



# 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			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
<b>Total</b>				<b>21</b>	<b>1</b>	<b>6</b>	<b>22</b>

Note: \*MC = Satisfactory/Unsatisfactory

\*Open Elective – Students should take Open Electives from List of Open Electives Offered by Other Departments/Branches Only.

## EE601PC: DIGITAL SIGNAL PROCESSING

<b>B.TECH. III YEAR II SEMESTER</b>								
Course Code	Category	Hours/Week			Credits	Maximum Marks		
<b>EE601PC</b>	<b>ESC</b>	L	T	P	C	CIA	SEE	Total
		3	0	0	3	30	70	100
<b>Prerequisite: Nil</b>								
<b>Course Objectives:</b>								
<ol style="list-style-type: none"> <li>1. This gives the basics of Signals and Systems required for all Electrical Engineering related courses</li> <li>2. To understand the behavior of signal in time and frequency domain</li> <li>3. To understand the characteristics of LTI systems</li> <li>4. This gives concepts of Signals and Systems and its analysis using different transform techniques.</li> <li>5. To study the designs and structures of digital (IIR and FIR) filters and analyze and synthesize for a given specifications.</li> </ol>								
<b>Course Outcomes:</b> Upon completing this course, the student will be able to								
<ol style="list-style-type: none"> <li>1. Differentiate various signal functions.</li> <li>2. Represent any arbitrary signal in time and frequency domain.</li> <li>3. Understand the characteristics of linear time invariant systems.</li> <li>4. Analyze the signals with different transform technique.</li> <li>5. Design a digital filter for a given specification.</li> </ol>								
<b>UNIT: I</b>		<b>SIGNAL ANALYSIS, FOURIER SERIES, FOURIER TRANSFORMS</b>						
Classification of Signals and systems, Exponential and Sinusoidal signals, Concepts of Impulse function, Unit Step function, Signum function. <b>Fourier series:</b> 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. <b>Fourier Transforms:</b> 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								
<b>UNIT: II</b>		<b>SIGNAL TRANSMISSION THROUGH LINEAR SYSTEMS, SAMPLING THEOREM</b>						
<b>Signal Transmission through Linear Systems:</b> 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 <b>Sampling theorem:</b> 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,								
<b>UNIT: III</b>		<b>LAPLACE TRANSFORMS, Z-TRANSFORMS</b>						
<b>Laplace Transforms:</b> 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. <b>Z-Transforms:</b> 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.								
<b>UNIT: IV</b>		<b>IIR DIGITAL FILTERS AND REALIZATION OF DIGITAL FILTERS</b>						

**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, 2<sup>nd</sup> 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>B.TECH. III YEAR II SEMESTER</b>								
Course Code	Category	Hours/Week			Credits	Maximum Marks		
EE602PC	ESC	L	T	P	C	CIA	SEE	Total
		3	0	0	3	30	70	100
<b>Prerequisite:</b> Digital System Design, Computer Organization, Basics of VLSI, Basic Programming Knowledge								
<b>Course Objectives:</b> <ol style="list-style-type: none"> <li>1. To develop an understanding of the functionality of microprocessors; Assembly language programming and interfacing techniques.</li> <li>2. To provide knowledge on functionality of microcontrollers; Assembly language programming and interfacing techniques.</li> <li>3. To develop an understanding of the operations and Programming of ARM Processor</li> <li>4. To study the basic concepts of Advanced ARM processors (A, R, M profile) and their applications.</li> </ol>								
<b>Course Outcomes:</b> Upon completing this course, the student will be able to <ol style="list-style-type: none"> <li>1. Understand the 8086<math>\mu</math>p architecture, its operation and apply the knowledge of instruction set &amp; assembler directives to write Programs using MASM.</li> <li>2. Understand the 8051<math>\mu</math>c architecture, its operation and apply the knowledge of instruction set to design applications.</li> <li>3. Apply the knowledge of 8051<math>\mu</math>c and Communication protocols to interface I/O devices.</li> <li>4. Understand the ARM processor internal architecture; apply the knowledge of instruction set to design applications.</li> <li>5. Understand the ARM CORTEX and OMAP Processor architecture and architecture and their applications.</li> </ol>								
<b>UNIT: I</b>	<b>8086 MICROPROCESSOR ARCHITECTURE &amp; INSTRUCTION SET</b>							
<b>8086 Architecture:</b> 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. <b>Instruction Set and Assembly Language Programming of 8086:</b> Instruction formats, Addressing modes, Instruction Set, Assembler Directives, Macros, and Simple Programs involving Logical, Branch and Call Instructions, Sorting, String Manipulations.								
<b>UNIT: II</b>	<b>8051 MICROCONTROLLER ARCHITECTURE &amp; REAL TIME CONTROL</b>							
<b>Introduction to Microcontrollers:</b> Overview of 8051 Microcontroller, Architecture, I/O Ports, Memory Organization, Addressing Modes and Instruction set of 8051. <b>8051 Real Time Control:</b> Programming Timer Interrupts, Programming External Hardware Interrupts, Programming the Serial Communication Interrupts, Programming 8051 Timers and Counters								
<b>UNIT: III</b>	<b>I/O, MEMORY &amp; SERIAL BUS INTERFACE</b>							
<b>I/O and Memory Interface:</b> LCD, Keyboard, External Memory RAM, ROM Interface, ADC, DAC Interface to 8051. <b>Serial Communication and Bus Interface:</b> Serial Communication Standards, Serial Data Transfer Scheme, On board Communication Interfaces-I2C Bus, SPI Bus, UART; External Communication Interfaces-RS232,USB.								
<b>UNIT: IV</b>	<b>ARM ARCHITECTURE</b>							

