GUJARAT TECHNOLOGICAL UNIVERSITY

M.E Semester: 1

Electrical Engineering

Subject Name : Power System Modeling & Simulation

Sr No.	Course Content
1	Network Formulation and Graph Theory: Introduction, Network Equations ,Graph Theory, Development of Network Matrices from Graph Theoretic Approach, Augment Cutset Incidence Matrix Cutset and Circuit Equations, Building Algorithm for the Bus Impedance Matrix Modification of Z_{BUS} matrix due to changes in the primitive network
2	Load Flow Studies: Introduction, Different techniques such as Gauss Saidal method, Newton Raphson method, De-Coupled method, Fast Decoupled method, Modified Fast Decoupled, Concept of Optimal Power Flow, Solution of Optimal power flow by Gradient method, Solution of Optimal power flow by Newton's method Linear Programming Methods, DC load flow, Converter variables, DC per unit system, Derivation of equations, Incorporation of control equations, Control of converter AC terminal voltage, Inverter operation, Unified AC-DC solution Multiconverter Systems, Programming considerations, Three-phase load flow Mismatch equations, The power flow Jacobian, Newton's method, Performance of the power flow, Zero sequence blocking, Continuation power flow
3	Power System Security: Introduction, Factors Affecting Power System Security, Short Circuit Studies of a Large Power System Networks, Symmetrical Fault Analysis Using Bus Impedance Matrix, Algorithm for Formation of Bus Impedance Matrix, Contingency Analysis: Detection of Network Problems, Overview of security analysis, Linear Sensitivity Factors, Contingency Selection, Concentric Relaxation, Bounding
4	Introduction to State Estimation in Power Systems: Introduction, Power system state estimation, Maximum Likelihood Weighted Least Squares Estimation, Introduction, , Maximum Likelihood Concepts, Matrix Formulation, State Estimation of an AC network , Development of Method, State Estimation by Orthogonal Decomposition, An Introduction to Advanced topics in state estimation, Detection and Identification of Bad measurements, Estimation of quantities not being

	measured, Network Observability and Pseudo measurements, Application of Power Systems State Estimation
5	Sparsity Techniques, Transients and Stability of Power System: Introduction, Sparse System ,Theorems of Sparse Matrix Method , Various application areas and sparsity, Direct solution of sparse network equations by optimally ordered triangular factorization, Electromagnetic Transient Simulation, Introduction, Traveling waves on transmission lines, Successive Reflections, Bewle Lattice Diagram, Multimachine Systems, Multimachine Transient Stability
6	Numerical Integration Techniques: Numerical integration techniques: One step methods, Taylor series based methods, Forward -Euler's method, Runge-Kutte methods, Trapezoidal method, backward-Euler's method, Accuracy and error analysis, Numerical stability analysis, Stiff systems, Step-size selection, Differential algebraic systems, Power system applications: Transient stability analysis

List of Reference books:

1. Power Generation Operation & Control, John Wiley & Sons, Inc, 1996- A. J. Wood and B. F. Wollenberg
2. AC-DC Power System Analysis, IEE London UK, 1998- Jos Arrillaga and Bruce Smith
3. Advanced Power System Analysis and Dynamics, New Age International Ltd, New Delhi, 1992- L. P. Singh
4. Power System Analyssi, Tata Mcgraw Hill, New Delhi, 1999- Hadi Sadat
5. Computational methods for Electric Power Systems, CRC press- Mariesa Crow

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E Semester: 1

Electrical Engineering

Subject Name : Advanced Power Electronics

Sr.No	Course content
1	Semiconductor Devices: Review of Semiconductor devices like Power BJT, SCR, MOSFET, IGBT, GTO, MCT; Static and dynamic characteristics of these devices; Single quadrant, Two quadrant and bid-directional switches
2	Switching Voltage Regulators: Introduction; Linear power supply (voltage regulators); Switching voltage regulators; Review of basic dc-dc voltage regulator configurations -Buck, Boost, Buck-Boost converters and their analysis for continuous and discontinuous mode; Other converter configurations like Flyback converter, Forward converter, Half bridge, Full bridge configurations, , Push-pull converter, C'uk converter, Sepic Converter; Design criteria for SMPS; Multi-output switch mode regulator.
3	Design of Magnetic Components: Design of power transformer; high frequency transformers for flyback, forward, half-bridge–full bridge and push pull converters; Design of inductors for various converter topologies; Design of current transformers; Different types of core materials.
4	DC-AC converters/Inverters: Classification; Review of line commutated inverters; Bridge inverters with 120°,180°,and 150° modes of operation; Harmonic reduction techniques; Sine-triangular PWM; Space Vector Pulse Width Modulation; Current Source Inverters
5	Gate and Base drive circuits: Preliminary design considerations; DC coupled drive circuits with unipolar and bipolar outputs; Importance of isolation in driver circuits; Electrically isolated drive circuits; Some commonly available driver chips (based on boot-strap capacitor); Cascade connected drive circuits; Thyristor drive circuits; Protection in driver circuits; Blanking circuits for bridge inverters.
6	Three phase AC voltage controllers and Cycloconverters: Review of On-off and phase control; Three phase half-wave and full wave controllers

	and their analysis with resistive loads; three phase bi-directional delta-connected controllers; 3-phase cyclo-converter circuits; circulating current operation; non-circulating current operation; mean output voltage and harmonics in supply current waveform

Activities :

1. Design of an inductor for a given DC-DC converter configuration. The converter topology and the specifications for the inductor should be specified by the course instructor. Each student should be assigned a different design problem.
2. Design of a transformer for an insolated DC-DC converter configuration. The converter topology and the specifications for the inductor should be specified by the course instructor. Each student should be assigned a different design problem.
3. Write a code to determine the switching positions of the single phase bridge inverter so that the output voltage waveform is free from 3^{rd}, 5^{th} and 7^{th} harmonics.
4. Hardware or simulation or mathematical analysis related assignments based on other topics related to the course.

