

**III YEAR I SEMESTER**

S. No.	Course Code	Course Title	L	T	P	Credits
1	EE501PC	Power Electronics	3	1	0	4
2	EE502PC	Control Systems	3	1	0	4
3	EE503PC	Microprocessors & Microcontrollers	3	0	0	3
4		Professional Elective-I	3	0	0	3
5	SM504MS	Business Economics and Financial Analysis	3	0	0	3
6	EE505PC	Microprocessors & Microcontrollers Laboratory	0	0	2	1
7	EE506PC	Power Electronics Laboratory	0	0	2	1
8	EN508HS	Advanced English Communication Skills Laboratory	0	0	2	1
9	*MC510	Intellectual Property Rights	3	0	0	0
		<b>Total Credits</b>	<b>18</b>	<b>2</b>	<b>6</b>	<b>20</b>

**III YEAR II SEMESTER**

S. No	Course Code	Course Title	L	T	P	Credits
1		Open Elective-I	3	0	0	3
2		Professional Elective-II	3	0	0	3
3	EE601PC	Digital Signal Processing	3	0	0	3
4	EE602PC	Power System Protection	3	0	0	3
5	EE603PC	Power System Operation and Control	3	0	0	3
6	EE604PC	Power System Laboratory	0	0	2	1
7	EE605PC	Control Systems Laboratory	0	0	2	1
8	EE606PC	Digital Signal Processing Lab	0	0	2	1
9	EE607PC	Industry Oriented Mini Project/Internship	0	0	4	2
10	*MC609	Environmental Science	3	0	0	0
		<b>Total Credits</b>	<b>18</b>	<b>0</b>	<b>10</b>	<b>20</b>

**Environmental Science in III Yr II Sem Should be Registered by Lateral Entry Students Only.**

**\*MC–Satisfactory/Unsatisfactory**

## EE501PC: POWER ELECTRONICS

III Year B.Tech. EEE I-Sem

L T P C  
3 1 0 4

**Prerequisite:** Analog Electronics, Digital Electronics

**Course Objectives:**

- To understand the various power semiconductor devices operations.
- To know the AC-DC, AC-AC power conversions.
- To know the DC-DC, DC-AC power conversions.

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

- Understand the differences between signal level and power level devices.
- Analyze controlled rectifier circuits.
- Analyze the operation of DC-DC choppers and voltage source inverters.

**UNIT-I:**

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

**UNIT-II:**

**AC-DC Converters (Phase Controlled Rectifiers):** Principles of single-phase fully-controlled converter with R, RL, and RLE load, Principles of single-phase half-controlled converter with RL and RLE load, Principles of three-phase fully-controlled converter operation with RLE load, Effect of load and source inductances, General idea of gating circuits, Single phase and Three phase dual converters

**UNIT-III:**

**DC-DC Converters (Chopper/SMPS):** Introduction, elementary chopper with an active switch and diode, concepts of duty ratio, average inductor voltage, average capacitor current. Buck converter - Power circuit, analysis and waveforms at steady state, duty ratio control of output voltage. Boost converter - Power circuit, analysis and waveforms at steady state, relation between duty ratio and average output voltage. Buck-Boost converter - Power circuit, analysis and waveforms at steady state, relation between duty ratio and average output voltage.

**UNIT-IV:**

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

**UNIT-V:**

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

**TEXT BOOKS:**

1. M. H. Rashid, "Power electronics: circuits, devices, and applications", Pearson Education India, 2009.
2. N. Mohan and T. M. Undeland, "Power Electronics: Converters, Applications and Design", John Wiley & Sons, 2007.

**REFERENCE BOOKS:**

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

## EE502PC: CONTROL SYSTEMS

III Year B.Tech. EEE I-Sem

L T P C

3 1 0 4

**Prerequisite:** Matrix Algebra and Calculus, Applied and Multivariable Calculus, Numerical Methods and Complex Variables, Fundamental physical laws

### Course objectives:

- Understand the mathematical modeling of physical systems.
- Comprehend the representation of dynamical systems through input-output models, including transfer functions and state-space models.
- Understand the design of controllers and compensators to enhance the performance and stability of dynamical systems

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

- Find the transfer function and state-space representation of linear time-invariant dynamical systems.
- Analyze the performance and stability of linear time-invariant systems in both time and frequency domains.
- Design classical controllers/compensators to improve the performance and stability of linear time-invariant systems.

### UNIT-I:

**Modeling of Physical Systems and Their Representations:** Industrial and domestic Control examples. Mathematical modeling of physical systems: Mechanical and Electrical Systems, Concept of Control Systems Configurations: Open — loop and Closed loop Systems, Introduction to types of Systems: Linear, Non-Linear, Time Varying and Time Invariant. Representation of Linear time-invariant Systems through Input-output Models: Transfer function, Block-diagram Techniques, Signal flow graph. Concept of Feedback Control, Benefits of Feedback and Effects of feedback. Controller Components: DC Servo motors, AC Servomotors, Synchros.

### UNIT-II:

**TIME – Domain Analysis With Input-Output Models:** Time response of first and second order systems for standard test inputs. Analysis of standard Second order systems with step input, Types of System, Error Analysis for Linear time Invariant Systems, Design specifications for second-order systems based on the time-response.

Concept of Stability. Routh-Hurwitz Criteria. Relative Stability analysis. Root-Locus technique. Construction of Root-loci.

**UNIT-III:**

**Frequency Domain Analysis:** Introduction to frequency response, Relationship between time and frequency response, Polar plots, Nyquist stability criterion. Relative stability using Nyquist criterion — gain and phase margin. Concept of Bode plots and construction. Closed-loop frequency response.

**UNIT-IV:**

**Introduction To Design Of Classical Controllers And Compensators:** Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness of control systems. Root-loci method of feedback controller design. Design specifications in frequency-domain. Frequency-domain methods of design. Application of Proportional, Integral and Derivative Controllers, Lead and Lag compensation in designs. Analog and Digital implementation of controllers.

**UNIT-V:**

**State Variable Analysis And Design:** Concept of State, State variables and State model. State – State Representation, Transformation of State variables, Solution of state equations and Complete response of the Systems. Stability Analysis of Linear Systems. Concept of controllability and observability. Design of State feedback Controllers through Pole-placement.

**TEXT BOOKS:**

1. M. Gopal, “Control Systems: Principles and Design”, McGraw Hill Education, 1997.
2. B. C. Kuo, “Automatic Control System”, Prentice Hall, 1995.

**REFERENCE BOOKS:**

1. K. Ogata, “Modern Control Engineering”, Prentice Hall, 1991.
2. I. J. Nagrath and M. Gopal, “Control Systems Engineering”, New Age International, 2009.

## EE503PC: MICROPROCESSORS & MICROCONTROLLERS

III Year B.Tech. EEE I-Sem

L T P C

3 0 0 3

**Prerequisite:** Programming, Digital Electronics

**Course Objectives:**

- To develop an understanding of the operations of microprocessors and micro controllers
- To understand machine language programming and interfacing techniques.
- To gain knowledge about input output and memory systems.

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

- Understand the internal architecture and organization of 8086, 8051 and ARMprocessors/controllers.
- Understand the interfacing techniques to 8086 and 8051
- Develop assembly language programming to design microprocessor/ micro controller-based systems.

**UNIT-I:**

8086 Architecture-Pin diagram, Register Organization, Memory Segmentation, Programming Model, Modes of operation, Timing diagrams, Memory addresses, Physical Memory Organization, 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, Software Debugging tools, MDS.