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, 2nd Edition 2006.
2. The 8051 Microcontroller, Kenneth. J. Ayala, Cengage Learning, 3rd Ed.
3. ARM System Developers guide, Andrew N SLOSS, Dominic SYMES, Chris WRIGHT, 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 8051 Microcontrollers, 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](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>B.TECH. III YEAR II SEMESTER</b>								
Course Code	Category	Hours/Week			Credits	Maximum Marks		
EE603PC	PCC	L	T	P	C	CIA	SEE	Total
		3	1	0	4	30	70	100
<b>Prerequisite:</b> Power System-I(EE405PC), Power System-II(EE502PC)								
<b>Course Objectives:</b> <ol style="list-style-type: none"> <li>2. To introduce all kinds of circuit breakers and relays</li> <li>3. To explain the voltage control and compensation methods</li> <li>4. To understand the phenomenon of Over Voltages and its classification</li> <li>5. To study Microprocessor Based Relays</li> </ol>								
<b>Course Outcomes:</b> Upon completing this course, the student will be able to <ol style="list-style-type: none"> <li>1. Compare electromagnetic, static and microprocessor-based relays</li> <li>2. Apply technology to protect power system components</li> <li>3. Interpret relay settings of over current and distance relays</li> <li>4. Evaluate quenching mechanisms used in air, oil and vacuum circuit breakers</li> <li>5. Analyze the testing of circuit breakers</li> </ol>								
<b>UNIT: I</b>	<b>PROTECTIVE RELAYS</b>							
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.								
<b>UNIT: II</b>	<b>OVER-CURRENT PROTECTION DISTANCE PROTECTION</b>							
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.								
<b>UNIT: III</b>	<b>PILOT RELAYING SCHEMES AC MACHINES AND BUS ZONE PROTECTION</b>							
Wire Pilot protection, Carrier current protection. AC Machines and Bus Zone Protection: Protection of Generators, Protection of transformers, Buszone protection, frame leakage protection.								
<b>UNIT: IV</b>	<b>STATIC RELAYS MICROPROCESSOR BASED RELAYS</b>							
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
<p>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.</p>	
<p><b>TEXT BOOKS:</b></p> <ol style="list-style-type: none"> <li>1. “Badriram”,” D.N. Vishwakarma”, Power System Protection and Switchgear, McGraw Hill Education; 2nd edition, 2017</li> <li>2. “Sunil S.Rao”, Switchgear Protection And Power Systems”, Khanna Publishers, 14th edition, 2019</li> </ol>	
<p><b>REFERENCE BOOKS:</b></p> <ol style="list-style-type: none"> <li>1. “U.A.Bakshi”, “M.V.Bakshi”, Switchgear and Protection, Technical Publications, 1st edition 2021</li> <li>2. “J.B. Gupta”, Fundamentals of Switchgear and Protection, S.K. Kataria&amp; Sons; 2013 edition, 2013</li> <li>3. “D.P. Kothari”, “I. J. Nagrath”, Modern Power System Analysis - Tata Mc Graw Hill Pub. Co., New Delhi, Fourth edition, 2011</li> </ol>	
<p><b>WEB REFERENCES:</b></p> <ol style="list-style-type: none"> <li>1. <a href="https://nptel.ac.in/courses/108/101/108101039/">https://nptel.ac.in/courses/108/101/108101039/</a></li> <li>2. <a href="https://nptel.ac.in/courses/108/105/108105167/">https://nptel.ac.in/courses/108/105/108105167/</a></li> </ol>	