Reference

1. "Power Electronics – Converters, Applications and Design", John Willey & sons, Inc., 3rd ed., 2003- Mohan, Undeland and Robbins
2. "Power Electronics - circuits, devices and applications", Prentice Hall of India, 2nd ed., 2000- Muhammad H. Rashid
3. "Modern Power Electronics ", S. Chand and Co. Ltd., New Delhi, 2000- P.C.Sen
4. "Design of magnetic components for switched mode power converters", Wiley Eastern Ltd., New Delhi, 1992- L. Umanand and S.R. Bhat
5. "Thyristorised power controllers", New Age International Publishers, 1986 (Reprint 2008)- G.K. Dubey, S.R. Doradia, A. Joshi, and R.M.K. Sinha,
6. "Fundamentals of Power Electronics", Springer International, 2nd ed., 2001- R.W. Erickson, D. Maksimovic

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E Semester: 1

Electrical Engineering

Subject Name : Modern Control System

Sr.No	Course content
1.	Mathematical Background – Matrices: Definition of Matrices; Matrix Algebra; Matrix Multiplication and Inversion; Rank of a Matrix; Differentiation and Integration of Matrices.
2.	State Space Analysis of Control Systems: State Variables; State-Space Representation of Electrical, Mechanical and Electromechanical Systems; State Space Representation of n^{th} Order Linear Differential Equation; Transformation to Phase Variable Canonical Form; Relationship Between State Equations and Transfer Functions; Characteristic Equation; Eigen Values and Eigen Vectors; Transformation to Diagonal Canonical Form; Jordan Canonical Form; Controllability Canonical Form; Observabilty Canonical Form; Decomposition of Transfer Function-Direct, Cascade and Parallel Decomposition; State Diagram; Solution of the Time-Invariant State Equation; State Transition Matrix and its Properties; Transfer Matrix; Transfer Matrix of Closed Loop Systems.
3. .	Controllability and Observability: Concept of Controllability and Observability; Kalman's Theorems on Controllability and Observability, Alternative Tests (Gilbert's Method) of Controllability and Observability; Principle of Duality; Relationship among Controllability, Observability and Transfer Function.
4.	Liapunov Stability Analysis : Stability of Equilibrium State in the Sense of Liapunov; Graphical Representation of Stability; Asymptotic Stability and Instability; Sign-Definiteness of Scalar Function; Second Method of Liapunov; Stability Analysis of Linear Systems; Krasovski's Theorem; Liapunov Function Based on Variable Gradient Method.
5.	State Feedback Control Design: Design of Robust Control Systems; State Feedback Control-Pole Placement Design, State Feedback with Integral Control.
6.	Observer Design: Design of Observer

Reference Books :

1. Modern Control Engineering, Fourth Edition, Prentice Hall, 2001- Katsuhiko Ogata

2. Automatic Control Systems, High Education Press, 2003- B. C. Kuo

3. Control Systems Engineering, Fifth Edition, New Age International Publishers, 2007- L. J. Nagrath & M. Gopal

4. Modern Control Systems, Sixth Edition, Addison-Wesley, 1993- Rich

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E Semester: 1

Electrical Engineering

Subject Name : Modern Power System Protection (Power Group)

Sr.No	Course content
1.	Basic Elements of Digital Protection: Application of Numerical relays for Interconnected power system networks, Basic Components of a Digital Relay, Signal Conditioning Subsystems, Transducers ,Surge Protection Circuits, Analogue Filtering, Analogue Multiplexers, Conversion Subsystem, The Sampling Theorem, Signal Aliasing Error, Sample and Hold Circuit, Digital Multiplexing ,Digital-to-Analogue Conversion,Analogue-to-Digital Conversion ,Digital Relay Subsystem, Benefits of digital relays
2.	Relay coordination of Interconnected Power System: Protection of an interconnected system, Link net structure, Flowchart of primary/Backup relay pairs, Flowchart of Time Multiplier Setting. Examples based on existing power system network
3.	Load-Shedding and Frequency Relaying: Introduction, Rate and Frequency Decline, Load-Shedding, Frequency Relays, Induction-Cylinder under frequency Relays, Digital Frequency Relays, microprocessor-Based Frequency Relay, Formulating a Load-Shedding Scheme, Maximum Anticipated Overload, Number of Load-Shedding Step, Size of the Load Shed at Each Step, Frequency Settings, Time Delay, Special Considerations for Industrial System
4.	Reclosing and Synchronizing: Introduction, Reclosing Precautions, Reclosing System Consideration, One-Shot vs. Multiple-Shot Reclosing Relays, Selective Reclosing, Deionizing Times for Three-Pole Reclosing, Live-Line/Dead-Bus, Live-Bus/Dead-Line Control, Instantaneous-Trip Lockout, Intermediate Lockout, Factors Governing Application of Reclosing Considerations for Applications of Reclosing , Feeders with No-Fault-Power Back-Feed and Minimum Motor Load, Single Ties to Industrial Plants with Local Generation, Lines with Sources at Both Ends, Reclosing Relays and Their Operation, Review of Breaker Operation, Single-Shot Reclosing Relays, Multishot Reclosing Relays, Synchronism Check, Phasing Voltage Synchronism Check Characteristic, Angular Synchronism

	Check Characteristic.
5	.Developments in New Relaying Principles Introduction, Traveling Wave Based Protection of Transmission Lines, Frequency Based Relaying , Series Compensated Line Protection, Introduction, The Degree of compensation, Voltage Profile of Series Compensated Line, Faults with Unbypassed Series Capacitors, Relay Problems Due to compensation, Voltage and Current Inversion, Problems in reach measurement, Protection of Series compensated line, Concept of Adaptive Relaying , Fault Location Algorithms
6.	Concept of Different Relay Algorithms Introduction of different techniques, Least square based methods, Introduction, Integral LSQ fit, Power series LSQ fit, Differential equation based techniques, Basic principles, Digital harmonic filtering by selected limits, Fourier analysis based techniques, Introduction, The full cycle window algorithm, The half cycle window algorithm.

List of Reference books:

1. Digital Protection- L P. Singh
2. Protective Relaying Theory and Applications, Walter A. Elmore, Marcel Dekker Inc; New York,
3. "Protecting Relaying," Marcel Dekker Inc; New York, 1998- J. L. Blackburn
4 "Power System Relaying," John Wiley & Sons, New York, 1996- S. H. Horowitz and A. G. Phadke
5 Power System Protection, IEEE Press, Wiley Interscience, A John Wiley & Sons Inc; New York, 1999- P. M. Anderson

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E Semester: 1

Electrical Engineering

Subject Name : NON-LINEAR CONTROL SYSTEMS (Control Group)

Sr.No	Course content
1.	Describing Function Analysis of Nonlinear Control System: Introduction to Nonlinear Systems, Describing Functions for Common Types of Nonlinearities, Describing Function Analysis, Stability and Limit Cycles.
2.	Phase Plane Analysis: Introduction: Analytical Methods for constructing Trajectories, Graphical Methods for constructing Trajectories; Isocline Method; Delta Method; Pell's Method; Lienard's Method; Classification of Singular Points; Limit Cycles; Phase-Place Analysis of Linear control system; Phase-plane Analysis of Non-linear control system. Minimum Time Trajectory; Optimum Switching Curve. Poincare-Bendixson Theorem.
3	Input-output analysis and stability: Small gain theorem, passivity, describing functions.
4	Mathematical background: Contraction mapping theorem, homeomorphisms, norms.
5	Lyapunov stability theory: Basic stability and instability theorems. Uniform stability, asymptotic stability, exponential stability. LaSalle's Theorem, indirect method.
6	Feedback linearization: Input-output linearization, full-state linearization, stabilization, tracking. Zero dynamics, MIMO systems, non-minimum phase systems, singularities.
7	Sliding mode control: Sliding surfaces, differential inclusions, solutions in the sense of Filippov
8	Gain scheduling: Controller and scheduling design.