**UNIT-II:**

**I/O Interface:** 8255 PPI, Various modes of operations and interface of I/O devices to 8086, A/D, D/A Converter Interfacing.

**Interfacing With Advanced Devices:** 8086 System bus structure, Memory and I/O Interfacing with 8086, Interfacing through various IC Peripheral Chips, 8257 (DMA Controller), 8259 (Interrupt Priority Control).

**UNIT-III:**

**Communication Interface:** Serial Communication Standards, USART Interfacing RS-232, IEEE-488, 20mA Current Loop, Prototyping and Troubleshooting,

**UNIT-IV:**

**Introduction To Micro Controllers:** Overview of 8051 Micro Controller, Architecture, I/O ports and Memory Organization, addressing modes and Instruction set of 8051, Simple Programs using Stack Pointer, Assembly language programming of 8051

**Interrupts Communication:** Interrupts - Timer/Counter and Serial Communication, Interrupt Priority in the 8051, Programming of 8051- Timers, Counters and Interrupts.

**UNIT-V:**

**Interfacing And Industrial Applications:** Applications of Micro Controllers, Interfacing 8051 to LED's, Keyboard Interfacing, Interfacing Seven Segment Display, ADC and DAC Interfacing, Stepper Motor Interfacing

**TEXT BOOKS:**

1. Advanced Microprocessors and Peripherals – A. K. Ray and K.M. Bhurchandani, MHE, 2<sup>nd</sup> Edition 2006.
2. The 8051 Microcontroller, Kenneth. J. Ayala, Cengage Learning, 3<sup>rd</sup> Ed.

**REFERENCE BOOKS:**

1. ARM System Developers guide, Andrew N SLOSS, Dominic SYMES, Chris WRIGHT, Elsevier, 2012
2. Microprocessors and Interfacing, D. V. Hall, MGH, 2<sup>nd</sup> 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.

**EE511PE: IOT APPLICATIONS IN ELECTRICAL ENGINEERING**  
**(Professional Elective-I.1)**

**III Year B.Tech. EEE I-Sem**

**L T P C**  
**3 0 0 3**

**Prerequisite:** Programming, Digital Electronics

**Course Objectives:**

- To learn about a few applications of Internet of Things and distinguish between motion less and motion detectors as IoT applications
- To know about Micro Electro Mechanical Systems (MEMS) fundamentals in design and fabrication process
- To understand about applications of IoT in smart grid and new concept of IoE for various applications

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

- To get exposed to recent trends in few applications of IoT in Electrical Engineering
- To understand about usage of various types of motionless sensors and motion detectors
- To get exposed to various applications of IoT in smart grid
- To get exposed to future working environment with Energy internet

**UNIT-I:**

**Sensors:** Definitions, Terminology, Classification, Temperature sensors, Thermoresistive, Resistance, temperature detectors, Silicon resistive thermistors, Semiconductor, Piezoelectric, Humidity and moisture sensors. Capacitive, Electrical conductivity, Thermal conductivity, time domain reflectometer, Pressure and Force sensors: Piezoresistive, Capacitive, force, strain and tactile sensors, Strain gauge, Piezoelectric.

**UNIT-II:**

**Occupancy and Motion detectors:** Capacitive occupancy, Inductive and magnetic, potentiometric - Position, displacement and level sensors, Potentiometric, Capacitive, Inductive, magnetic velocity and acceleration sensors, Capacitive, Piezoresistive, piezoelectric cables, Flow sensors, Electromagnetic, Acoustic sensors -Resistive microphones, Piezoelectric, Photo resistors.

**UNIT-III:**

**MEMS:** Basic concepts of MEMS design, Beam/diaphragm mechanics, electrostatic actuation and fabrication, Process design of MEMS based sensors and actuators, Touch sensor, Pressure sensor, RF MEMS switches, Electric and Magnetic field sensors.

**UNIT-IV:**

**IoT for Smart grid:** Driving factors, Generation level, Transmission level, Distribution level, Applications, Metering and monitoring applications, Standardization and interoperability, Smart home.

**UNIT-V:**

**Internet of Energy:** Concept of Internet of Energy, Evaluation of IoE concept, Vision and motivation of IoE, Architecture, Energy routines, information sensing and processing issues, Energy internet as smart grid.

**TEXT BOOKS:**

1. Jon S. Wilson, "Sensor Technology Hand book", Newnes Publisher, 2004
2. Tai Ran Hsu, "MEMS and Microsystems: Design and manufacture", 1<sup>st</sup> Edition, McGraw hill Education, 2017
3. Ersan Kabalci and Yasin Kabalci, "From Smart grid to Internet of Energy", 1<sup>st</sup> Edition, Academic Press, 2019.

**REFERENCE BOOKS:**

1. Raj Kumar Buyya and Amir Vahid Dastjerdi, "Internet of Things: Principles and Paradigms", Kindle Edition, Morgan Kaufmann Publisher, 2016
2. Yen Kheng Tan and Mark Wong, "Energy Harvesting Systems for IoT Applications": Generation, Storage and Power Management, 1<sup>st</sup> Edition, CRC Press, 2019
3. RMD Sundaram Shriram, K. Vasudevan and Abhishek S. Nagarajan, "Internet of Things", Wiley, 2019.

## EE512PE: HIGH VOLTAGE ENGINEERING

(Professional Elective-I.2)

III Year B.Tech. EEE I-Sem

L T P C

3 0 0 3

**Prerequisite:** Power Systems – I, Electro Magnetic Fields

### Course Objectives:

- To deal with the detailed analysis of Breakdown occurring in gaseous, liquids and solid dielectrics
- To inform about generation and measurement of High voltage and current
- To introduce High voltage testing methods

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

- Understand the basic physics related to various breakdown processes in solid, liquid and gaseous insulating materials, generation and measurement of D. C., A.C., & Impulse voltages.
- Knowledge of tests on H. V. equipment and on insulating materials, as per the standards.
- Knowledge of how over-voltages arise in a power system, and protection against these over-voltages.

### 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 overvoltage's, 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 (Translated by Dr. M. P. Chourasia), "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.

**EE513PE: COMPUTER AIDED ELECTRICAL MACHINE DESIGN**  
**(Professional Elective-I.3)**

**III Year B.Tech. EEE I-Sem**

**L T P C**  
**3 0 0 3**

**Prerequisite:** Electrical Machines-I, Electrical Machines-II

**Course Objectives:**

- To know the major considerations in electrical machine design, electrical engineering materials, space factor, choice of specific electrical and magnetic loadings,
- To analyze the thermal considerations, heat flow, temperature rise, rating of machines.
- To understand the design of machines and CAD design concepts

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

- Understand the construction and performance characteristics of electrical machines.
- Understand the various factors which influence the design: electrical, magnetic and thermal loading of electrical machines
- Understand the principles of electrical machine design and carry out a basic design of an ac machine using software tools.

**UNIT-I:**

**Introduction:** Major considerations in electrical machine design, electrical engineering materials, space factor, choice of specific electrical and magnetic loadings, thermal considerations, heat flow, temperature rise, rating of machines.

**UNIT-II:**

**Transformers:** Sizing of a transformer, main dimensions, kVA output for single- and three-phase transformers, window space factor, overall dimensions, operating characteristics, regulation, no load current, temperature rise in transformers, design of cooling tank, methods for cooling of transformers.