## EE604PC: POWER SYSTEM OPERATION AND CONTROL

<b>B.TECH. III YEAR II SEMESTER</b>								
Course Code	Category	Hours/Week			Credits	Maximum Marks		
<b>EE604PC</b>	<b>PCC</b>	L	T	P	C	CIA	SEE	Total
		3	0	0	3	30	70	100
<b>Prerequisite:</b> Power System-I(EE405PC), Power System-II(EE502PC)								
<b>Course Objectives:</b> <ol style="list-style-type: none"> <li>1. To understand real power control and operation</li> <li>2. To know the importance of frequency control</li> <li>3. To analyze different methods to control reactive power</li> <li>4. To analyze different methods to control reactive power</li> </ol>								
<b>Course Outcomes:</b> Upon completing this course, the student will be able to <ol style="list-style-type: none"> <li>1. Analyze the optimal scheduling of power plants</li> <li>2. Analyze the steady state behavior of the power system for voltage and frequency fluctuations</li> <li>3. Describe reactive power control of a power system</li> <li>4. Design suitable controller to dampen the frequency and voltage steady state oscillations</li> <li>5. Analyze SCADA and EMS functions</li> </ol>								
<b>UNIT: I</b>	<b>LOAD –FREQUENCY CONTROL</b>							
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.								
<b>UNIT: II</b>	<b>REACTIVE POWER – VOLTAGE CONTROL</b>							
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.								
<b>UNIT: III</b>	<b>ECONOMIC LOAD DISPATCH</b>							
Statement of economic dispatch problem – cost of generation – incremental cost curve - co-ordination equations without loss and with loss, solution by direct method and $\lambda$ -iteration method.								
<b>UNIT: IV</b>	<b>UNIT COMMITMENT</b>							
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.								
<b>UNIT: V</b>	<b>COMPUTER CONTROL OF POWER SYSTEMS</b>							
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>B.TECH. III YEAR II SEMESTER</b>								
<b>Course Code</b>	<b>Category</b>	<b>Hours/Week</b>			<b>Credits</b>	<b>Maximum Marks</b>		
<b>EE611PE</b>	<b>PEC</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>	<b>CIA</b>	<b>SEE</b>	<b>Total</b>
		3	0	0	3	30	70	100
<b>Prerequisite:</b> Mathematics –I(MA101BS) & Mathematics –II(MA201BS)								
<p><b>Course Objectives:</b></p> <ol style="list-style-type: none"> <li>1. To introduce various optimization techniques like classical, linear programming, transportation problem, simplex algorithm, dynamic programming</li> <li>2. Constrained and unconstrained optimization techniques for solving and optimizing an electrical and electronic engineering circuits design problems in real world situations</li> <li>3. To learn characteristics of constrained problems</li> <li>4. To explain the concept of Dynamic programming and its applications to project implementation</li> </ol>								
<p><b>Course Outcomes:</b> After completion of this course, the student will be able to</p> <ol style="list-style-type: none"> <li>1. Explain the need of optimization of engineering systems</li> <li>2. Understand optimization of electrical and electronics engineering problems</li> <li>3. Apply classical optimization techniques, linear programming, simplex algorithm, transportation problem</li> <li>4. Compare and contrast different unconstrained optimization methods</li> <li>5. Develop algorithm using constrained non-linear programming and dynamic programming</li> </ol>								
<b>UNIT: I</b>	<b>CLASSICAL OPTIMIZATION TECHNIQUES</b>							
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.								
<b>UNIT: II</b>	<b>LINEAR PROGRAMMING</b>							
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. <b>Transportation Problem:</b> 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.								
<b>UNIT: III</b>	<b>UNCONSTRAINED OPTIMIZATION TECHNIQUES</b>							
One dimensional minimization methods, Classification, Fibonacci method and Quadratic interpolation method: Univariant method, Powell’s method and steepest descent method.								

<b>UNIT: IV</b>	<b>CONSTRAINED NONLINEAR PROGRAMMING</b>
<p>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.</p>	
<b>UNIT: V</b>	<b>DYNAMIC PROGRAMMING</b>
<p>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</p>	
<b>TEXT BOOKS:</b>	
<ol style="list-style-type: none"> <li>1. Singiresu S. Rao, Engineering Optimization: Theory and Practice by John Wiley and Sons, 4th edition, 2009.</li> <li>2. H. S. Kasene&amp; K. D. Kumar, Introductory Operations Research, Springer (India), Pvt. Ltd., 4th edition ,2004</li> </ol>	
<b>REFERENCE BOOKS:</b>	
<ol style="list-style-type: none"> <li>1. “George Bernard Dantzig”, “Mukund Narain Thapa”, Linear programming, Springer series in operations research 3rd edition, 2003.</li> <li>2. “H.A. Taha”, Operations Research: An Introduction, 8th Edition, Pearson/Prentice Hall, 2007.</li> <li>3. “KalyanmoyDeb”,Optimization for Engineering Design – Algorithms and Examples, PHI Learning Pvt. Ltd, New Delhi, 2005.</li> </ol>	
<b>WEB REFERENCES:</b>	
<ol style="list-style-type: none"> <li>1. <a href="https://nptel.ac.in/courses/111/105/111105039/">https://nptel.ac.in/courses/111/105/111105039/</a></li> </ol>	