Reference Books :

1. S. Sastry, Nonlinear Systems: Analysis, Stability, and Control, Springer 1999.
2. H. Khalil, Nonlinear Systems, Prentice Hall, 2002.
3. Jean-Jacques E. Slotine, Weiping Li, Applied nonlinear control, Prentice Hall, 1991

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E Semester: 1

Electrical Engineering

Subject Name: Electrical Drives (Power Electronics Group)

Sr.No	Course content
1	Fundamentals of Electrical Drives Dynamics of electrical drives, components of load torque, classification of load torque, concept of multi-quadrant operation, steady-state stability criteria.
2	DC Drives with phase controlled converters 1-phase fully controlled converter fed separately excited DC motor, modes of operation, steady-state motor performance equations, mode identification, speed-torque characteristics, operation with controlled fly-wheeling; operation with 1-phase half controlled converter; 3-phase fully controlled converter fed separately excited motor; Pulse width modulated rectifiers, equal pulse-width modulation, sinusoidal pulse width modulation; current control; multi-quadrant operation of fully-controlled converter fed DC motor; Dual converters based drives; Closed loop control of DC drives.
3	DC drives with dc-dc converters Principle of Motoring operation of separately excited and series motor with DC-DC converter, Steady-state analysis for time ratio control and current limit control; Regenerative braking; Dynamic and composite braking; multi-quadrant operation with dc-dc converters
4	Fundamental of Induction Motor (IM) and its control Review of IM: Steady-state analysis of an Induction motor; Starting and Braking methods; Speed control methods: variable terminal voltage, variable frequency control, rotor resistance control, injection of voltage in the rotor circuit; operation with a current source: operation with fixed frequency, variable frequency control.
5	Control of IM with solid state converters Control of IM using VSI : Six step inverter, PWM inverter, braking and multi-quadrant control, VVVF control Control of IM using CSI:Three-phase CSI, Braking, PWM in a thyristor CS inverter, PWM with GTO based CSI, Variable frequency drives, Comparison of

	CSI and VSI based drives. Current controlled PWM inverters:AC voltage controllers : AC voltage controller circuits, four quadrant control and closed-loop operation; fan/pump and crane/hoist drives; ac voltage controller starters Slip power controlled IM drives:analysis of stator rotor resistance control, Static scherbius drive: power factor considerations, rating and applications, performance
6	Synchronous motor drives (6 Hrs) Wound field cylindrical rotor motor, equivalent circuits, operation with constant voltage and frequency response : motoring and regenerative braking operations, power factor control and V-curves, operation with current source; Wound field salient pole motor; operation with variable voltage source and constant frequency; Starting and braking when fed from constant freq source; brushless excitation of wound field machines; Permanent magnet motor operating from a fixed frequency source; Operation with non-sinusoidal supplies.

References:

1. “Power semiconductor controlled drives”, Prentice Hall, New Jersey, 1989- G.K. Dubey
2. 'Fundamentals of Electrical Drives', Narosa, N. Delhi and Toppan Singapore, 1994- G.K. Dubey
3. “Modern Power Electronics and AC Drives”, Prentice Hall India, New Delhi, 2002- B.K. Bose
4. “Power Electronics - circuits, devices and applications”, Prentice Hall of India, 2nd ed., 2000- Muhammad H. Rashid
5. “Thyristor DC Drives”, John Wiley and Sons Ltd., April 1981- P.C. Sen

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E Semester: 1

Electrical Engineering

Subject Name: Advanced Micro Architecture (Micro Group)

Sr.No	Course content
1.	Parallel Architecture: Memory input-output subsystem – hierarchical memory structure, virtual memory system, memory allocation and management, input output subsystem, Cache memory.
2.	Pipeline Architecture: Principles of pipelining and vector processing Pipelining- an overlapped parallelism- instruction and arithmetic Pipeline- principles of designing pipeline processors,
3.	Vector Architecture: Vector Processing requirements. Vector methods, structures and algorithms for array processors, SID computer and performance enhancement.
4.	Multiprocessor Architecture Functional structures, inter-connection networks, parallel memory organization, Multiprocessor OS, exploiting concurrence for multiprocessing.
5	Inter Processor Communication: Interprocess communication mechanism, dead lock and protection, multiprocessing scheduling strategies, parallel algorithms for multiprocessors.
6	Reduced Instruction Set Computers (RISC) and ARM Architecture: Instruction execution characteristics, Use of a larger register file, Compiler based register optimization, RISC architecture: Motorola 88510, R4650
7	Superscalar Architecture: CPU structure and function- Power PC and Pentium, Linear and nonlinear pipeline processors.

Reference Books

1. Computer Architecture : Henry Peterson
2. Computer Organization & Architecture; William Stalling
3. Computer system architecture ; Morris Mano
4. Structured Computer Architecture; Tannembaum

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E Semester: 1

Electrical Engineering

Subject Name : Energy Management

Sr.No	Course content
1.	Energy management: Concept of energy management, elements of energy management, energy cost, energy performance, energy saving calculations, balancing energy use and requirement, maximizing system efficiencies, optimizing input energy requirement, Demand Side Management
2.	Quality and Reliability of Industrial / Commercial Power Systems: Introduction, Harmonics in supply system, Voltage Sag, Power Factor Reliability analysis of power system
3.	Economic aspects of energy audit: Cost evaluation by ROI, IRR Cost evaluation by payback terms. Organization for energy management. Conservation measures and diagnostic review
4.	Energy Audit & Case Studies: Introduction, types and walkthrough energy audit. Energy audit at unit level, Industrial Audit approaches. Procedure for energy audit and equipments required. Comprehensive Energy audit Site testing Measurement & Analysis of Electrical System like Induction Motors, Transformers, synchronous Machines, Illumination system, Domestic Appliances Site testing Measurement & Analysis of Electrical System like Boilers, Furnaces, Refrigeration and Air-conditioning System
5	The Electric Utility in Industry: Introduction, Electric utilities characterized by function, Different regulated electric utility frameworks, “Electric Utility” structure in deregulated industry, Energy conservation task in industry, Co – generation, Energy conservation in cement, textile, sugar, etc. industry Energy conservation in building.
6	Energy performance assessment of motors / variable speed drives Introduction, Efficiency of the induction motor, Determining motor loading Field tests for determining efficiency, Performance evaluation of rewound motors, Format for data collection, Concept of variable frequency drives and Applications, Factors for successful implementation of variable speed drives, Information needed to evaluate energy savings for variable speed application

