio Ethics, Intellectual Property Rights.

TEXT BOOKS:

1. Professional Ethics: R. Subramanian, Oxford University Press, 2015.
2. Ethics in Engineering Practice & Research, Caroline Whitbeck, 2e, Cambridge University Press 2015.

REFERENCES:

1. Engineering Ethics, Concepts Cases: Charles E Harris Jr., Michael S Pritchard, Michael J Rabins, 4e, Cengage learning, 2015.
2. Business Ethics concepts & Cases: Manuel G Velasquez, 6e, PHI, 2008.

Course Code: 19EE3211

POWER SYSTEMS ANALYSIS

L	T	P	C
3	1	-	4

B. Tech III Year II Semester

Prerequisite: Power Systems-I & Power Systems –II

Course Objectives:

- To understand the application of graph theory in power system.
- To know the importance of load flow studies in power system.
- To understand the different types of load flow methods.
- To analyze different types of load flow methods.
- To understand the importance of compensation in power system.
- To understand the rotor angle stability of power systems.

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

- To understand and develop Y-bus and Z-bus matrices.
- To explain the importance of load flow studies and its application in power system.
- To perform load flow computations and analyze the load flow results.
- To analyze the different compensating techniques in power system
- To estimate stability and instability in power systems

UNIT – I: POWER SYSTEM NETWORK MATRICES:

Graph Theory: Definitions and Relevant concepts in Graph Theory, Network Matrices. Transmission Network Representations: Bus Admittance frame and Bus Impedance frame.
Formation of Y-bus: Direct and Singular Transformation Methods, Numerical Problems.
Formation of Z-bus: Modification of existing Z-Bus Matrix for addition of a new branch, & complete Z-Bus building algorithm Numerical Problems.

UNIT – II: POWER FLOW STUDIES – I

Introduction: Necessity of Power Flow Studies, Bus classification and Notations, Convergence & Bus mismatch criteria.
Load Flow Methods: Gauss-Seidal Method in complex form without & with voltage control buses, line flows and loss calculations, Newton Raphson method in Polar and Rectangular form, derivation of Jacobian elements, Numerical Problems for one or two iterations.

UNIT – III: POWER FLOW STUDIES - II

Introduction to sensitivity & decoupled sub matrices of J-matrix, Decoupled load flow method and its assumptions, Fast Decoupled load method and its assumptions, Comparison of Different Methods – DC load Flow method, Numerical problems for one or two iterations.

UNIT – IV: REACTIVE POWER CONTROL

Overview of Reactive Power control – Reactive Power compensation in transmission systems - advantages and disadvantages of different types of compensating equipment for transmission systems; load compensation – Specifications of load compensator, Uncompensated and compensated transmission lines: shunt and Series Compensation.

UNIT – V: POWER SYSTEM STABILITY ANALYSIS

Introduction to Power System Stability issues. Rotor dynamics & Swing equation, Power angle equation with & without neglecting line resistance, Steady State Stability, Determination of Transient Stability through Equal Area Criterion for single machine infinite system, Critical clearing angle & time, Numerical problems. Multimachine transient analysis: Classical representation of system and its assumptions, Solution of Swing Equation by Point-by-Point Method, Methods to improve Stability.

TEXT BOOKS:

1. I. J. Nagrath& D. P. Kothari, *Modern Power System Analysis*, McGraw Hill Education, 4th Edition, 2011.
2. Hadi Saadat, *Power System Analysis*, McGraw Hill Education, 2002.

REFERENCE BOOKS:

1. M. A. Pai, *Computer Techniques in Power System Analysis*, McGraw Hill Education, 3rdEdition, 2014.
2. Grainger and Stevenson, *Power System Analysis*, McGraw Hill Education, 2003.
3. Abhijit Chakrabarthi and Sunita Haldar, *Power System Analysis Operation and Control*, 3rdEdition, PHI Learning Pvt. Ltd, 2010.