## EE612PE: WIND AND SOLAR ENERGY SYSTEMS

### (Professional Elective II)

<b>B.TECH. III YEAR II SEMESTER</b>								
Course Code	Category	Hours/Week			Credits	Maximum Marks		
<b>EE612PE</b>	<b>PEC</b>	L	T	P	C	CIA	SEE	Total
		3	0	0	3	30	70	100
<b>Prerequisite:</b> Nil								
<b>Course Objectives:</b>								
<ol style="list-style-type: none"> <li>1. To study the physics of wind power and energy</li> <li>2. To understand the principle of operation of wind generators</li> <li>3. To know the solar power resources</li> <li>4. To analyze the solar photo-voltaic cells</li> <li>5. To discuss the solar thermal power generation</li> </ol>								
<b>Course Outcomes:</b> Upon completing this course, the student will be able to								
<ol style="list-style-type: none"> <li>1. Understand the energy scenario and the consequent growths of the power generate renewable energy sources.</li> <li>2. Identify the basic physics of wind and solar power generation.</li> <li>3. Apply the power electronic interfaces for wind and solar generation.</li> <li>4. Understand the issues related to the grid-integration of solar and wind energy systems.</li> <li>5. Identify the network integration issues.</li> </ol>								
<b>UNIT: I</b>	<b>PHYSICS OF WIND POWER</b>							
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.								
<b>UNIT: II</b>	<b>WIND GENERATOR TOPOLOGIES</b>							
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.								
<b>UNIT: III</b>	<b>SOLAR ENERGY TECHNOLOGIES</b>							
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.								
<b>UNIT: IV</b>	<b>NETWORK INTEGRATION ISSUES</b>							
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.								
<b>UNIT: V</b>	<b>SOLAR THERMAL POWER GENERATION</b>							
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>B.TECH. III YEAR II SEMESTER</b>								
<b>Course Code</b>	<b>Category</b>	<b>Hours/Week</b>			<b>Credits</b>	<b>Maximum Marks</b>		
		<b>L</b>	<b>T</b>	<b>P</b>		<b>C</b>	<b>CIA</b>	<b>SEE</b>
<b>EE613PE</b>	<b>PEC</b>							
		3	0	0	3	30	70	100
<b>Prerequisite:</b> Control Systems(EE404PC)								
<b>Course Objectives:</b>								
<ol style="list-style-type: none"> <li>1. To understand the fundamentals of digital control systems representations, z-transforms and discrete complex domain.</li> <li>2. To understand the concepts of state variables analysis for discrete LTIV systems.</li> <li>3. To understand the concepts of controllability and observability of discrete time systems</li> <li>4. To get exposed the design aspects of controllers and for discrete time systems</li> <li>5. To understand the concepts of the stability for discrete LTIV systems</li> </ol>								
<b>Course Outcomes:</b> At the end of this course, students will demonstrate the ability to								
<ol style="list-style-type: none"> <li>1. Obtain discrete representation of LTI systems.</li> <li>2. Find the state space analysis of discrete time systems.</li> <li>3. Test and analyze the controllability and observability for discrete time systems</li> <li>4. Analyze stability of discrete time systems using various methods</li> <li>5. Design state feedback controllers and observers.</li> </ol>								
<b>UNIT: I</b>	<b>REPRESENTATION OF DISCRETE TIME SYSTEMS</b>							
<p>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.</p> <p>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.</p>								
<b>UNIT: II</b>	<b>DISCRETE TIME STATE SPACE ANALYSIS</b>							
<p>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 &amp; observability.</p>								
<b>UNIT: III</b>	<b>STABILITY ANALYSIS OF DISCRETE TIME SYSTEM</b>							
<p>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.</p>								

<b>UNIT: IV</b>	<b>DESIGN OF DIGITAL CONTROL SYSTEM BY CONVENTIONAL METHODS</b>
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.	
<b>UNIT: V</b>	<b>DESIGN STATE FEEDBACK CONTROLLERS AND OBSERVERS</b>
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.	
<b>TEXT BOOKS:</b>	
<ol style="list-style-type: none"> <li>1. “K. Ogata”, Digital Control Engineering, Prentice Hall, Englewood Cliffs, 1995.</li> <li>2. “M. Gopal”, Digital Control Engineering, Wiley Eastern, 1988.</li> <li>3. “V, I, George”.”C. P. Kurian”, Digital Control Systems, CENGAGE Learning, 2012</li> </ol>	
<b>REFERENCE BOOKS:</b>	
<ol style="list-style-type: none"> <li>1. “G. F. Franklin”, “J. D. Powell”, “M. L. Workman”, Digital Control of Dynamic Systems, Addison-Wesley, 1998.</li> <li>2. “B.C. Kuo”, Digital Control System, Holt, Rinehart and Winston, 1980.</li> </ol>	
<b>WEB REFERENCES:</b>	
<ol style="list-style-type: none"> <li>1. <a href="https://nptel.ac.in/courses/108/103/108103008/">https://nptel.ac.in/courses/108/103/108103008/</a></li> </ol>	