7	Energy performance assessment of Pumps, Compressors, Blowers and Cooling Towers: Introduction and types, Performance terms and definitions, Performance Analysis and suggestions
8	Modern Energy efficient technologies Maximum demand controller , Automatic power factor controller, Energy efficient motors, Soft starters with energy saver, Energy efficient transformers, electronic ballast, occupancy sensors etc. Energy efficient lightning controls, Energy saving in transportation system especially electric vehicle, Energy saving in air conditioning system

Reference:

1. A Guide to Energy Management by Barney L Capehart, William J Kennedy, Wayne C Turner
2. Energy Technology by S. Rao
3. Energy conservation techniques by P.M. Dave & M.N.sheth
4. Course Material for Accredited Energy Managers & Energy Auditors – Bureau of Energy Efficiency

   website : www.energymanagertraining.com, www.bee-india.gov.in

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E Semester: 1

Electrical Engineering

Subject Name : Simulation Laboratory

SIMULATION LABORATORY

This laboratory should have equal wieghtage of MATLAB and LabVIEW based simulations. Students should be able to work on both these tools effectively so that s/he can use it for possible project work in second year.

A. MATLAB based simulation experiments :

1. Introduction to basics of MATLAB programming.
2. Introduction to various tool boxes like control system, optimization tool box etc.
3. Introduction to Simulink and various bolcksets.
4. Plotting response of first order circuits and second order circuits with the help of MATLAB programming.
5. Solution of set of linear equations by programming.
6. Solution of set of non-linear equations by programming of N-R method.
7. Simulation of first order circuits and second order circuits using Simulink (Use of different ode solvers and different time step etc may be elaborated).
8. Analysis of three phase bridge rectifier circuits with different type of R-L-E load in Simulink.
9. Analysis of performance of 400 kV long transmission line with the help of Simulink with suitable voltage sources at both ends.
10. Design of speed control system of D.C shunt motor with suitable load.
11. Simulation of control system represented in state space form.

The student should be able to utilize the potential of MATLAB as simulation and design tool.

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E Semester: 1

Electrical Engineering

Subject Name : Core Laboratory-I

The laboratory deals with the practical aspects of the three core subjects and the elective subject offered in this semester. It is planned to impart the practical insight of these subjects to the students through the actual implementation, analysis and/or simulation of some of the theories covered in the subjects. The representative outline of the lab is as under:

Core-1:

1. Load flow using Gauss Seidel method
2. Load flow using Newton Raphson method
3. Load flow using Fast Decoupled method
4. Z_{BUS} building algorithm for fault analysis
5. Programme for solution of sparse network equations by optimally ordered triangular factorization
6. Tutorial/Example on State estimation of power system network
7. Solution of differential equation using forward Euler's method, backward Euler's method and trapezoidal method

Core-2:

1. Design of an inductor for a given DC-DC converter configuration. The converter topology and the specifications for the inductor should be specified by the course instructor.
2. Study of V/f control method of the three phase induction motor
3. Observe the output voltage, input current and output current waveform and hence, study the harmonic spectrums of input and output current waveform
4. Also measure the speed, terminal voltage and line current at various frequencies and plot v/f ratio versus speed.

B. Study the performance of a DC drive employing DC chopper.

1. Observe the input and output voltage and currents.
2. Observe the waveforms for low load and high load operation.
3. Study the effect of time-ratio control and/or frequency control on the performance of the motor.

C. Study the firing scheme/circuit of a 3-phase AC voltage controller and hence, observe the output voltage and current of a 3-phase AC-voltage controller (configuration left at the liberty of the instructor) with balanced R and R-L load. Evaluate the harmonic contents in the output waveforms.

D. Study of driver circuits for 3-phase bridge inverter and hence, to operate the inverter in 120°, 150° and 180° mode. Record the output voltage waveforms with R and R-L load and critically evaluate them.

Core-3:

1. Steady state error and stability analysis for the given system using MATLAB.
2. Obtain transient response (Step and Ramp input) for the given control system using MATLAB.
3. Design of P, PI and PID controller for DC motor position control using MATLAB.
4. Design of P, PI and PID controller for digital pendulum system.
5. Design state feedback controller for the DC motor speed control using MATLAB.
6. Design state feedback controller for the pendulum using MATLAB.

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E Semester: 2

Electrical Engineering

Subject Name : Advanced Electrical machines

Sr. No.	Course Content
1.	Brushless DC Machines: Construction and working principle, Equivalent magnetic circuit, Type of converter and speed control, Comparison between the axial and radial permanent magnet motors, applications.
2.	Stepper Motors: Definition and types of stepper motors, Various modes of operation of Variable reluctance (VR) stepper motors, Micro stepping control of stepper motor, Multi stack VR stepper motor construction and working, Construction and working of Permanent Magnet (PM) stepper motor, Construction and working of Hybrid stepper motor, Torque-angle characteristics of the stepper motor.
3.	Switched Reluctance Motor: Construction, operating performance, Type of converter and speed control, applications.
4.	Linear Induction Machines: Construction, operation, performance, control and applications.
5.	Energy Efficient motors: Standard motor efficiency, concept of Energy efficient motor. Efficiency evaluation technique, Direct Measurement method, Loss, Segregation method, Comparison, motor efficiency labeling, Energy efficient motor standards. Motor life cycle, Direct Savings and pay back analysis, Efficiency evaluation factor.
6.	Wind mill Generator: Comparision with synchronous generator , constant voltage & frequency generation, reactive power compensation,
7.	Condition Monitoring of Electrical Machines: Concept of condition monitoring, benefit of condition monitoring, Fault detection & diagnosis techniques for Transformer and Induction motor, Recent trends in condition monitoring.
8.	Basic principle of electric machine analysis: Introduction, magnetically coupled circuits, electromechanical energy conversion, machine windings and air-gap MMF-Winding inductances and voltage equations.
9.	Reference frame theory: Introduction, Equation of transformation, stationary c ircuit variables transformed to the arbitrary reference frame- commonly used reference frames- transformation between reference frames, transformation of a

	balanced set, balanced steady state phasor relationships, balanced steady state voltage equations, variables observed from several frames of reference.