Course Code: 19EE3212

POWER SYSTEM PROTECTION AND SWITCH GEAR	L	T	P	C
	3	-	-	3

B. Tech III Year II Semester

Prerequisites: Power Systems-I and Power Systems-II

Course Objectives:

- To introduce all kinds of circuit breaker for protection
- To introduce various types of relays
- To describe about protection of Generators and Transformers
- To describe the line protection and importance of neutral grounding
- To understand the phenomenon of over voltages and its classifications

Course Outcomes: At the end of this course, students will be able to

- Understand the quenching mechanisms used in various circuit breakers
- Understand the choice of relays for appropriate protection of power systems equipment
- Apply technology to protect power system components
- Analyze the need of line protection and grounding system
- Analyze the phenomenon of voltage surges

UNIT-I: CIRCUIT BREAKERS

Elementary principles of arc interruption, Recovery, restriking voltage and recovery voltages – Restriking phenomenon, average and Max. RRRV, Numerical problems, Current chopping and Resistance switching. CB ratings and specifications, numerical problems, types of circuit breakers: Minimum oil circuit breakers, Air blast circuit breakers, Vacuum and SF6 circuit breakers.

UNIT-II: PROTECTIVE RELAYS

Principle of operation and construction of attracted armature, balanced beam, induction Disc and induction cup relays.

Relays classification: Instantaneous, DMT and IDMT types

Application of relays: Over current / under voltage relays, Direction relays, Differential Relays and percentage differential relays. Universal torque equation,

Distance relays: Impedance, reactance and Mho and Off-set Mho relays, Characteristics of Distance Relays and Comparison. Introduction to static relays, Microprocessor relay.

UNIT-III:APPARATUS PROTECTION

Protection of generators against stator faults, rotor faults, and abnormal conditions. Restricted Earth fault and interterm fault protection, Numerical problem on % Winding Unprotected.

Protection of Transformers: Percentage differential Protection, Numerical problem on design of CT's ratio, Buchholtz relay protection.

UNIT-IV: LINE PROTECTION & GROUNDING

Protection of lines: Over current, carrier current and three-zone distance relay protection using impedance relays. Tran slay relay

Protection of Bus bars: Grounded and ungrounded neutral systems – effects of ungrounded neutral on system performance. Methods of neutral grounding: solid, resistance, reactance – arcing grounds and grounding practices.

UNIT-V: SURGE AND SURGE PROTECTION

Generation of over voltages in power systems – Protection against lightning over voltages – valve type and Zinc oxide lightning arresters, insulation and coordination – BIL, impulse ratio. Standard impulse test wave, volt-time characteristics.

TEXT BOOKS:

1. Badri Ram and Vishwakarma D N, *Power System Protection and Switchgear*, Tata McGraw-Hill, New Delhi , 2011.
2. Ravindranath B and Chander M, *Power System Protection and Switchgear*, New Age International, New Delhi, July 2011.

REFERENCES:

1. Soni M L, Gupta P V, Bhatnagar U S and Chakrabarti A, *A Text Book on Power Systems Engineering*, DhanpatRai& Co., New Delhi, 2013.
2. Sunil S Rao, *Switchgear Protection and Power Systems*, Khanna Publishers, New Delhi, 2012.
3. Y.G. Paithankar and S.R. Bhide, *Fundamentals of Power System Protection*, PHI Learning Private Limited, New Delhi,2010. 4. Cooper busman Application note
4. J. L. Blackburn, *Protective Relaying: Principles and Applications*, Marcel Dekker, New York, 1987.
5. G. Phadke and J. S. Thorp, *Computer Relaying for Power Systems*, John Wiley & Sons, 1988.
6. Donald Reimert, "*Protective Relaying for Power Generation Systems*", Taylor and Francis, CRC Press, 2006

Course Code: 19EC3216

MICROPROCESSORS AND MICROCONTROLLERS	**L**	**T**	**P**	**C**
B. Tech III Year II Semester	**3**	**-**	**-**	**3**

Prerequisites: Computer Architecture, Digital Electronics.