**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
EE614PE	PEC	3	0	0	3	30	70	100
<b>Prerequisite :</b> Digital Electronics(EE403PC)								
<p><b>Course Objectives :</b></p> <ol style="list-style-type: none"> <li>1. Give exposure to different steps involved in the fabrication of ICs using MOS transistor, CMOS/BICMOS transistors.</li> <li>2. Explain electrical properties of MOS and BiCMOS devices to analyze the behavior of inverters designed with various loads.</li> <li>3. Give exposure to the design rules to be followed to draw the layout of any logic circuit.</li> <li>4. Provide concept to design different types of logic gates using CMOS inverter and analyze their transfer characteristics.</li> <li>5. Provide design concepts to design building blocks of data path of any system using gates.</li> <li>6. Understand basic programmable logic devices and testing of CMOS circuits.</li> </ol>								
<p><b>Course Outcomes :</b> Upon successful completion of the course, students will be able to:</p> <ol style="list-style-type: none"> <li>1. Acquire qualitative knowledge about the fabrication process of integrated circuits using MOS transistors.</li> <li>2. Draw the layout of any logic circuit which helps to understand and estimate parasitic of any logic circuit</li> <li>3. Design different types of logic gates using CMOS inverter and analyze their transfer characteristics</li> <li>4. Design building blocks of data path subsystems and memories using basic digital logic devices.</li> <li>5. Design simple logic circuits using PLA,PAL, FPGA and CPLD</li> <li>6. Understand different types of faults that can occur in a system and learn the concept of testing.</li> </ol>								
<b>UNIT- I</b>		<b>INTRODUCTION</b>						
<p><b>Introduction to IC Technology – MOS, PMOS, NMOS, CMOS &amp; BiCMOS.</b></p> <p><b>Basic Electrical Properties of MOS and BiCMOS Circuits:</b> 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.</p>								
<b>UNIT- II</b>		<b>VLSI CIRCUIT DESIGN PROCESSES</b>						
<p><b>VLSI Circuit Design Processes:</b>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.</p>								
<b>UNIT- III</b>		<b>GATE LEVEL DESIGN</b>						
<p><b>Gate Level Design :</b>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</p>								
<b>UNIT- IV</b>		<b>DATA PATH SUBSYSTEMS &amp; ARRAY SUBSYSTEMS</b>						
<p><b>Data Path Subsystems:</b> Subsystem Design, Shifters, Adders, ALUs, Multipliers, Parity generators, Comparators, Zero/One Detectors, Counters.</p> <p><b>Array Subsystems:</b> SRAM, DRAM, ROM, Serial Access Memories</p>								
<b>UNIT- V</b>		<b>PROGRAMMABLE LOGIC DEVICES &amp; CMOS TESTING</b>						

**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, EshraghianDouglas 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](https://books.google.co.in/books?id=CO8zq6_vcr8C&printsec=frontcover)

## EE605PC: ELECTRICAL SYSTEMS SIMULATION LAB

<b>B.TECH. III YEAR II SEMESTER</b>								
Course Code	Category	Hours/Week			Credits	Maximum Marks		
EE605PC	PCC	L	T	P	C	CIA	SEE	Total
		0	0	2	1	30	70	100
<b>Prerequisite:</b> Power System-I(EE405PC), Power System-II(EE502PC), <b>Softwares Required:</b> MATLAB/PSCAD/PSPICE/PSIM								
<b>Course Objectives:</b> <ol style="list-style-type: none"> <li>1. To perform voltage distributions across insulator strings</li> <li>2. To understand the high frequency transients</li> <li>3. To perform parameter estimation and fault analysis on Transmission lines</li> <li>4. To perform parameter estimation and fault analysis on Transmission lines</li> </ol>								
<b>Course Outcomes:</b> Upon completing this course, the student will be able to <ol style="list-style-type: none"> <li>1. Analyze various transmission line calculations</li> <li>2. Determine time constants for RL, RC and RLC circuits</li> <li>3. analyze the Voltage distribution across insulator string</li> <li>4. Determine fault currents of transmission line</li> <li>5. Analyze the experimental data and draw the conclusions</li> </ol>								
<b>List of Experiments:</b> <ol style="list-style-type: none"> <li>1. Generation of high frequency transients through RLC circuit</li> <li>2. Voltage distribution across insulator string</li> <li>3. Comparison of lumped and distributed transmission lines</li> <li>4. Calculation of fault currents of transmission line</li> <li>5. Time constant calculation of RL circuit</li> <li>6. Time constant calculation of RC circuit</li> <li>7. Time constant calculation of RLC circuit</li> <li>8. Simulation of Resonance circuit</li> <li>9. Calculation of R, L, C, Zs of 3-phase Transmission Line</li> <li>10. Estimation of TARIFF based on load curve</li> </ol>								