Text Books/References:

1. "Brushless Permanent-Magnet Motor Design", Mcgraw Hill- D. C. Hanselman
2. "Stepper Motors: Fundamentals, Applications and Design", New Age International Pvt. Ltd, 2002- V. V. Athani
3. "Electric Machinery", TMH Publication, 2002- A. E. Fitzerald, Charles Kingsley and Stephen D Umans
4. "Condition Monitoring of Electrical Machines", John Wiley & Sons. 1987 - P. Tavner and J. Penam
5. "Principles of Power Electronics", John Wiley and Sons, 2003- P. C. Sen
6. "Alternating Current Machines" (ELBS publication) - M.G.Say
7. Analysis of electric machinery and drive systems, Second edition, Wiley interscinece- Paul C.Krause, Oleg Wasynnczuk, and S.D. Sudhoff
8. Dynamic simulation of electric machinery, Prentice Hall PTR, 1997- C.M.Ong
9. Wind Electrical Systems By Bhadra, Kastha & Benerajee (OXFORD Higher Education)

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E Semester: 2

Electrical Engineering

Subject Name : Digital Signal processing

Sr No.	Course Content
1	Discrete time systems, z-transform, LTI systems, description by difference equations, system function, Impulse response and frequency response, Realization structures for IIR and FIR digital systems.
2	Discrete convolution, Discrete Fourier Transform and Fast Fourier Transforms, Inverse DFT, Algorithms for efficient computation of DFT and FFT. Fast convolution. Correlation.
3	Implementation of DSP algorithms, Block diagram and signal flow graph representations, Basic IIR and FIR filter structures, Cascaded, parallel and lattice realizations, computational complexity., Finite word length effects and quantization errors
4	Digital filter design. FIR and IIR filters, linear phase filters, design techniques for IIR and FIR filters,. Analysis of finite word length effects.
5	Estimation of Auto-correlation and Power Spectra of random signals. Non-parametric methods – averaging periodograms, Welch method, Blackman and Tukey method, Parametric methods, AR, MA and ARMA models, Yule Walker method, Levinson-Durbin algorithm
6	Multi-rate digital signal processing. Poly-phase decomposition, multistage decimators and interpolators, Digital filter banks. Adaptive filtering, minimum mean square error criterion, Wiener filter, LMS adaptive algorithm
7	General purpose DSP processors, Implementation of DSP algorithms on General purpose processors, Special purpose DSP processors –Hardware digital filters and FFT processors.
8	Applications in voice processing, radar, Image processing.

References:

1. Digital Signal Processing: Principles, Algorithms and Applications: 3rd Ed.- Prentice-Hall (India)- Proakis and Manolakis
2. Digital Signal Processing: A Computer Based Approach: Tata McGraw Hill- S.Mitra
3. Digital Signal Processing : Rabiner and Gold
4. Digital Signal Processing : Johnson

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E Semester: 2

Electrical Engineering

Subject Name : Power System Dynamics & Control (Power Group)

Sr No.	Course Content
1.	Generator Modeling - I (Machine Viewpoint):Classical Machine Description, Voltage Generation, Open-Circuit Voltage, Armature Reaction, Terminal Voltage, Power Delivered by Generator, Synchronizing Generator to an Infinite Bus, Synchronous Condenser, Role of Synchronous Machine Excitation in Controlling Reactive Power.
2	Generator Modeling – II (Circuit Viewpoint):Energy Conversion, Application to Synchronous Machine, The Park Transformation, Park's Voltage Equation, Park's Mechanical Equation, Circuit Model, Instantaneous Power Output, Applications, Synchronous Operation, Steady-state Model, Simplified Dynamic Model, Generator Connected to Infinite Bus (Linier Model).
3	Excitation and Prime Mover Controllers: Excitation System, Excitation System Modeling, Excitation System – Standard Block Diagram, System Representation by State Equation, Prime Mover Control System.
4	Transmission Lines, SVC and Loads: Transmission Lines, D-Q Transmission using α – β Variables, Static VAR Compensators, Loads.
5	Dynamics of a Synchronous Generator Connected to Infinite Bus:System Model, Synchronous Machine Model, Application of Model 1.1, Calculation of Initial Conditions, System Simulation, Consideration of Other Machine Model, Inclusion of SVC Model.
6	Analysis of Single Machine System: Small Signal Analysis with Block Diagram Representation, Characteristic Equation (CE) and Application of Routh-Hurwithz Criteion, Synchronizing and Damping Torque Analysis, Small Signal Model : State Equation, Nonlinear Oscillations – Hopf Bifurcation.
7	Analysis of Multi-machine System: Simplified system Model, Detailed models: Case I, Detailed models: Case II, Inclusion of Load and SVC dynamics, Modal Analysis of Large Power Systems, Case Studies.

Reference Books :

1. Power Systems Analysis By Vijay Vittal, Bergen , Pearson Education
2. Power System Dynamics By K R Padiyar, B S Publications
3. Power System Stability & Control, By- P.Kundur,Tata Mcgraw hill
4. www.**ee**.**iitb**.ac.in/~peps/**download**s.html

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E Semester: 2

Electrical Engineering

Subject Name : DIGITAL CONTROL SYSTEMS (Control Group)

Sr. No.	Course Content
1	Introduction;
2	The Z-Transformation; Properties of Z-Transform; Solving Differential Equation by the Z-Transform Method; The Inverse Z-Transformation
3	Sampling Theorem Frequency Response Characteristics of Zero-order Holding Devices; Pulse transfer Function; Pulse Transfer Functions of Closed-Loop system;
4	Stability Analysis in the Z-plane; Bilinear transformation, Jury's Stability test;
5	Root Locus technique;
6	Steady state error and error constants; Frequency response and Nyquist Stability criteria in the Z-plane;
7	Time Domain and Frequency Domain Technique for Designing Compensators in the Z-plane;
8	State space Representation of Discrete time System; Decomposition of Discrete Transfer Functions-Direct, Cascade and Parallel Decomposition Solution of Discrete time state equations; Evaluation of state transition Matrix, Discretisation of Continuous Time-state Equations.