Course Objectives:

- To familiarize the architecture of microprocessors and micro controllers
- To provide the knowledge about interfacing techniques of bus & memory.
- To understand the concepts of ARM architecture
- To study the basic concepts of Advanced ARM processors

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

- Understands the internal architecture, organization and assembly language programming of 8086 processors.
- Understands the internal architecture, organization and assembly language programming of 8051/controllers
- Understands the interfacing techniques to 8086 and 8051 based systems.
- Understands the internal architecture of ARM processors and basic concepts of advanced ARM processors.

UNIT -I: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: 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 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, TMH, 2nd Edition 2006.
2. ARM System Developers guide, Andrew N SLOSS, Dominic SYMES, Chris WRIGHT, Elsevier, 2012

REFERENCE BOOKS:

1. The 8051 Microcontroller, Kenneth. J. Ayala, Cengage Learning, 3rd Ed, 2004.
2. Microprocessors and Interfacing, D. V. Hall, TMGH, 2nd Edition 2006.
3. The 8051 Microcontrollers, Architecture and Programming and Applications -

Course Code: 19EE3271

SMART GRID TECHNOLOGIES	L	T	P	C
B. Tech III Year II Semester	**3**	**-**	**-**	**3**

Prerequisite: Power Systems

Course Objectives: to prepare the students to

- Understand concept of smart grid and its advantages over conventional grid.
- Know smart metering techniques and learn wide area measurement techniques.
- Understand the various energy storage techniques.
- Understand the problems associated with integration of distributed generation.
- Understand the various communications technologies in smart grid.

Course Outcomes: Students will be able to

- Distinguish between conventional grid and smart grid.
- Apply smart metering concepts in smart grids.
- Explain various energy storage techniques.
- Understand the concepts of micro grid.
- Develop smart grid solutions using modern communication technologies.

UNIT-I: INTRODUCTION TO SMART GRID

Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Traditional Power Grid and Smart Grid, Advantages –Indian Smart Grid –Key Challenges for Smart Grid.

UNIT-II: SMART METERS &COMMUNICATION TECHNOLOGIES

Introduction to Smart Meters, Real Time Pricing, Automatic Meter Reading (AMR), Advanced Metering Infrastructure (AMI), Outage Management System (OMS), Plug in Hybrid Electric Vehicles (PHEV), Smart Sensors, Smart Substations, Substation Automation, Feeder Automation Wide Area Measurement System (WAMS), Phasor Measurement Unit (PMU)

UNIT-III: INFORMATION AND STORAGE SYSTEMS

Geographic Information System (GIS), Intelligent Electronic Devices (IED) & their application for monitoring & protection, Smart storage like Battery, Pumped Hydro, Compressed Air Energy Storage, fuel-cells and Fly wheel energy storage

UNIT-IV: MICROGRID

Concept of microgrid, need & applications of microgrid, Microgrid benefits, Microgrid drivers Issues of interconnection, protection & control of microgrid, Integration of renewable energy sources

UNIT-V: COMMUNICATION TECHNIQUES IN SMART GRID

Introduction to various communication techniques in smart grids, Home Area Network (HAN), Neighbourhood Area, Network (NAN), Wide Area Network (WAN), Bluetooth, Zig Bee, GPS, Wi-Fi, Wi-Max based communication.