**UNIT-III:**

**Induction Motors:** Sizing of an induction motor, main dimensions, length of air gap, rules for selecting rotor slots of squirrel cage machines, design of rotor bars & slots, design of end rings, design of wound rotor, magnetic leakage calculations, leakage reactance of poly-phase machines, magnetizing current, short circuit current, circle diagram, operating characteristics.

**UNIT-IV:**

**Synchronous Machines:** Sizing of a synchronous machine, main dimensions, design of salient pole machines, short circuit ratio, shape of pole face, armature

design, armature parameters, estimation of airgap length, design of rotor, design of damper winding, determination of full load field mmf, design of field winding, design of turbo alternators, rotor design.

#### **UNIT-V:**

**Computer Aided Design (CAD):** Limitations (assumptions) of traditional designs need for CAD analysis, synthesis and hybrid methods, design optimization methods, variables, constraints and objective function, problem formulation. Introduction to FEM based machine design. Introduction to complex structures of modern machines-PMSMs, BLDCs, SRM and claw-pole machines.

#### **TEXT BOOKS:**

1. A. K. Sawhney, "A Course in Electrical Machine Design", Dhanpat Rai and Sons, 1970.
2. M.G. Say, "Theory & Performance & Design of A.C. Machines", ELBS London.

#### **REFERENCE BOOKS:**

1. S. K. Sen, "Principles of Electrical Machine Design with computer programmes", Oxford and IBHPublishing, 2006.
2. K. L. Narang, "A Text Book of Electrical Engineering Drawings", Satya Prakashan, 1969.
3. A. Shanmugasundaram, G. Gangadharan and R. Palani, "Electrical Machine Design Data Book", New Age International, 1979.
4. M. V. Murthy, "Computer Aided Design of Electrical Machines", B.S. Publications, 2008.
5. Electrical machines and equipment design exercise examples using Ansoft's Maxwell 2D machine design package.

## SM504MS: BUSINESS ECONOMICS AND FINANCIAL ANALYSIS

III Year B.Tech. EEE I-Sem

L T P C

3 0 0 3

**Course Objective:** To learn the basic business types, impact of the economy on Business and Firms specifically. To analyze the Business from the Financial Perspective.

**Course Outcome:** The students will understand the various Forms of Business and the impact of economic variables on the Business. The Demand, Supply, Production, Cost, Market Structure, Pricing aspects are learnt. The Students can study the firm's financial position by analysing the Financial Statements of a Company.

### UNIT – I: Introduction to Business and Economics

**Business:** Structure of Business Firm, Theory of Firm, Types of Business Entities, Limited Liability Companies, Sources of Capital for a Company, Non-Conventional Sources of Finance.

**Economics:** Significance of Economics, Micro and Macro Economic Concepts, Concepts and Importance of National Income, Inflation, Money Supply and Inflation, Business Cycle, Features and Phases of Business Cycle. Nature and Scope of Business Economics, Role of Business Economist, Multidisciplinary nature of Business Economics.

### UNIT - II: Demand and Supply Analysis

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

**Supply Analysis:** Determinants of Supply, Supply Function and Law of Supply.

### UNIT - III: Production, Cost, Market Structures & Pricing

**Production Analysis:** Factors of Production, Production Function, Production Function with one variable input, two variable inputs, Returns to Scale, Different Types of Production Functions.

**Cost analysis:** Types of Costs, Short run and Long run Cost Functions.

**Market Structures:** Nature of Competition, Features of Perfect competition, Monopoly, Oligopoly, Monopolistic Competition. **Pricing:** Types of Pricing, Product Life Cycle based Pricing, Break Even Analysis, Cost Volume Profit Analysis.

**UNIT - IV: Financial Accounting:** Accounting concepts and Conventions, Accounting Equation, Double-Entry system of Accounting, Rules for maintaining Books of Accounts, Journal, Posting to Ledger, Preparation of Trial Balance, Elements of Financial Statements, Preparation of Final Accounts(Simple Problems).

**UNIT - V: Financial Ratios Analysis:** Concept of Ratio Analysis, Importance and Types of Ratios, Liquidity Ratios, Turnover Ratios, Profitability Ratios, Proprietary Ratios, Solvency, Leverage Ratios – Analysis and Interpretation (simple problems).

**TEXT BOOKS:**

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

**REFERENCE BOOKS:**

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

## EE505PC: MICROPROCESSORS & MICROCONTROLLERS LAB

III Year B.Tech. EEE I-Sem

L T P C  
0 0 2 1

**Prerequisites:** Digital Electronics, Microprocessors and Microcontrollers

**Course Objectives:**

- To develop an understanding of the operations of microprocessors and micro controllers;
- To develop assembly language programming to perform various applications.
- To understand the interfacing of various external devices to the processor and controllers.

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

- Understands the internal architecture and organization of 8086, 8051 and ARMprocessors/controllers.
- Understands the interfacing techniques to 8086 and 8051 and can develop assembly languageprogramming to design microprocessor/ micro controller-based systems.
- Develop programs for interfacing various external devices,

The following programs/experiments are to be written for assembler and to be executed the same with8086 and 8051 kits.

**List of Experiments:**

1. Programs for 16-bit arithmetic operations 8086(using various addressing modes)
2. Programs for sorting an array for 8086.
3. Programs for searching for a number of characters in a string for 8086.
4. Programs for string manipulation for 8086.
5. Programs for digital clock design using 8086.
6. Interfacing ADC and DAC to 8086.
7. Parallel communication between two microprocessor kits using 8255.
8. Serial communication between two microprocessor kits using 8251.
9. Interfacing to 8086 and programming to control stepper motor.
10. Programming using arithmetic, logical and bit manipulation instructions of 8051.
11. Program and verify Timer/Counter in 8051.
12. Program and verify interrupt handling in 8051.
13. UART operation in 8051.
14. Communication between 8051 kit and PC
15. Interfacing LCD to 8051
16. Interfacing Matrix/Keyboard to 8051
17. Data transfer from peripheral to memory through DMA controller 8237/8257

**TEXT BOOKS:**

1. Advanced Microprocessors and Peripherals – A. K. Ray and K.M. Bhurchandani, MHE, 2<sup>nd</sup> Edition 2006.
2. The 8051 Microcontroller, Kenneth. J. Ayala, Cengage Learning, 3<sup>rd</sup> Ed.

**REFERENCE BOOKS:**

1. ARM System Developers guide, Andrew N SLOSS, Dominic SYMES, Chris WRIGHT, Elsevier, 2012
2. Microprocessors and Interfacing, D. V. Hall, MGH, 2<sup>nd</sup> 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.

## EE506PC: POWER ELECTRONICS LAB

III Year B.Tech. EEE I-Sem

L T P C  
0 0 2 1

**Prerequisite:** Power Electronics

### **Course Objectives:**

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

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

- Understand the operating principles of various power electronic converters.
- Use power electronic simulation packages & hardware to develop the power converters.
- Analyse and choose the appropriate converters for various applications

### **Any eight experiments should be conducted**

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

### **Any two experiments should be conducted**

1. DC Jones chopper with R and RL Loads
2. Three Phase half-controlled bridge converter with R-load
3. Single Phase dual converter with RL loads
4. (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
5. (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
6. Simulation of Buck chopper
7. Simulation of single-phase Inverter with PWM control
8. 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.
9. Study of PWM techniques

**TEXT BOOKS:**

1. M. H. Rashid, Simulation of Electric and Electronic circuits using PSPICE – by M/s PHIPublications.
2. User's manual of related software's

**REFERENCE BOOKS:**

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

## EN508HS: ADVANCED ENGLISH COMMUNICATION SKILLS LAB

III Year B.Tech. EEE I-Sem

L T P C

0 0 2 1

### 1. INTRODUCTION:

The introduction of the Advanced Communication Skills Lab is considered essential at 3<sup>rd</sup> year level. At this stage, the students need to prepare themselves for their careers which may require them to listen to, read, speak and write in English both for their professional and interpersonal communication in the globalized context.