## EE606PC: MICROPROCESSORS AND MICROCONTROLLERS LAB

<b>B.TECH. III YEAR II SEMESTER</b>								
<b>Course Code</b>	<b>Category</b>	<b>Hours/Week</b>			<b>Credits</b>	<b>Maximum Marks</b>		
<b>EE606PC</b>	<b>ESC</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>	<b>CIA</b>	<b>SEE</b>	<b>Total</b>
		0	0	2	1	30	70	100
<b>Prerequisite:</b> Digital Electronics(EE403PC)								
<b>Course Objectives:</b> <ol style="list-style-type: none"> <li>1. To develop an understanding of the Assembly language programming on 8086Microprocessor.</li> <li>2. To develop an understanding of the interfacing techniques with 8086 Microprocessor.</li> <li>3. To develop an understanding of the Assembly language programming using Keil IDE on 8051<math>\mu</math>c.</li> <li>4. To develop an understanding of the interfacing techniques with 8051 Microcontroller.</li> </ol>								
<b>Course Outcomes:</b> Upon completing this course, the student will be able to <ol style="list-style-type: none"> <li>1. Understand and apply the knowledge of addressing modes, instruction set &amp; assembler directives of 8086 to perform arithmetic operations, sorting &amp; String programs using MASM.</li> <li>2. Design &amp; test the function of Stepper motor and 8255 by interfacing with 8086.</li> <li>3. Understand and apply the knowledge of addressing modes, instruction set of 8051 to perform arithmetic, logical &amp; bit manipulation programs using Keil.</li> <li>4. Able to verify the operation of timer/counter/UART/interrupt handler in 8051.</li> </ol>								
<b>List of Experiments:</b> <p style="margin-left: 20px;"><b>Cycle 1: Using 8086 Processor Kits and/or Assembler (6 Weeks)</b></p> <ol style="list-style-type: none"> <li>1. Assembly Language Programs to perform Arithmetic, Logical, and String Operations.</li> <li>2. Assembly Language Programs to perform Rotate, Shift, Swap and Branch Operations.</li> <li>3. Interfacing stepper motor, ADC &amp; DAC to 8086.</li> </ol> <p style="margin-left: 20px;"><b>Cycle 2: Using Keil IDE- (5 weeks)-</b></p> <ol style="list-style-type: none"> <li>1. Assembly Language Programs to Perform Arithmetic, Logical Operations.</li> <li>2. Assembly Language Programs to perform Rotate, Shift, Swap and Branch Instructions</li> <li>3. Time delay Generation Using Timers of 8051.</li> <li>4. UART operation (Serial communication) in 8051.</li> <li>5. Program and verify interrupt handling in 8051.</li> </ol> <p style="margin-left: 20px;"><b>Cycle 3: Interfacing I/O Devices to 8051 (5 Weeks)</b></p> <ol style="list-style-type: none"> <li>1. Interfacing LCD to 8051</li> <li>2. Interfacing Matrix Keyboard to 8051</li> <li>3. Interfacing 8-bit ADC to 8051.</li> <li>4. Interfacing DAC to 8051.</li> </ol>								
<b>List of Equipment/Software (with Specifications or Range) Required:</b> <ol style="list-style-type: none"> <li>1. Computer Systems(Intel) with Windows 7 or higher Operating System</li> <li>2. MASM 611 Software (Open source)</li> <li>3. Keil <math>\mu</math>Vision IDE Software (Open Source)</li> <li>4. 8086 <math>\mu</math>p kits, stepper motor interfacing module, 8051 <math>\mu</math>c kits, LCD interfacing module, Matrix Keyboard interfacing module, ADC interfacing module, DAC interfacing module.</li> </ol>								