TEXT BOOKS:

1. Ali Keyhani, *Design of smart power grid renewable energy systems*, Wiley IEEE, 2011
2. Stuart Borlase, *Smart Grids, Infrastructure, Technology and Solutions*, CRC Press, 2013
3. Clark W. Gellings, *The Smart Grid: Enabling Energy Efficiency and Demand Response*, CRC Press, 2009

REFERENCES:

1. JanakaEkanayake, Nick Jenkins, KithsiriLiyanage, *Smart Grid: Technology and Applications*,Wiley, 2012
2. A.G.Phadke, *Synchronized Phasor Measurement and their Applications*, Springer, 2008.
3. S. Chowdhury, S. P. Chowdhury, and P. Crossley, *Microgrids and active distribution networks*, IET, 2009,
4. http://uni-site.ir/khuelec/wp-content/uploads/Microgrids-and-Active- Distribution-Networks.pdf
5. Prof. N. P. Padhy and Prof. Premalatha Jena, NPTEL course – *Introduction to Smart. Grid.*

Course Code: 19EE3272

HIGH VOLTAGE ENGINEERING	L	T	P	C
B. Tech III Year II Semester	**3**	**-**	**-**	**3**

Prerequisite: Power Systems –I, Electro Magnetic Fields, Electrical Measurements.

Course Objectives:

- The electrical properties and physical processes by which high currents are produced, leading to breakdown are understood, for both the uniform and non-uniform fields --- for solids, liquids and gaseous media.
- Knowledge and control in generation of high voltages and currents, for AC, DC and impulse, is obtained.
- Measuring circuits, for measurement of high voltages and currents explained, including for dielectric constant, loss factor and partial discharge.
- The physical processes of lightning discharges, over voltages caused by lightning and switching surges, is understood along with protection mechanisms.
- Quality assurance testing of HV electrical equipment, as per the national / international standards, is explained, along with the examination of HV Laboratory lay-out, with its safety concerns.

Course outcomes: At the end of the course, the student will able to

- Nature of Breakdown mechanism in solid, liquid and gaseous dielectrics.
- Generation of over voltages in laboratories.
- Measurement of over voltages.
- Various types of over voltages in power system and protection methods.
- Testing of power apparatus and insulation coordination.

UNIT – I: BREAKDOWN IN GASES

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 Liquid and Solid Insulating Materials: 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 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 oscillographs 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 overvoltages,Protection against over-voltages, Surge diverters, Surge modifiers.

UNIT – V: HIGH VOLTAGE TESTING OF ELECTRICAL APPARATUS AND HIGH VOLTAGE LABORATORIES

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:

1. M. S. Naidu and V. Kamaraju, *High Voltage Engineering*, McGraw Hill Education, 2013.
2. C. L. Wadhwa, *High Voltage Engineering*, New Age International Publishers, 2007.

REFERENCE BOOKS:

1. D. V. Razevig, *High Voltage Engineering Fundamentals*, Khanna Publishers, 1993.
2. E. Kuffel, W. S. Zaengl and J. Kuffel, *High Voltage Engineering Fundamentals*, Newnes Publication, 2000.
3. R. Arora and W. Mosch, *High Voltage and Electrical Insulation Engineering*, John Wiley &Sons, 2011.
4. Various IS standards for HV Laboratory Techniques and Testing.

Course Code: 19EE3273

AI TECHNIQUES IN ELECTRICAL ENGINEERING	L	T	P	C
B. Tech III Year II Semester	**3**	**-**	**-**	**3**

Prerequisites: Power Systems, Digital Electronics, Electrical Machines.

Course Objectives:

- To understand soft commanding methodologies, such as artificial neural networks and Learning methods.
- To observe the concepts of ANN models.
- To practice the concept of fuzziness involved in various systems and comprehensive knowledge of fuzzy logic control and to design the fuzzy control
- To analyze genetic algorithm, genetic operations and genetic mutations.
- To Apply the AI techniques in load forecasting, DC&AC Motors.

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

- Understand the artificial neural networks, feed forward neural networks and Learning methods.
- Understand the concepts of BPA, SOM and FLN models.
- Develop fuzzy logic control for applications in electrical engineering
- Develop genetic algorithm for applications in electrical engineering.
- Apply the AI knowledge for load forecasting and motor load.