The proposed course should be a laboratory course to enable students to use 'good' English and perform the following:

- Gathering ideas and information to organize ideas relevantly and coherently.
- Engaging in debates.
- Participating in group discussions.
- Facing interviews.
- Writing project/research reports/technical reports.
- Making oral presentations.
- Writing formal letters.
- Transferring information from non-verbal to verbal texts and vice-versa.
- Taking part in social and professional communication.

### 2. OBJECTIVES:

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

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

### 3. SYLLABUS:

The following course content to conduct the activities is prescribed for the Advanced English Communication Skills (AECS) Lab:

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

usage of vocabulary.

2. **Activities on Reading Comprehension** –General Vs Local comprehension, reading for facts, guessing meanings from context, scanning, skimming, inferring meaning, critical reading& effective googling.
3. **Activities on Writing Skills** – Structure and presentation of different types of writing – *letter writing/Resume writing/ e-correspondence/Technical report writing/* – planning for writing – improving one’s writing.
4. **Activities on Presentation Skills** — Oral presentations (individual and group) through JAM sessions/seminars/PPTs and written presentations through posters/projects/reports/ e-mails/assignments etc.
5. **Activities on Group Discussion and Interview Skills** — Dynamics of group discussion, intervention, summarizing, modulation of voice, body language, relevance, fluency and organization of ideas and rubrics for evaluation- Concept and process, pre-interview planning, opening strategies, answering strategies, interview through tele-conference & video-conference and Mock Interviews.

#### **4. MINIMUM REQUIREMENT:**

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

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

#### **5. SUGGESTED SOFTWARE:**

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

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

#### **TEXT BOOKS:**

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

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

**REFERENCE BOOKS:**

1. Learn Correct English – A Book of Grammar, Usage and Composition by Shiv K. Kumar and Hemalatha Nagarajan. Pearson 2007
2. Professional Communication by Aruna Koneru, McGraw Hill Education (India) Pvt. Ltd, 2016.
3. Technical Communication by Meenakshi Raman & Sangeeta Sharma, Oxford University Press 2009.
4. Technical Communication by Paul V. Anderson. 2007. Cengage Learning pvt. Ltd. New Delhi.
5. English Vocabulary in Use series, Cambridge University Press 2008.
6. Handbook for Technical Communication by David A. McMurrey & Joanne Buckley. 2012. Cengage Learning.
7. Communication Skills by Leena Sen, PHI Learning Pvt Ltd., New Delhi, 2009.
8. Job Hunting by Colm Downes, Cambridge University Press 2008.
9. English for Technical Communication for Engineering Students, Aysha Vishwamohan, Tata McGraw-Hill 2009.

## \*MC510: INTELLECTUAL PROPERTY RIGHTS

**III Year B.Tech. EEE I-Sem**

**L T P C**  
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### **Course Objectives:**

- Significance of intellectual property and its protection
- Introduce various forms of intellectual property

### **Course Outcomes:**

- Distinguish and Explain various forms of IPRs.
- Identify criteria to fit one's own intellectual work in particular form of IPRs.
- Apply statutory provisions to protect particular form of IPRs.
- Appraise new developments in IPR laws at national and international level

### **UNIT – I**

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

### **UNIT – II**

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

### **UNIT – III**

**Law of copyrights:** Fundamental of copyright law, originality of material, rights of reproduction, rights to perform the work publicly, copyright ownership issues, copyright registration, notice of copyright, International copyright law.

**Law of patents:** Foundation of patent law, patent searching process, ownership rights and transfer

### **UNIT – IV**

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

### **UNIT – V**

New development of intellectual property: new developments in trade mark law; copyright law, patent law, intellectual property audits.

International overview on intellectual property, international — trade mark law, copyright law, international patent law, and international development in trade secrets law.

### **TEXT BOOK:**

1. Intellectual property right, Deborah. E. Bouchoux, Cengage learning.

### **REFERENCE BOOK:**

1. Intellectual property right – Unleashing the knowledge economy, prabuddha ganguli, TataMcGraw Hill Publishing company ltd.

## EE611OE: RENEWABLE ENERGY SOURCES

(Open Elective-I.1)

III Year B.Tech. EEE II-Sem

L T P C

3 0 0 3

**Pre-requisites:** None

**Course Objectives:**

- To recognize the awareness of energy conservation in students
- To identify the use of renewable energy sources for electrical power generation
- To collect different energy storage methods and detect about environmental effects of energy conversion

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

- Understand the principles of wind power and solar photovoltaic power generation, fuel cells.
- Assess the cost of generation for conventional and renewable energy plants
- Design suitable power controller for wind and solar applications and analyze the issues involved in the integration of renewable energy sources to the grid

**UNIT-I:**

**Introduction**

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

**Wind Power Plants:**

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

**UNIT-II:**

**Photovoltaic Power Plants**

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.

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

### **UNIT-III:**

#### **Induction Generators**

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

### **UNIT-IV:**

#### **Storage Systems**

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

### **UNIT-V:**

#### **Integration of Alternative Sources of Energy**

Principles of Power Injection-Instantaneous Active and Reactive Power Control Approach Integration of Multiple Renewable Energy Sources-Islanding and Interconnection Control-DG Control and Power Injection.

#### **Interconnection Of Alternative Energy Sources with the Grid:**

Interconnection Technologies -Standards and Codes for Interconnection-Interconnection Considerations -Interconnection Examples for Alternative Energy Sources.

### **TEXT BOOKS:**

1. Felix A. Farret, M. Godoy Simoes, “Integration of Alternative Sources of Energy”, John Wiley&Sons, 2006.
2. Solanki: Renewable Energy Technologies: Practical Guide For Beginneers, PHI Learning Pvt.Ltd., 2008.

### **REFERENCE BOOKS:**

1. D. Mukherjee: Fundamentals of Renewable Energy Systems, New Age International publishers,2007.
2. Remus Teodorescu, Marco Liserre, Pedro Rodríguez: Grid Converters for Photovoltaic and WindPower Systems, John Wiley & Sons, 2011.
3. Gilbert M. Masters: Renewable and Efficient Electric Power Systems, John Wiley & Sons, 2004.

## EE612OE: FUNDAMENTAL OF ELECTRIC VEHICLES

(Open Elective-I.2)

III Year B.Tech. EEE II-Sem

L T P C

3 0 0 3

**Pre-requisites:** None; Interest in electric Vehicles

### **Course Objectives:**

- To understand the fundamentals of Electric Vehicles (EVs), especially in Indian Context.
- To examine technology associated with each element of EV drive-train;
- To get into the economics of EVs in India vis-à-vis petrol vehicles.

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

- Understand the fundamentals of Electric Vehicles.
- Design of batteries, EV motors and Power electronic controllers for EV systems.
- Analyze the economics of EV market and EV data using Analytical tools.