Reference Books:

1. Katsuhiko Ogata, Discrete-time Control Systems, Second Edition, Pearson Education, 1995.
2. M. Gopal, Digital control and state variable methods: conventional and neural-fuzzy control systems, Second Edition, Tata-McGraw-Hill, 2003

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E Semester: 2

Electrical Engineering

Subject Name : Application of Power Electronics in Power Systems (Power Electronics Group)

Sr. No.	Course Content
1	Introduction: Background, Electrical Transmission Networks, Flow of power in AC system and conventional control mechanisms, Definition of Flexible ac Transmission Systems (FACTS) and brief description, Possible benefits from FACTS, Emerging Transmission Networks.
2	Reactive-Power Control in Electrical Power Transmission Systems: Reactive Power, Uncompensated Transmission Lines, Passive Compensation
3	Principles of Conventional Reactive-Power Compensators Synchronous Condensers, The Saturated Reactor (SR) , The Thyristor- Controlled Reactor (TCR), The Thyristor-Controlled Transformer (TCT) , The Fixed Capacitor-Thyristor-Controlled Reactor (FC-TCR) , The Mechanically Switched Capacitor-Thristor-Controlled Reactor (MSC-TCR), The Thyristor-Switched capacitor and Reactor, The Thyristor-Switched capacitor-Thyristor-Controlled Reactor (TSC-TCR), A Comparison of Different SVCs, Summary
4	Static shunt compensators: Objective of shunt compensation, Methods of controllable var generation, SVC, and STATCOM, Comparison between SVC and STATCOM.
5	The Thyristor-Controlled Series Capacitor (TCSC): Series Compensation, The TCSC Controller, Operation of the TCSC, The TSSC, Analysis of the TCSC, Capability Characteristics, Harmonic Performance, Losses. Response of the TCSC, Modeling of the TCSC
6	TCSC Applications: Open-Loop Control, Closed-Loop Control, Improvement of the System- Stability Limit, Enhancement of System Damping, Sub synchronous Resonance (SSR) Mitigation, Voltage-Collapse Prevention, TCSC Installations
7	Combined compensators: Introduction, operating principle and control structure of UPFC, IPFC, Generalized and multi functional FACTS controllers
8	Special Purpose Facts Controllers: Sub synchronous Resource; NGH-SSR Damping Scheme, Thyristor-Controlled Breaking Resistor (TCBR)

Reference Books:

1. Thyristor-based FACTS controllers for Electrical Transmission Systems : R. Mohan Mathur, R K Verma, Wiley IEEE Press
2. Understanding FACTS, N.G.Hingorani and L.Gyugyi, Standard Publishers, Delhi, 2001
3. FACTS Controllers in Power Transmission & Distribution: Padiyar K R, New Age International (P) Limited.
4. Reactive Power Control in Electric Systems: T J E Miller, John Willey
5. Power System Stability and Control, Prabha Kundur, Tata McGrawhill

GUJARAT TECHNOLOGICAL UNIVERSITY
M.E Semester: 2

Electrical Engineering

Subject Name : Digital Image Processing (Micro)

Sr. No.	Course Content
1	Image Processing Operation, Digital Image Representation: Coordinate Conventions, Images as Matrices, Reading, writing and displaying Images, Data Classes Image Types: Binary and Intensity Images; Conversion of Image classes and types, Array Indexing, Vector Indexing.
2	Intensity and Spatial Transforms: Intensity Transformation Functions : Logarithmic and Contrast-Stretching Transformations; Histogram Processing and Function Plotting - Generating and Plotting Image Histograms , Histogram Equalization and Histogram Matching (Specification) , Spatial Filtering- Linear and Non Linear, Standard Filters.
3	Frequency Domain Processing: Filtering in frequency domain-DFT, Generating Frequency domain filters- from Spacial Domain, Direct Method.Mesh Grid Array, LP filters, Sharpening- HP filters, HF emphesis filtering, Wireframe and surface Plotting
4	Image Restoration: Degradation Model, Noise Models, Periodic Noise, Estimation of Noise Parameters, Direct Inverse Filters-Winner Filtering, Constrained LS filters, Adaptive Noise Filters, Noise reduction –Spatial Domian, Frequency domain. Blind Deconvolution
5	Color Image Processing: Image Representation- RGB, Indexed Images. Space coversion- NYSC, YCbCr, HSV, HIS, CMY and CMYK; Basics of Color Image processing, Smooting and Sharpening,Segmentation
6	Image Compression: Color Redundancy- Interpixel, Psychological, Huffman code-coding & Decoding, RGB Compression-JPEG, JpEG2000
7	Image Segmentaion: Point, Line and Edge detection, Hough Transform for Detection, Thrshoulding -Local and Globel, Region Based Segmenation, Wvalet transform and application for Image Segementation, Distacne Transform and Watershed Segmentation
8	Object Recognition: Distance Measures, Decision Theoratic Methods-Maximum Distance classifier, Correlation matching, String Matching, Optimal Statistical Classifier, Adative Recognition.

Reference Books

1. Gonzalez and Woods: Digital Image Processing
2. Gonzalez and Woods: Digital Image Processing using MATLAB
3. Anil K Jain: Fundamentals of Digital Image Processing - PHI
4. Castleman: Digital Image Processing
5. Madhuri Joshi: Digital Image Processing

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E Semester: 2

Electrical Engineering

Subject Name : Flexible AC Transmission systems (Power)

Sr.No	Course content
1.	Introduction Background.,Electrical Transmission Networks., Conventional Control , Mechanisms.,Flexible ac Transmission Systems (FACTS),Emerging Transmission Networks.
2.	Reactive-Power Control in Electrical Power Transmission Systems: Reactive Power, Uncompensated Transmission Lines,Passive Compensation
3.	Principles of Conventional Reactive-Power Compensators Synchronous Condensers , The Saturated Reactor (SR) , The Thyristor-Controlled Reactor (TCR) , The Thyristor-Controlled Transformer (TCT) , The Fixed Capacitor-Thyristor-Controlled Reactor (FC-TCR) , The Mechanically Switched Capacitor-Thristor-Controlled Reactor (MSC-TCR) , The Thyristor-Switched capacitor and Reactor, The Thyristor-Switched capacitor-Thyristor-Controlled Reactor (TSC-TCR), A Comparison of Different SVCs, Summary
4.	SVC Control Components and Models Measurement Systems , The Voltage Regulator, Gate-Pulse Generation, The Synchronizing System, Additional Control and Protection Functions, Modeling of SVC for Power-System Studies
5.	Concepts of SVC Voltage Control Voltage Control, Effect of Network Resonances on the Controller Response, The 2nd Harmonic Interaction between the SVC and ac Network, Application of the SVC to Series-Compensated ac Systems, 3rd Harmonic Distortion, Voltage-Controlled Design Studies
6.	Applications Increase in Steady-State Power-Transfer Capacity, Enhancement of Transient Stability, Augmentation of Power-System Damping, SVC Mitigation of Subsychronous Resonance (SSR), Prevention of Voltage Instability
7.	The Thyristor-Controlled Series Capacitor (TCSC)