## EE607PC: DIGITAL SIGNAL PROCESSING LAB

<b>B.TECH. III YEAR II SEMESTER</b>									
<b>Course Code</b>	<b>Category</b>	<b>Hours/Week</b>			<b>Credits</b>	<b>Maximum Marks</b>			
<b>EE607PC</b>	<b>ESC</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>	<b>CIA</b>	<b>SEE</b>	<b>Total</b>	
		0	0	2	1	30	70	100	
<b>Prerequisite:</b> Nil									
<p><b>Course Objectives:</b></p> <ol style="list-style-type: none"> <li>1. To Generate and characterize various continuous and discrete time signals</li> <li>2. Find frequency response of systems</li> <li>3. Design of digital IIR and FIR filters</li> <li>4. To implement Laplace transform on a given signal</li> </ol>									
<p><b>Course Outcomes:</b> Upon completing this course, the student will be able to</p> <ol style="list-style-type: none"> <li>1. Understand basics of MATLAB syntax, functions and programming</li> <li>2. Generate and characterize various continuous and discrete time signals.</li> <li>3. Analyze the spectral characteristics of signals using Fourier analysis.</li> <li>4. Analyze the systems using Laplace transform and Z-transform.</li> <li>5. Design and simulate Digital IIR and FIR filter using MATLAB</li> <li>6. Analyse frequency response for the given system</li> </ol>									
<p><b>List of Experiments:</b></p> <ol style="list-style-type: none"> <li>1. Basic Operations on Matrices.</li> <li>2. Generation of Various Signals and Sequences (Periodic and Aperiodic), such as Unit Impulse, Unit Step, Square, Saw tooth, Triangular, Sinusoidal, Ramp, Sinc.</li> <li>3. Operations on Signals and Sequences such as Addition, Multiplication, Scaling, Shifting, Folding, Computation of Energy and Average Power.</li> <li>4. Finding the Even and Odd parts of Signal/Sequence and Real and Imaginary parts of Signal.</li> <li>5. Convolution for Signals and sequences.</li> <li>6. Verification of Linearity and Time Invariance Properties of a given Continuous/Discrete System.</li> <li>7. Finding the Fourier Transform of a given signal and plotting its magnitude and phase spectrum.</li> <li>8. Waveform Synthesis using Laplace Transform.</li> <li>9. Locating the Zeros and Poles and plotting the Pole-Zero maps in S-plane and Z-Plane for the given transfer function.</li> <li>10. Verification of Sampling Theorem.</li> <li>11. To find Frequency Response of a given System given in Transfer Function/ Differential equation form.</li> <li>12. Implementation of LP FIR Filter for a given Sequence/Signal.</li> <li>13. Implementation of HP IIR Filter for a given Sequence/Signal</li> <li>14. Impulse Response of First order and Second Order Systems.</li> </ol>									
<p><b>List of Equipment/Software(with Specifications or Range) Required:</b>            The Programs shall be implemented in Software (Using MATLAB / Lab View / C Programming/ Equivalent)</p>									

## MC610: CYBER SECURITY

B.TECH. III YEAR I SEMESTER								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
MC610	MC	L	T	P	C	CIA	SEE	Total
		3	0	0	0	0	100	0
<b>Prerequisite:</b> NIL								
<b>Course Objectives:</b> <ol style="list-style-type: none"> <li>To familiarize various types of cyber-attacks and cyber-crimes</li> <li>To give an overview of the cyber laws</li> <li>To study the defensive techniques against these attacks</li> </ol>								
<b>Course Outcomes:</b> After completion of this course the student is able to <ol style="list-style-type: none"> <li>Cyber-attacks, types of cybercrimes, cyber laws and also how to protect them self and ultimately the entire Internet community from such attacks.</li> </ol>								
<b>UNIT: I</b>	<b>INTRODUCTION TO CYBER SECURITY</b>							
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.								
<b>UNIT: II</b>	<b>CYBERSPACE AND THE LAW &amp; CYBER FORENSICS</b>							
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.								
<b>UNIT: III</b>	<b>CYBERCRIME</b>							
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.								
<b>UNIT: IV</b>	<b>CYBER SECURITY</b>							

Introduction, Single-Variable Optimization, Multivariable Optimization with No Constraints, Multivariable Optimization with Equality Constraints, Multivariable Optimization with Inequality Constraints, Convex Programming Problem.	
<b>UNIT: II</b>	<b>LINEAR PROGRAMMING:</b>
Introduction, Revised Simplex Method, Duality in Linear Programming, Decomposition Principle, Sensitivity or Postoptimality Analysis, Transportation Problem, Karmarkar's Method, Quadratic Programming	
<b>UNIT: III</b>	<b>NON-LINEAR PROGRAMMING</b>
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.	
<b>Unit: IV</b>	<b>GEOMETRIC PROGRAMMING</b>
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.	
<b>Unit: V</b>	<b>DYNAMIC PROGRAMMING</b>
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.	
<b>TEXT BOOKS:</b>	
<ol style="list-style-type: none"> <li>1. "C B Gupta", Optimization Techniques in Operations Research, 1st Edition, I K International Publications, New Delhi, 2013.</li> <li>2. "Singireshel S Rao", Engineering Optimizations, 4th Edition, Elsevier Butterworth, Heineman, USA, 2011.</li> </ol>	
<b>REFERENCE BOOKS:</b>	
<ol style="list-style-type: none"> <li>1. "Jasibir Arora", Introduction to Optimum Design, 4th Edition, Academic press in an Imprint of Elsevier, USA, 2016.</li> <li>2. "N V S Raju", Optimization Methods for Engineering, 1st edition, PHI Publications, New Delhi, 2014</li> <li>3. "Edwin K", "P Chang", "Stanislaw H. Zak", An Introduction to Optimization, 3rd Edition, Jhon Wiley, New York, 2013</li> </ol>	
<b>WEB REFERENCES:</b>	
<ol style="list-style-type: none"> <li>1. <a href="https://nptel.ac.in/courses/111/105/111105039/">https://nptel.ac.in/courses/111/105/111105039/</a></li> <li>2. <a href="https://www.udemy.com/course/optimization-for-engineering-students">https://www.udemy.com/course/optimization-for-engineering-students</a></li> </ol>	