UNIT-I: ARTIFICIAL NEURAL NETWORKS

Introduction, Organization of the Brain, Biological Neuron, Artificial Neuron Models, McCulloch-Pitts Model, Neural networks Architecture– Single layer and multi-layer feed-forward and feedback networks, learning process-supervised learning-unsupervised learning–Hebbian learning.

UNIT-II: ANN PARADIGMS

Back propagation Algorithm (BPA), Self–Organizing Map (SOM), Radial Basis Function Network-Functional Link Network (FLN), Hopfield Network.

UNIT-III: FUZZY LOGIC

Introduction –Fuzzy versus crisp, Fuzzy sets-Membership function –Basic Fuzzy set operations, Properties of Fuzzy sets –Fuzzy Cartesian Product, Operations on Fuzzy relations –Fuzzy logic–Fuzzy Quantifiers, Defuzzification methods.

UNIT-IV: GENETIC ALGORITHMS

Basic principle, Evolution of genetic algorithm –Basic Concepts-Encoding –Fitness Function-Reproduction operators, Genetic Modeling -Cross over-Single site cross over, two-point cross over –Multi point cross over Uniform cross over, Matrix cross over-Mutation operator.

UNIT-V: APPLICATIONS OF AI TECHNIQUES

Fault diagnosis and load forecasting, Economic load dispatch, Load frequency control, Single area system and two area system, Reactive power control, Speed control of DC and AC Motors.

TEXT BOOKS

1. S. Rajasekaran and G. A. V. Pai, *Neural Networks, Fuzzy Logic & Genetic Algorithms*, PHI Learning Private Limited, New Delhi, 2003.
2. Rober J. Schalkoff, *Artificial Neural Networks*, Tata McGraw Hill Edition, 2011.

REFERENCES:

1. P. D. Wasserman,*Neural Computing Theory & Practice*, Coriolis Group, New York, 1989.
2. Bart Kosko,*Neural Network & Fuzzy System*, Prentice Hall, 1992.
3. D. E. Goldberg, *Genetic Algorithms*, Addison-Wesley, 1999.
4. J. Duncan Glover, Mulukutla S. Sarma, and Thomas J. Overbye, Power System analysis and design, Cengage Learning, 6^{th} edition, 2017.

Course Code: 19EC3254

MICROPROCESSORS AND MICROCONTROLLERS LAB	**L**	**T**	**P**	**C**
B. Tech III Year II Semester	**-**	**-**	**2**	**1**

Prerequisites: Digital Electronics, Microprocessors and Microcontrollers.

Course Objectives:

- To Introduce Assembly Language Program concepts
- Write ALP for arithmetic and logical operations in 8086 and 8051
- To Interface I/O devices with 8051 microcontroller and ARM

Course Outcomes: At the end of the course, student will be able to

- Implement the basic programming for Arithmetic and Logical operations in 8086 microprocessor and 8051 Microcontroller CO2.
- Identity the assembly level programming in given problem.
- Implement interfacing of I/O devices with 8051 Microcontroller and ARM

Cycle 1: Using 8086 Processor Kits and/or Assembler

Assembly Language Programs to 8086 to Perform

1. Arithmetic, Logical, String Operations on 16 Bit and 32-Bit Data.
2. Logical Operations, Rotate, Shift, Swap and Branch Operations.

Cycle 2: Using 8051 Microcontroller Kit

Introduction to IDE

1. Assembly Language Programs to Perform Arithmetic (Both Signed and Unsigned) 16 Bit Data Operations, Logical Operations (Byte and Bit Level Operations), Rotate, Shift, Swap and Branch Instructions
2. Time delay Generation Using Timers of 8051.
3. Serial Communication from / to 8051 to / from I/O devices.

Cycle 3: Interfacing I/O Devices to 8051

1. Matrix Keypad to 8051.
2. Sequence Generator Using Serial Interface in 8051.
3. 8 bit ADC Interface to 8051.
4. Triangular Wave Generator through DAC interfaces to 8051.