	Series Compensation, The TCSC Controller, Operation of the TCSC, The TSSC, Analysis of the TCSC, Capability Characteristics, Harmonic Performance, Losses. Response of the TCSC, Modeling of the TCSC
8.	TCSC Applications Open-Loop Control, Closed-Loop Control, Improvement of the System-Stability Limit, Enhancement of System Damping,, Sub synchronous Resonance (SSR) Mitigation, Voltage-Collapse Prevention, TCSC Installations
9.	Emerging FACTS Controllers The STATCOM, THE SSSC, The UPFC, Comparative Evaluation of Different FACTS Controllers, Future Direction of FACTS Technology

Reference Books:

1. Thyristor-based FACTS controllers for Electrical Transmission Systems : R Mohan Mathur, R K Verma, Wiley IEEE Press
2. Understanding FACTS, N.G.Hingorani and L.Gyugyi, Standard Publishers, Delhi, 2001
3. FACTS Controllers in Power Transmission & Distribution: Padiyar K R, New Age International (P) Limited.
4. Reactive Power Control in Electric Systems: T J E Miller, John Willey
5. Power System Stability and Control, Prabha Kundur, Tata McGrahill

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E Semester: 2

Electrical Engineering

Subject Name: MODELLING AND SIMULATION OF DYNAMIC SYSTEMS (Control)

Sr.No	Course content
1.	Introduction Dynamics systems, Examples of dynamic; systems, Definitions related to dynamic systems, Classification of system inputs, classification of system models. System modeling and simulation.
2.	Modeling of Mechanical and Electrical Systems: Translational systems: Springs, Dampers, Mass, Rotational Systems: D'Alembert's Principle, Lagranges's Equation, Three dimensional motion Elective Systems: Basic Elements, Passive Circuit Analysis, Active circuit analysis: The operational amplifier Mechanics
3.	Fluid Systems: Properties of fluids: Density, equation of state, Liquids and Gases, Viscosity, Propagation of speed, Thermal properties, Reynolds Number Effects. Derivation of passive components, resistance, inductance and capacitance. Thermal System: Basic Effects, conduction, convection and Radiation, Circuit analysis of static thermal system: Signal and Multiple lumped capacitance modeling
4.	Transform Methods for Generalized Response: Impulse response, Convolution integral: Response to arbitrary inputs when impulse response is known, Frequency response, Response to periodic Inputs, transient inputs and random signal. Simulation Methods: Limitations of analytical methods, Analog Simulation. Digital Simulation: Specific Digital Simulation techniques
5.	Generalized Modeling Methods: Frequency response methods, Pulse testing methods, Random Signal testing methods, Parameter tracking methods, Multiple regression and least square methods, Subsystem Coupling Methods.
6.	Applications (Distributed Parameter Models) Longitudinal vibrations of a rod, Lumped Parameter approximations for rod vibration, Conduction heat translation in an Insulated Bar, Lumped parameter approximations for heat transfer in insulated bar. Magnetic Levitation system for an Experimental Rail vehicle.

Reference Books:

1. System Modeling and Response: Theoretical and Experimental Approaches. Ernest O. Dobling, John Wiley and Sons, 1980.
2. Modeling and Simulation of Dynamic Systems: Robert Woods, Kent L. Lawrence, PHI.

3. Simulation Modeling and Analysis: Averill M. Law, W. David Kelton. McGraw Hill
4. System Dynamics: Modeling Analysis, Simulation, Design: Ernest O. Dobling, Marcel Dekker Inc.
5. Modeling of Dynamical Systems Vol. I: H. Nicholson (Editor), Peter Peregrinus Ltd., on behalf of IEE (Useful for unit 6) 116842, 1980 Edition
6. Dynamic Modeling and Control of Engineering Systems: J. Lowen Sheaser, Bohan T. Kulawski Macmillan Publishing Company NY, 158275, 1990 Edition

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E Semester: 2

Electrical Engineering

Subject Name : Advanced Power Converters (Power electronics)

Sr.No	Course content
1.	Resonant Converters Introduction, Classification of resonant converters, basic resonant circuit concepts, load resonant converters, resonant switch converters, zero-voltage switching, clamped voltage topologies, resonant dc link inverters with zero voltage switching, high-frequency-link integral-half-cycle converters
2.	Multi-level converters Bridge inverters, Need for multi-level inverters, Concept of multi-level, Topologies for multi-level: Diode Clamped, Flying capacitor and Cascaded multi-level configurations; Features and relative comparison of these configurations; Switching device currents; DC-link capacitor voltage balancing, features of multi-level converters, Applications
3.	Matrix converters Fundamentals of matrix converter technology, Analysis of bi-directional switch topologies, Modulation techniques for matrix converters, Performance and control of matrix converters, commutation and protection issues
4.	Flexible AC Transmission Systems Introduction, Principle of power transmission, Principle of shunt compensation, Shunt compensators: Thyristor controlled reactor, Thyristor switched capacitor, Static VAR compensator; Principle of series compensation; Series compensators: Thyristor switched series capacitor, Thyristor controlled switched capacitor, Forced commutated controlled switched capacitor; Series static VAR compensator, Advanced SSVC, Phase angle compensator, UPFC.
5.	Multi-pulse converters Concept of multi-pulse, Types of multi-pulse converters, different transformer connections for multi-pulse converters, Applications of multi-pulse converters.
6.	Converters for some special applications Power electronic converters for renewable energies like solar and wind, Induction Heating, HVDC etc.

Activities:

1. Comparison of harmonic spectrum of different configurations of multi-level converter and bridge converters.
2. Determination of the performance indices for 12, 24, 48 and 96 pulse converters.
3. Simulating a closed-loop scheme for reactive VAR compensation using static VAR compensation.
4. Presentation on any one course related topic from the recent literature.

Reference Books:

1. "Power Electronics – Converters, Applications and Design", John Willey & sons, Inc., 3rd ed., 2003- Mohan, Undeland and Robbins
2. "Power Electronics - circuits, devices and applications"- Muhammad H. Rashid Prentice Hall of India, 3rd ed., 2009.
3. "Power Electronics Handbook", Academic Press, California, 2001- Muhammad H. Rashid
4. "Control in Power - Marian P. Kazmierkowskim R. Krishnan and F. Blaabjerg Electronics"
5. "Modern Power Electronics ", S. Chand and Co. Ltd., New Delhi, 2000- P.C.Sen
6. Recent Literature
7. Paice Derek A , "Power Electronic Converter Harmonics: Multi-Pulse Methods for Clean Power", IEEE Press New York
8. Dubey G.K. Doradla S.R. Joshi A. Sinha R.M.K, "Thyristorised Power Controllers", New age International ltd., New Delhi,1996.