**EE600OE: RENEWABLE ENERGY SOURCES**  
(Open Elective-I)

B.TECH. III YEAR II SEMESTER								
Course Code	Category	Hours/Week			Credits	Maximum Marks		
EE600OE	OEC	L	T	P	C	CIA	SEE	Total
		3	0	0	3	30	70	100
<b>Prerequisite:</b> NIL								
<b>Course Objectives:</b>								
<ol style="list-style-type: none"> <li>1. To develop the awareness of energy conservation</li> <li>2. To identify the use of renewable energy sources for electrical power generation</li> <li>3. To classify different energy storage methods.</li> <li>4. To explain about environmental effects of energy conversion.</li> </ol>								
<b>Course Outcomes:</b> Upon completing this course, the student will be able to								
<ol style="list-style-type: none"> <li>1. Understand the principles of wind power and solar photovoltaic power generation, fuel cells.</li> <li>2. Assess the cost of generation for conventional and renewable energy plants</li> <li>3. Design suitable power controller for wind and solar applications</li> <li>4. Analyze the issues involved in the integration of renewable energy sources to the grid</li> <li>5. Discuss the various energy storage methods.</li> </ol>								
<b>UNIT: I</b>	<b>ECONOMICS RENEWABLE ENERGY</b>							
<p>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.</p> <p><b>Wind Power Plants:</b> 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.</p>								
<b>UNIT: II</b>	<b>PHOTOVOLTAIC POWER PLANTS AND FUEL CELLS</b>							
<p>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.</p> <p>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.</p>								
<b>UNIT: III</b>	<b>INDUCTION GENERATORS</b>							
<p>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.</p>								
<b>UNIT: IV</b>	<b>STORAGE SYSTEMS</b>							

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>B.TECH. III YEAR II SEMESTER</b>								
Course Code	Category	Hours/Week			Credits	Maximum Marks		
<b>EE601OE</b>	<b>OEC</b>	L	T	P	C	CIA	SEE	Total
		3	0	0	3	30	70	100
<b>Prerequisite:</b> Laplace Transforms, Numerical Methods and Complex variables (MA401BS)								
<b>Course Objectives:</b> <ol style="list-style-type: none"> <li>1. To understand the basic concepts of reliability, various models of reliability</li> <li>2. To analyze reliability of various systems</li> <li>3. To discuss the concept of Discrete Markov Chains</li> <li>4. To explain the techniques of frequency and duration for reliability evaluation of repairable Systems</li> </ol>								
<b>Course Outcomes:</b> Upon completing this course, the student will be able to <ol style="list-style-type: none"> <li>1. Discuss various systems of reliability networks</li> <li>2. Evaluate the reliability of simple and complex systems</li> <li>3. Estimate the limiting state probabilities of repairable systems</li> <li>4. Apply various distribution functions for reliability evaluation.</li> <li>5. Apply various mathematical models for evaluating reliability of irreparable systems</li> </ol>								
<b>UNIT: I</b>	<b>BASIC PROBABILITY THEORY</b>							
Elements of probability, probability distributions, Random variables, Density and Distribution functions- Mathematical expected – variance and standard deviation Binomial Distribution: Concepts, properties, engineering applications.								
<b>UNIT: II</b>	<b>NETWORK MODELING AND EVALUATION OF SIMPLE SYSTEMS</b>							
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								
<b>UNIT: III</b>	<b>PROBABILITY DISTRIBUTIONS IN RELIABILITY EVALUATION</b>							
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.								
<b>Network Reliability Evaluation Using Probability Distributions:</b> Reliability Evaluation of Series systems, Parallel systems – Partially redundant systems- determination of reliability measure- MTTF for series and parallel systems – Examples.								
<b>UNIT: IV</b>	<b>DISCRETE MARKOV CHAINS</b>							
Basic concepts- Stochastic transitional probability matrix- time dependent probability evaluation- Limiting State Probability evaluation- Absorbing states – Application.								
<b>Continuous Markov Processes:</b> Modeling concepts- State space diagrams- Unreliability evaluation of single and two component repairable systems								
<b>UNIT: V</b>	<b>FREQUENCY AND DURATION TECHNIQUES</b>							
Frequency and duration concepts, application to multi state problems, Frequency balance approach.								
<b>Approximate System Reliability Evaluation:</b> 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/>