Cycle 4: Interfacing I/O devices to ARM

1. LCD interfacing to ARM
2. Buzzer interfacing to ARM

TEXT BOOKS:

1. Advanced Microprocessors and Peripherals by A K Ray, Tata McGraw-Hill Education, 2006
2. The 8051 Microcontrollers: Architecture, Programming & Applications by Dr. K. Uma Rao, Andhe Pallavi, Pearson, 2009.

REFERENCES:

1. ARM System Developers guide, Andrew N SLOSS, Dominic SYMES, Chris WRIGHT, Elsevier, 2012
2. Microprocessors and Interfacing, D. V. Hall, MGH, 2nd Edition 2006.
3. Introduction to Embedded Systems, Shibu K.V, MHE, 2009
4. The 8051 Microcontrollers, Architecture and Programming and Applications -K.Uma Rao, Andhe Pallavi, Pearson 2009.

Course Code: 19EE3251

POWER SYSTEMS LAB **L T P C**

B. Tech III Year II Semester **- - 2 1**

Prerequisite: Power System-I, Power System-II, Power System Protection, Power System Operation and Control, Electrical Machines.

Course Objectives:

- Perform testing of CT, PT's and Insulator strings
- To find sequence impedances of 3-Φ synchronous machine and Transformer
- To perform fault analysis on Transmission line models.
- To study transformer protection system

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

- Analyze the characteristics of relays
- Understand Different protection methods
- Calculate the efficiency of string insulator
- Analyze the experimental data and draw the conclusions**.**

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

Part - A

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.

In addition to the above six experiments, at least any four of the experiments from the following list are required to be conducted.

Part – B

1. Characteristics of Negative Sequence Relay
2. Equivalent circuit of three winding transformer
3. Sub-Transient reactance of salient pole synchronous machine
4. Testing of CT and PT.
5. Analysis of Ferranti effect on Transmission Lines under light loadings.
6. Calculation of insulator string efficiency

TEXT BOOKS:

1. C.L. Wadhwa: Electrical Power Systems –Third Edition, New Age International Pub. Co., 2001.
2. Hadi Sadat: Power System Analysis –Tata Mc Graw Hill Pub. Co. 2002.

REFERENCES:

1. D. P. Kothari: Modern Power System Analysis-Tata Mc Graw Hill Pub. Co. 2003

Course Code: 1**9EE3252**

POWER ELECTRONICS LAB

L	T	P	C
-	-	2	1

B.Tech III Year II Semester

Prerequisite: Power Electronics.

Course Objectives:

- Apply the concepts of power electronic converters for efficient conversion/control of power from source to load.
- Design the power converter with suitable switches meeting a specific load requirement.

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

- Understand the operating principles of various power electronic converters.
- Study and understand the different firing circuits of SCR.
- Study and understand the concept of different commutation circuits.
- Use power electronic hardware to develop the power converters.
- Analyze and choose the appropriate converters for various applications

Any ten experiments should be conducted

1. Study of characteristics of SCR.
2. Study of gate firing circuits of SCR's.
3. Single-phase half-controlled bridge converter with *R* and *RL* loads.
4. Single-phase fully controlled bridge converter with *R* and *RL* loads.
5. Three-phase half-controlled bridge converter with *R* and *RL* loads.
6. Single-phase A.C voltage controller with *R*& *RL* loads.
7. Single-phase Cyclo-converter with *R* and *RL* loads.
8. Single-phase series and parallel inverter with *R* and *RL* loads.
9. Single-phase bridge inverter with *R* and *RL* loads.
10. Forced commutation circuits (Class-A, Class-B, Class-C, Class-D & Class-E).
11. Single-phase Inverter with PWM control technique.
12. Single-phase dual converter with *R* and *RL* loads.

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