### **UNIT-I:**

#### **Introduction**

Overview of Electric Vehicles in India, India's EV program, Charging and Swapping Infrastructure, brief introduction of batteries, Lithium for batteries, EV Subsystems.

### **UNIT-II:**

**Vehicle Dynamics:** Forces acting when a vehicle move, Aerodynamic drag, Rolling Resistance and Uphill Resistance, Power and Torque to accelerate. **Drive Cycle:** Concept of Drive Cycle, Drive Cycles and Energy used per km.

### **UNIT-III:**

**EV Powertrain:** Design of EV Drive Train, Introduction to Battery Parameters, Why Lithium Ion Battery? Batteries in Future, Li-Ion Battery Cells, SoH and SoC estimation and Self Discharge, Battery Pack Development, Computation of Effective cost of battery, Charging Batteries.

**Fundamentals of EV Battery Pack design:** Mechanical, Thermal and Electrical Design, BMS Design of Electric Vehicle.

### **UNIT-IV:**

**EV Motors and Controllers:** Fundamentals and Design, Understanding Flow of Electricity, Magnetism and Heat, Power and Efficiency, Torque Production, Speed and Back EMF, the d-q Equivalent circuit, Field-oriented Control, Understanding Three phase AC and DC to AC conversion systems, Understanding the thermal design of the motors, Engineering Considerations, Future Frontiers.

**UNIT-V:**

**EV Charging:** Introduction, Slow or Fast EV Chargers, Battery Swapping, Standardization and On board Chargers, Public Chargers, Bulk Chargers/Swap Stations, Economics of Public Chargers in context, Analytics and Tools for EV systems.

**TEXT BOOKS:**

1. Electric Powertrain - Energy Systems, Power electronics and drives for Hybrid, electric and fuelcell vehicles by John G. Hayes and A. Goodarzi, Wiley Publication
2. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004
3. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003

**REFERENCE BOOKS:**

1. James Larminie, John Lowry, *Electric Vehicle Technology Explained*, Wiley, 2003
2. Chris Mi, M. Abul Masrur, David Wenzhong Gao, *Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives*, John Wiley & Sons Ltd., 2011
3. Fundamentals of Electric Vehicles: technology and economics  
[https://onlinecourses.nptel.ac.in/noc20\\_ee99/previous](https://onlinecourses.nptel.ac.in/noc20_ee99/previous)  
<https://archive.nptel.ac.in/courses/108/106/108106170/>
4. Link to EV101 course —  
<https://www.pupilfirst.school/courses/641/curriculum> Link to EV201 course:  
<https://www.pupilfirst.school/courses/643/curriculum>

**EE621PE: CYBER-PHYSICAL SYSTEMS**  
**(Professional Elective-II.1)**

**III Year B.Tech. EEE II-Sem**

**L T P C**  
**3 0 0 3**

**Pre-requisites:** None; Interest in cyber-physical systems

**Course Objectives:**

- To gain insight into the seamless integration of computational algorithms and physical processes within cyber-physical systems.
- To develop proficiency in analyzing and managing the dynamic interactions between the cyber and physical components in diverse applications.
- To explore practical applications, focusing on the design, implementation, and optimization of cyber-physical systems for real-world

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

- Achieve a thorough understanding of the core principles that form the foundation of Cyber-Physical Systems.
- Apply the knowledge to successfully identify safety specifications and critical properties crucial for ensuring the safety of CPS.
- Develop proficiency in utilizing abstraction techniques for system designs, and effectively express pre- and post-conditions as well as invariants for CPS models.

**UNIT-I:**

**Introduction to Cyber-Physical Systems (CPS):** Cyber-Physical Systems in the real world, Basic principles of design and validation of CPS, Industry 4.0 and its implications, Auto SAR and IIOT (Industrial Internet of Things), Applications in Building Automation and Medical CPS.

**UNIT-II:**

**CPS Platform Components:** CPS Hardware platforms: Processors, Sensors, Actuators, CPS Network: Wireless Hart, CAN, Automotive Ethernet, CPS Software stack: Real-Time Operating Systems (RTOS), Scheduling, Overview of CPS Software components and their mapping to Electronic Control Units (ECUs).

**UNIT-III:**

**Principles of Automated Control Design:** Dynamical Systems and Stability, Controller Design Techniques, Stability Analysis using Common Lyapunov Functions (CLFs) and Multiple Lyapunov Functions (MLFs), Performance analysis under Packet drop and Noise.

#### **UNIT-IV:**

**CPS Implementation and Performance Analysis:** Translating features into software components, Mapping software components to ECUs, Performance Analysis of CPS, considering scheduling, bus latency, and faults, Network congestion and its impact on control performance.

#### **UNIT-V:**

**Formal Methods, Software Analysis, and Secure Deployment:** Advanced Automata-based modeling and analysis, Timed and Hybrid Automata for CPS, Formal Analysis techniques: Flow pipe construction, reachability analysis, Analysis of CPS Software: Weakest Pre-conditions, Bounded Model Checking, Frama-C, CBMC, Secure Deployment of CPS: Attack models, Secure Task mapping, and Partitioning, State estimation for attack detection. **Case Studies in CPS Automotive Case Study:** Vehicle ABS hacking, **Power Distribution Case Study:** Attacks on Smart Grids

#### **TEXT BOOKS:**

1. Raj Rajkumar, Dionisio De Niz, and Mark Klein, *Cyber-Physical Systems*, Addison-Wesley Professional
2. Rajeev Alur, *Principles of Cyber-Physical Systems*, MIT Press, 2015.

#### **REFERENCE BOOKS:**

1. André Platzer, *Logical Analysis of Hybrid Systems: Proving Theorems for Complex Dynamics.*, Springer, 2010. 426 pages, ISBN 978-3-642-14508-7.
2. Jean J. Labrosse, *Embedded Systems Building Blocks: Complete and Ready-To-Use Modules in C*, The publisher, Paul Temme, 2011.
3. Introduction to Embedded Systems - A Cyber-Physical Systems Approach, by E. A. Lee and S. A. Seshia, 2014. The book is available in two forms: a free PDF download and low-cost paperback.

## EE622PE: POWER SEMICONDUCTOR DRIVES

(Professional Elective-II.2)

III Year B.Tech. EEE II-Sem

L T P C

3 0 0 3

**Prerequisite:** Power Electronics, Electrical Machines – I, Electrical Machines – II

### Course Objectives:

- To introduce the drive system and operating modes of drive and its characteristics
- To understand Speed — Torque characteristics of different motor drives by various powerconverter topologies
- To appreciate the motoring and braking operations of drive and differentiate DC and AC drives

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

- Identify the drawbacks of speed control of motor by conventional methods.
- Differentiate Phase controlled and chopper-controlled DC drives speed-torque characteristics merits and demerits
- Understand Ac motor drive speed–torque characteristics using different control strategies its merits and demerits and describe Slip power recovery schemes

### UNIT-I:

#### Control of DC Motors

Introduction to Thyristor controlled Drives, Single Phase semi and fully controlled converters connected to DC separately excited and DC series motors – continuous current operation – output voltage and current waveforms – Speed and Torque expressions – Speed – Torque Characteristics- Problems on Converter fed DC motors.

Three phase semi and fully controlled converters connected to DC separately excited and DC series motors – output voltage and current waveforms – Speed and Torque expressions – Speed – Torque characteristics — Problems.

