B.Tech VII Semester - Syllabus

Course Titles and Course Codes

1. Switchgear and Protection (22PC1EE401)
2. Principles of Digital Signal Processing (22PC1EC421)
3. PROFESSIONAL ELECTIVE – III Electric Vehicle (22PE1EE403)
4. Power Systems Laboratory (22PC2EE401)
5. Principles of Digital Signal Processing Laboratory (22PC2EC421)
6. Major Project Phase – I (22PW4EE401)

Switchgear and Protection (22PC1EE401)

Unit - I

Circuit Breakers: Elementary principles of arc interruption, Recovery, Restriking Voltage Max. RRRV and Numerical Problems. CB ratings, Description and Operation of Minimum Oil Circuit breakers, Air Blast Circuit Breakers, Vacuum and SF6 circuit breakers.

Unit - II

Protective Relays: Essential qualities of protective relaying, concept of Electromagnetic Relays, Universal torque equation, over current, Directional relays, travelling wave-based line directional (TW32) and Differential (TW87) Relays.

Distance Relays: Impedance, Reactance and Mho Relays, Characteristics of Distance Relays and Comparison..

Unit - III

Equipment Protection Schemes: Differential Protection scheme of Generators, Negative Sequence Relay, Protection of Transformers: Percentage Differential Protection, Numerical Problem on Design of CT's Ratio, Buchholz relay Protection, Differential Over-Current protection of Bus bars. Three-zone distance relay protection using Impedance relays, Relay Coordination, Peterson Coil Grounding.

Unit - IV

Static Relays: Basic construction of Static Relays, Advantages of static relays – Instantaneous over current relay, General equation for comparators, Phase comparator, Amplitude Comparator - Duality between amplitude and phase comparators.

Unit - V

Digital Protection: Introduction to Numerical protection, Digital protection Technology Overview-Digital Relay Architecture, Signal path in Numerical Relay, Digital Relaying Algorithm, Fault location; Introduction to PMU and its use, Application of Artificial Intelligence to Power System Protection (Digital Relaying).

Principles of Digital Signal Processing (22PC1EC421)

Unit - I

Introduction to Signals and Systems: Classification of Continuous time Signals & Systems. Linear shift invariant systems, stability and causality-Introduction to digital signal processing, Sampling of Continuous signals- -Sampling Process-Sampling Theorem. Classification of discrete time signals and sequences- Discrete time systems.

Unit - II

Fourier Analysis: Introduction to Discrete Fourier series, Discrete Fourier Transform: Properties of Discrete Fourier Transform, linear convolution and circular convolution of sequences using DFT, Computation of DFT, Relation between DFT and Z-Transform.

Fast Fourier Transform: Radix -2 decimation in time and decimation in frequency FFT algorithms, Inverse FFT

Unit - III

Z- Transform: Introduction to Z-transform, Properties of Z- Transform, Inverse ZTransform, Application of Z-Transforms for Linear constant coefficient difference equations, Realization of Digital filters, system function – stability criterion.

Unit - IV

IIR Filters: Analog filter approximations-Design of Butterworth Chebyshev filters, Design of IIR digital filter from analog filter using- impulse invariant and bilinear transformation techniques, design examples, realization of IIR filters-direct, canonic, cascade, and parallel forms.

Unit - V

FIR Filters: Characteristics of FIR Digital Filters, Frequency response, Design of FIR filters using – Rectangular and Hamming windows, comparison of FIR and IIR filters, realization of FIR filters-direct, cascade forms. Digital Signal **Processors:** General DSP processor architecture, TMS320C67 processor architecture, features, addressing modes, and applications.

Professional Elective – III Electric Vehicle (22PE1EE403)

Unit - I

Introduction to Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drivetrains on energy supplies. Conventional Vehicles: Forces acting on a vehicle, vehicle power source (plant) characteristics, transmission characteristics: Manual, Hydro-dynamic and Continuously Variable Transmissions, mathematical model of vehicle, vehicle performance.

Unit - II

Electric Drive-Trains: Advantages of Electric Vehicles (EVs), Basic concept of electric vehicle traction, introduction to various electric drive-train topologies, Electric Vehicle Performance, power flow control, fuel efficiency analysis.

Unit - III

Hybrid Electric Drive-Trains: Basic architecture and concept of hybrid traction, patterns of power flow, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis, Concept of Drive Cycle.

Unit - IV

Electric Propulsion Unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency, axial flux machine topologies for EV applications.

Unit - V

Sizing of the Drive System: Matching the electric machine and the internal combustion engine (ICE), Sizing of the propulsion motor, Sizing of engine-generator, Sizing the power electronics based on Switch Technology - Switching Frequency and Ripple capacitor design, Supporting subsystems. Energy Management Strategies-Introduction to energy management strategies in HEVs, classification and comparison of different energy management strategies.

Power Systems Laboratory (22PC2EE401)

Experiments

1. Characteristics of Electromagnetic IDMT over current relay.
2. Characteristics of Microprocessor-based Over/Under voltage relay.
3. Differential protection of 1-Φ transformer.
4. Testing of CT and PT's, insulator strings.
5. Fault location of underground cable.
6. Measurement of Capacitance of 3-core cables.
7. Determination of sequence impedances of a 3-Φ synchronous machine.
8. Determination of sequence impedances of a 3-Φ Transformer.
9. Fault analysis of transmission system.
10. Formation of Y BUS.
11. Load flow analysis with GS Method.
12. Load flow analysis with FDLF method.
13. Load frequency control of two-area system.
14. Simulation of Renewable Power Generation (Solar, Wind).

Principles of Digital Signal Processing Laboratory (22PC2EC421)

Experiments

The following experiments are to be performed using MATLAB:

1. Operations on signals and sequences such as Addition, Multiplication, Scaling, Shifting, Folding, Computation of Energy and Average Power.
2. Verification of Linearity and Time Invariance Properties of a given Continuous/ Discrete System.
3. Linear Convolution and Circular Convolution.
4. Computation of Unit sample, Unit step and sinusoidal responses of the given LTI system and verifying its Physical realizability and stability properties.
5. Discrete Fourier Transform / Inverse Discrete Fourier Transform.
6. Fast Fourier Transform .
7. Sampling theorem verification.
8. IIR Filter implementation.
9. FIR Filter implementation.

The following experiments are to be performed using DSP Processor Kit:

1. Generation of sine wave and square wave using DSP trainer kit.
2. To Verify Linear Convolution and Circular Convolution.
3. PWM generation on DSP training kit.