### UNIT-II:

#### Four Quadrant Operation of DC Drives

Introduction to Four quadrant operation – Motoring operations, Electric Braking – Plugging, Dynamic, and Regenerative Braking operations. Four quadrant operation of D.C motors by single phase and three phase dual converters – Closed loop operation of DC motor (Block Diagram Only)

**Control of DC Motors by Choppers:** Single quadrant, two quadrant and four quadrant chopper fed dc separately excited and series motors – Continuous current operation – Output voltage and current wave forms – Speed and torque expressions – speed-torque characteristics – Problems on Chopper fed D.C Motors – Closed

Loop operation (Block Diagram Only)

**UNIT-III:**

**Control of Induction Motor**

Variable voltage characteristics-Control of Induction Motor by Ac Voltage Controllers – Waveforms – speed torque characteristics.

Variable frequency characteristics-Variable frequency control of induction motor by Voltage source and current source inverter and cyclo-converters- PWM control – Comparison of VSI and CSI operations – Speed torque characteristics – numerical problems on induction motor drives – Closed loop operation of induction motor drives (Block Diagram Only)

**UNIT-IV:**

**Rotor Side Control of Induction Motor**

Static rotor resistance control – Slip power recovery – Static Scherbius drive – Static Kramer Drive – their performance and speed torque characteristics – advantages, applications, problems.

**UNIT-V:**

**Control of Synchronous Motors**

Separate control and self-control of synchronous motors – Operation of self-controlled synchronous motors by VSI, CSI and Cyclo-converters. Load commutated CSI fed Synchronous Motor – Operation – Waveforms – speed torque characteristics – Applications – Advantages and Numerical Problems –Closed Loop control operation of synchronous motor drives (Block Diagram Only), variable frequency control – Cyclo-converter, PWM based VSI& CSI.

**TEXT BOOKS:**

1. “G K Dubey”, Fundamentals of Electric Drives, CRC Press, 2002.
2. “Vedam Subramanyam”, Thyristor Control of Electric drives, Tata McGraw Hill Publications, 1987.

**REFERENCE BOOKS:**

1. “S K Pillai”, A First course on Electrical Drives, New Age International (P) Ltd. 2<sup>nd</sup> Edition. 1989
2. “P. C. Sen”, Thyristor DC Drives, Wiley-Blackwell, 1981
3. “B. K. Bose”, Modern Power Electronics, and AC Drives, Pearson 2015.
4. “R. Krishnan”, Electric motor drives - modelling, Analysis and control, Prentice Hall PTR, 2001

**EE623PE: WIND AND SOLAR ENERGY SYSTEMS**  
**(Professional Elective-II.3)**

**III Year B.Tech. EEE II-Sem**

**L T P C**  
**3 0 0 3**

**Prerequisite:** Renewable Energy Systems

**Course Objectives:**

- To study the physics of wind power and energy, understanding the principles governing wind generator operation.
- To gain knowledge about solar power resources, analyze solar photovoltaic cells, and discuss solar thermal power generation.
- To identify and understand network integration issues associated with renewable energy sources like wind and solar power.

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

- Understand the energy scenario and the consequent growths of the power generate renewable energy sources.
- Understand the basic physics of wind and solar power generation.
- Understand the power electronic interfaces for wind and solar generation and grid-integration issues.

**UNIT-I:**

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

**UNIT-II:**

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

**UNIT-III:**

**The Solar Resource:** Introduction, solar radiation spectra, solar geometry, Earth Sun angles, observer Sun angles, solar day length, Estimation of solar energy availability.

**Solar Photovoltaic:** Technologies-Amorphous, mono-crystalline, polycrystalline; V-I characteristics of a PV cell, PV module, array, Power Electronic Converters for Solar Systems, Maximum Power point Tracking (MPPT) algorithms. Converter Control.

**UNIT-IV:**

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

**UNIT-V:**

**Solar Thermal Power Generation:** Technologies, Parabolic trough, central receivers, parabolic dish, Fresnel, solar pond, elementary analysis.

**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.

**REFERENCE BOOKS:**

1. S. P. Sukhatme, "Solar Energy: Principles of Thermal Collection and Storage", McGraw Hill, 1984.
2. H. Siegfried and R. Waddington, "Grid integration of wind energy conversion systems" John Wiley and Sons Ltd., 2006.
3. G. N. Tiwari and M. K. Ghosal, "Renewable Energy Applications", Narosa Publications, 2004.
4. J. A. Duffie and W. A. Beckman, "Solar Engineering of Thermal Processes", John Wiley & Sons, 1991.

## EE601PC: DIGITAL SIGNAL PROCESSING

III Year B.Tech. EEE II-Sem

L T P C  
3 0 0 3

**Pre-requisites:** Laplace Transforms, Numerical Methods and Complex variables, Control Systems

**Course Objectives:**

- Provide foundational knowledge for the analysis and processing of digital signals.
- Explore the relationships between continuous-time and discrete-time signals and systems, emphasizing time, frequency, and Z-plane analysis.
- Introduce real-world signal processing applications while studying the design and structures of digital filters, including IIR and FIR, and addressing finite word length effects.

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

- Demonstrate proficiency in performing time, frequency, and Z-transform analysis on signals and systems.
- Understand the inter-relationship between DFT and various transforms, appreciate the significance of filter structures, and recognize the effects of round-off errors in the design.
- Apply knowledge to design digital filters, comprehend fast computation methods such as FFT, and understand trade-offs between normal and multi-rate DSP techniques, including finite length word effects.

**UNIT-I:**

**Introduction:** Introduction to Digital Signal Processing: Discrete Time Signals & Sequences, conversion of continuous to discrete signal, Normalized Frequency, Linear Shift Invariant Systems, Stability, and Causality, linear differential equation to difference equation, Linear Constant Coefficient Difference Equations, Frequency Domain Representation of Discrete Time Signals and Systems

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

**UNIT-II:**

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

**Fast Fourier Transforms:** Fast Fourier Transforms (FFT) - Radix-2 Decimation-

in-Time and Decimation-in-Frequency FFT Algorithms, Inverse FFT, and FFT with General Radix-N.

**UNIT-III:**

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

**UNIT-IV:**

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

**UNIT-V:**

**Multi-Rate Digital Signal Processing:** Introduction, Down Sampling, Decimation, Up sampling, Interpolation, Sampling Rate Conversion, Conversion of Band Pass Signals, Concept of Resampling, Applications of Multi Rate Signal Processing.  
**Finite Word Length Effects:** Limit cycles, Overflow Oscillations, Round-off Noise in IIR Digital Filters, Computational Output Round off Noise, Methods to Prevent Overflow, Tradeoff between Round Off and Overflow Noise, Measurement of Coefficient Quantization Effects through Pole-Zero Movement, DeadBand Effects.

**TEXT BOOKS:**

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

**REFERENCE BOOKS:**

1. Fundamentals of Digital Signal Processing – Loney Ludeman, John Wiley, 2009
2. Digital Signal Processing – Fundamentals and Applications – Li Tan, Elsevier, 2008
3. Fundamentals of Digital Signal Processing using MATLAB – Robert J. Schilling, Sandra L. Harris, Thomson, 2007
4. Digital Signal Processing - A Practical approach, Emmanuel C. Ifeachor and Barrie W. Jervis, 2<sup>nd</sup> Edition, Pearson Education, 2009

## EE602PC: POWER SYSTEM PROTECTION

III Year B.Tech. EEE II-Sem

L T P C  
3 0 0 3

**Pre-requisites:** Power Systems-I, Power Systems-II

**Course Objectives:**

- To introduce all kinds of circuit breakers and relays for protection of Generators, Transformers and feeder bus bars from Over voltages and other hazards.
- To describe neutral grounding for overall protection.
- To understand the phenomenon of Over Voltages and its classification.

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

- Compare and contrast electromagnetic, static and microprocessor-based relays
- Apply technology to protect power system components.
- Analyze quenching mechanisms used in air, oil and vacuum circuit breakers

**UNTI-I:**

**Protective Relays:** Introduction, Need for power system protection, effects of faults, evolution of protective relays, zones of protection, primary and backup protection, essential qualities of protection, classification of protective relays and schemes, current transformers, potential transformers, basic relay terminology.

**Operating Principles and Relay Construction:** Electromagnetic relays, thermal relays, static relays, microprocessor based protective relays.

**UNTI-II:**

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

**UNTI-III:**

**Pilot Relaying Schemes:** Wire Pilot protection, Carrier current protection.

**AC Machines and Bus Zone Protection:** Protection of Generators, Protection of transformers, Bus-zone protection, frame leakage protection.

**UNTI-IV:**

**Static Relays:** Amplitude and Phase comparators, Duality between AC and PC, Static amplitude comparator, integrating and instantaneous comparators, static phase comparators, coincidence type of phase comparator, static over current relays, static directional relay, static differential relay, static distance relays, Multi input

comparators, concept of Quadrilateral and Elliptical relay characteristics.

**Microprocessor Based Relays:** Advantages, over current relays, directional relays, distance relays.

**UNTI-V:**

**Circuit Breakers:** 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, SF<sub>6</sub> circuit breaker, operating mechanism, selection of circuit breakers, high voltage DC breakers, ratings of circuit breakers, testing of circuit breakers.

**Fuses:** Introduction, fuse characteristics, types of fuses, application of HRC fuses, discrimination.

**TEXT BOOKS:**

1. Badriram and D.N. Vishwakarma, Power System Protection and Switchgear, TMH 2001.
2. U. A. Bakshi, M. V. Bakshi: Switchgear and Protection, Technical Publications, 2009.

**REFERENCE BOOKS:**

1. C. Russel Mason – “The art and science of protective relaying, Wiley Eastern, 1995
2. L. P. Singh “Protective relaying from Electromechanical to Microprocessors”, New Age International

## EE603PC: POWER SYSTEM OPERATION AND CONTROL

III Year B.Tech. EEE II-Sem

L T P C

3 0 0 3

**Pre-requisites:** Power System-I, Power System-II

**Course Objectives:**

- Understand the principles and significance of real power control, emphasizing the importance of frequency control in power systems.
- Analyze various methods for effective reactive power control in power systems.
- Grasp the concepts of unit commitment, economic load dispatch, and real-time control, highlighting their importance in power system operation.

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

- Understand operation and control of power systems.
- Analyze various functions of EMS functions and stability of machines.
- Understand power system deregulation and restructuring

**UNIT-I:**

**Load Flow Studies**

Introduction, Bus classification -Nodal admittance matrix - Load flow equations - Iterative methods - Gauss and Gauss Seidel Methods, Newton-Raphson Method-Fast Decoupled Method-Merits and demerits of the above methods-System data for load flow study

**UNIT-II:**

**Economic Operation Of Power Systems**

Distribution of load between units within a plant-Transmission loss as a function of plant generation, Calculation of loss coefficients-Distribution of load between plants.

**UNIT-III:**

**PF Control**

Introduction, load frequency problem-Megawatt frequency (or P-f) control channel, MVAR voltages (or Q-V) control channel-Dynamic interaction between P-f and Q-V loops. Mathematical model of speed-governing system-Turbine models, division of power system into control areas, P-f control of single control area (the uncontrolled and controlled cases)-P-f control of two area systems (the uncontrolled cases and controlled cases)

**UNIT-IV:**

**Power System Stability**

The stability problem-Steady state stability, transient stability and Dynamic Stability-Swing equation. Equal area criterion of stability-Applications of Equal area criterion, Step by step solution of swing equation-Factors affecting transient stability, Methods to improve steady state and Transient stability, Introduction to voltage stability

**UNIT-V:****Computer Control of Power Systems**

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

**TEXT BOOKS:**

1. C. L. Wadhwa, Electrical Power Systems, 3rd Edn, New Age International Publishing Co., 2001.
2. D. P. Kothari and I. J. Nagrath, Modern Power System Analysis, 4th Edn, Tata McGraw Hill Education Private Limited 2011.

**REFERENCE BOOKS:**

1. D. P. Kothari: Modern Power System Analysis-Tata Mc Graw Hill Pub. Co. 2003.
2. Hadi Sadat: Power System Analysis –Tata Mc Graw Hill Pub. Co. 2002.

## EE604PC: POWER SYSTEM LAB

III Year B.Tech. EEE II-Sem

L T P C  
0 0 2 1

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

### Course Objectives:

- To perform testing of CT, PT's and Insulator strings
- To find sequence impedances of 3- $\Phi$  synchronous machine and Transformer
- To perform fault analysis on Transmission line models and Generators.

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

- Perform various load flow techniques
- Understand Different protection methods
- Analyse 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- $\Phi$  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- $\Phi$  synchronous machine.
6. Finding the sequence impedances of 3- $\Phi$  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. Formation of YBUS.
2. Load Flow Analysis using Gauss Seidel (GS) Method.
3. Load Flow Analysis using Fast Decoupled (FD) Method.
4. Formation of ZBUS.
5. Simulation of Compensated Line

### 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.

### REFERENCE BOOK:

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

## EE605PC: CONTROL SYSTEMS LAB

III Year B.Tech. EEE II-Sem

L T P C  
0 0 2 1

**Prerequisite:** Control Systems

**Course Objectives:**

- Understand system representations like transfer function and state space, and assess systemdynamic response.
- Evaluate system performance using both time and frequency domain analyses, identifying methods to enhance performance.
- Design controllers and compensators to improve system performance based on the assessments from time and frequency domain analyses.

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

- Improve system performance by skillfully selecting appropriate controllers and compensatorstailored to specific applications.
- Apply diverse time domain and frequency domain techniques to effectively assess and enhancesystem performance.
- Demonstrate the application of various control strategies to different systems such as powersystems and electrical drives, showcasing adaptability and versatility in control applications.

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

1. Time response of Second order system
2. Characteristics of Synchros
3. Programmable logic controller — Study and verification of truth tables of logic gates, simple Boolean expressions, and application of speed control of motor.
4. Effect of feedback on DC servo motor
5. Transfer function of DC motor
6. Transfer function of DC generator
7. Characteristics of AC servo motor
8. Lag and lead compensation – Magnitude and phase plot

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

9. Temperature controller using PID
10. Effect of P, PD, PI, PID Controller on a second order systems
11. (a) Simulation of P, PI, PID Controller.  
(b) Linear system analysis (Time domain analysis, Error analysis) using suitable software
12. Stability analysis (Bode, Root Locus, Nyquist) of Linear Time Invariant

system using suitable software

13. State space model for classical transfer function using suitable software -Verification.
14. Design of Lead-Lag compensator for the given system and with specification using suitable software

**TEXT BOOKS:**

1. M. Gopal, "Control Systems: Principles and Design", McGraw Hill Education, 1997.
2. B. C. Kuo, "Automatic Control System", Prentice Hall, 1995.

**REFERENCE BOOKS:**

1. K. Ogata, "Modern Control Engineering", Prentice Hall, 1991.
2. I. J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International, 2009.

## EE606PC: DIGITAL SIGNAL PROCESSING LAB

III Year B.Tech. EEE II-Sem

L T P C  
0 0 2 1

**Pre-requisites:** Digital Signal Processing

**Course Objectives:**

- To implement Linear and Circular Convolution.
- To implement FIR and IIR filter and architecture of DSP processor.
- To demonstrate Finite word length effect.

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

- Carry out simulation of DSP system and abilities towards DSP processor-based implementation of DSP systems.
- Analyze Finite word length effect on DSP systems and applications of FFT to DSP.
- Implement adaptive filters for various applications of DSP.

**List of Experiments (programs):**

1. Generation of Sinusoidal Waveform / Signal based on Recursive Difference Equations
2. To find DFT / IDFT of given DT Signal
3. To find Frequency Response of a given System given in Transfer Function/ Differential equation form.
4. Implementation of FFT of given Sequence
5. Determination of Power Spectrum of a given Signal(s).
6. Implementation of LP FIR Filter for a given Sequence/Signal.
7. Implementation of HP FIR Filter for a given Sequence/Signal
8. Implementation of LP IIR Filter for a given Sequence/Signal
9. Implementation of HP IIR Filter for a given Sequence/Signal
10. Generation of Sinusoidal Signal through Filtering
11. Generation of DTMF Signals
12. Implementation of Decimation Process
13. Implementation of Interpolation Process
14. Implementation of I/D Sampling Rate Converters
15. Audio application such as to plot a Time and Frequency display of Microphone plus a Cosine using DSP. Read a .wav file and match with their respective spectrograms.
16. Noise Removal: Add noise above 3 KHz and then remove, interference suppression using 400Hz tone.
17. Impulse Response of First order and Second Order Systems.

(The above Programs shall be implemented in Software (Using MATLAB / Lab View / C Programming/Equivalent) and Hardware (Using TI / Analog Devices / Motorola / Equivalent DSP processors)

Note: - Minimum of 12 experiments has to be conducted.

### **LIST OF MAJOR EQUIPMENTS & SOFTWARE**

- MATLAB with Simulink
- TMS 320C50 DSP Processors (Kit & Add-on Cards)
- Signal Processing Tool Box
- Function Generators (1MHz)
- Cathode Ray Oscilloscope (30MHz)

### **TEXT BOOKS:**

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

### **REFERENCE BOOKS:**

1. Fundamentals of Digital Signal Processing – Loney Ludeman, John Wiley, 2009
2. Digital Signal Processing – Fundamentals and Applications – Li Tan, Elsevier, 2008
3. Fundamentals of Digital Signal Processing using MATLAB – Robert J. Schilling, Sandra L. Harris, Thomson, 2007
4. Digital Signal Processing - A Practical approach, Emmanuel C. If each orand Barrie W. Jervis, 2<sup>nd</sup> Edition, Pearson Education, 2009

### **ONLINE RESOURCES:**

1. NPTEL DSP Course: Lectures, notes, and lab assignments for DSP ([NPTEL DSP Course](#))
2. DSP Course on edX: Video lectures, lab assignments, and quizzes ([DSP Course on edX](#))
3. <https://sjce.ac.in/wp-content/uploads/2021/11/dsp-lab-manual-2021-22.pdf>

## \*MC609: ENVIRONMENTAL SCIENCE

**III Year B.Tech. EEE II-Sem**

**L T P C**  
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### **Course Objectives:**

- Understanding the importance of ecological balance for sustainable development.
- Understanding the impacts of developmental activities and mitigation measures.
- Understanding the environmental policies and regulations.

**Course Outcomes:** Based on this course, the Engineering graduate will understand /evaluate / develop technologies on the basis of ecological principles and environmental regulations which in turn helps in sustainable development

### **UNIT - I**

**Ecosystems:** Definition, Scope and Importance of ecosystem. Classification, structure, and function of an ecosystem, Food chains, food webs, and ecological pyramids. Flow of energy, Biogeochemical cycles, Bioaccumulation, Biomagnification, ecosystem value, services and carrying capacity, Field visits.

### **UNIT - II**

**Natural Resources: Classification of Resources:** Living and Non-Living resources, **water resources:** use and over utilization of surface and ground water, floods and droughts, Dams: benefits and problems. **Mineral resources:** use and exploitation, environmental effects of extracting and using mineral resources, **Land resources:** Forest resources, **Energy resources:** growing energy needs, renewable and non renewable energy sources, use of alternate energy source, case studies.

### **UNIT - III**

**Biodiversity And Biotic Resources:** Introduction, Definition, genetic, species and ecosystem diversity. Value of biodiversity; consumptive use, productive use, social, ethical, aesthetic and optional values. India as a mega diversity nation, Hot spots of biodiversity. Field visit. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts; conservation of biodiversity: In-Situ and Ex-situ conservation. National Biodiversity act.

### **UNIT - IV**

**Environmental Pollution and Control Technologies: Environmental Pollution:** Classification of pollution, **Air Pollution:** Primary and secondary pollutants, Automobile and Industrial pollution, Ambient air quality standards. **Water pollution:** Sources and types of pollution, drinking water quality standards. **Soil Pollution:** Sources and types, Impacts of modern agriculture, degradation of soil. **Noise Pollution:**

Sources and Health hazards, standards, **Solid waste:** Municipal Solid Waste management, composition and characteristics of e-Waste and its management. **Pollution control technologies:** Wastewater Treatment methods: Primary, secondary and Tertiary.

Overview of air pollution control technologies, Concepts of bioremediation. **Global Environmental Problems and Global Efforts:** Climate change and impacts on human environment. Ozone depletion and Ozone depleting substances (ODS). Deforestation and desertification. International conventions / Protocols: Earth summit, Kyoto protocol, and Montréal Protocol.

#### **UNIT - V**

**Environmental Policy, Legislation & EIA:** Environmental Protection act, Legal aspects Air Act- 1981, Water Act, Forest Act, Wild life Act, Municipal solid waste management and handling rules, biomedical waste management and handling rules, hazardous waste management and handling rules. EIA: EIA structure, methods of baseline data acquisition. Overview on Impacts of air, water, biological and Socio-economical aspects. Strategies for risk assessment, Concepts of Environmental Management Plan(EMP). **Towards Sustainable Future:** Concept of Sustainable Development, Population and its explosion, Crazy Consumerism, Environmental Education, Urban Sprawl, Human health, Environmental Ethics, Concept of Green Building, Ecological Foot Print, Life Cycle assessment (LCA), Low carbon life style.

#### **TEXT BOOKS:**

1. Textbook of Environmental Studies for Undergraduate Courses by Erach Bharucha for University Grants Commission.
2. Environmental Studies by R. Rajagopalan, Oxford University Press.

#### **REFERENCE BOOKS:**

1. Environmental Science: towards a sustainable future by Richard T. Wright. 2008 PHL Learning Private Ltd. New Delhi.
2. Environmental Engineering and science by Gilbert M. Masters and Wendell P. Ela. 2008 PHILearning Pvt. Ltd.
3. Environmental Science by Daniel B. Botkin & Edward A. Keller, Wiley INDIA edition.
4. Environmental Studies by Anubha Kaushik, 4<sup>th</sup> Edition, New age international publishers.
5. Text book of Environmental Science and Technology - Dr. M. Anji Reddy 2007, BS Publications.