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E Semester: 2

Electrical Engineering

Subject Name : Embedded system Design (Micro)

Sr.No	Course content
1.	Embedded system Introduction: Introduction to Embedded System, History, Design challenges, optimizing design metrics, time to market, applications of embedded systems and recent trends in embedded systems, embedded design concepts and definitions, memory management, hardware and software design and testing, communication protocols like SPI, SCI, I2C, CAN etc
2.	System Architecture: Introduction to ARM core architecture, ARM extension family, instruction set, thumb Instruction set, Pipeline, memory management, Bus architecture, study of on-chip peripherals like I/O ports, timers, counters, interrupts, on-chip ADC, DAC, RTC modules, WDT, PLL, PWM, USB etc.
3.	Interfacing and Programming: Basic embedded C programs for on-chip peripherals studied in system architecture. Need of interfacing, interfacing techniques, interfacing of different displays including Graphic LCD (320X240), interfacing of input devices including touch screen etc, interfacing of output devices like thermal printer etc., embedded communication using CAN and Ethernet, RF modules, GSM modem for AT command study etc.
4.	Real time Operating System Concept: Architecture of kernel, task scheduler, ISR, Semaphores, mailbox, message queues, pipes, events, timers, memory management, RTOS services in contrast with traditional OS. Introduction to uCOSII RTOS, study of kernel structure of uCOSII, synchronization in uCOSII, Inter-task communication in uCOSII, memory management in uCOSII, porting of RTOS.
5.	Embedded Linux Introduction to the Linux kernel, Configuring and booting the kernel, The root file system, Root file directories, /bin, /lib etc., Linux file systems, Types of file system: Disk, RAM, Flash, Network. Some debug techniques- Syslog and strace, GDB, TCP/IP Networking- Network configuration, Device control from user space- Accessing hardware directly, Multi processing on Linux and Inter Process Communication- Linux process model and IPCs,

	Multithreading using pThreads - Threads vs. Processes and pThreads, Linux and Real-Time- Standard kernel problems and patches., Device Driver Basics, Writing Device Driver, Boot loaders, configuring uBOOT for target, Kernel configuration, Linux Porting and Flashing, File System etc

Reference Books:

1. " Embedded sytem design " , PHI- Frank Vahid
2. " Embedded Sytems " TMH- Rajkamal
3. " Embedded systems software primer" Pearson- David Simon
4. "ARM System-on-Chip Architecture" Pearson- Steve Furber
5. " MicroC/OS-II" Indian Low Price Edition- Jean J Labrose

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E Semester: 2

Electrical Engineering

Subject Name : ELECTRICAL POWER UTILIZATION

Sr.No	Course content
1.	Electric Traction: Features of an ideal traction system, Systems of electric traction, Mechanism of train movement, Speed-time curve, Traction supply system, Transmission line to substation, Feeding and distributing system on an ac traction, System of current collection-traction, Motors-tractive effort and horse power, Speed control Schemes Electric braking
2.	Electric heating & welding: Classification, Radiant heating, Induction heating, High frequency eddy current Heating, Dielectric heating, Arc furnace, Electric welding, Heating element, Methods and equipments, Electrolysis and Electroplating applications
3.	Illumination: Radiant energy-terms and definitions, Laws of illumination, Polar curves, Photometry, MSCP, Integrating sphere, luminous efficacy, illumination levels for various purposes, Light fittings, Factory lighting, Flood lighting, Street lighting Energy conservation in lighting: Types of lamps and ballasts
4.	Air conditioning and refrigeration: Control of temperature, Protection of motors, Simple heat load and motor ,Calculations, Function of complete air conditioning system, Type of compressor Motor, Cool storage, Estimation of tonnage capacity and motor power, Technology of electric and hybrid electric vehicles
5.	Electrolytic processes: Fundamental principles, Extraction and refining of metals, Electrodeposition, Manufacture of chemicals, Power supply for elecgtrolysis purposes.
6.	Domestic electrical appliances: Construction and working of washing machine, mixer, hair dryer, vacuum cleaner, microwave oven.

References Books**:**

1. “Utilisation of Electric Energy”, Orient Longman,1986- Taylor E Openshaw
2. “Utilization of electric power and electric traction”, S K Kataria & Sons, 2002- J B Gupta
3. “Generation, Distribution and utilization of electrical energy”, Wiley Eastern Limited,1993- Wadhwa. C.L
4. “A course in electric power”, Dhanapat Rai & sons, 2001- Soni, Gupta, Bhatnagar
5. “Electrical Power”,Khanna pulishers,1988- S.L.Uppal
6. “Utilisation of Electric energy”- Garg and Girdhar

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E Semester: 2

Electrical Engineering

Subject Name : Core Laboratory- II

The laboratory deals with the practical aspects of the two core subjects offered in third semester. It is planned to impart the practical insight of these subjects to the students through analysis and/or simulation of some of the theories covered in the subjects. The representative outline of the lab is as under:

Core-4- :

List of laboratory experiments:

1. Torque- angle characteristic of stepper motor.

2. Case study of payback period of energy efficient motor.

3. Operating characteristics of wind mill generator.

4. Fault detection of induction motor.

5. Fault detection of transformer.

6. Performance characteristic of brushless excited motor.

7. Force and torque analysis of linear induction motor.

8. Induction motor modeling by reference frame theory

Core-5:

LABORATORY EXERCISES

1. Write a C code to generate: wave tables using: Interpolation, Truncation, Rounding techniques.

2. Write C-function modules to generate Wave-tables for: Sine, Triangular and Square Wave

3. Write a C code to evaluate DTF and IDFT of a discrete sequence.

4. Study of MATLAB, SIMULINK and Tool boxes- SP, DSP, FDA, SPTools

5. Use Tool boxes to develop MATLAB Codes for the following signal processing operations

(a). Function Generation: Real function , Complex function

(b). Signal Operations: Linear Convolution, Circular Convolution, De convolution, Autocorrelation, Cross correlation,

(c). Sampling: Up Sampling, down sampling, Dissemination, Interpolation

(d). Transforms: DFT, DCT

6. Use FDA, SPTools…

(a). to design Chebyshev, Butterworth, Composite, Moving Average filters.

(b). for Analysis of FIR and IIR Filters

Subject Name : Elective Laboratory

The laboratory deals with the practical aspects of the two elective subjects of respective group offered in this semester. It is planned to impart the practical insight of these subjects to the students through the actual implementation, analysis and/or simulation of some of the theories covered in the subjects. The representative outline of the lab is as under:

Elective-2 (Power System Dynamics and Control)-Power Group:

List of Experiments:

1. Simulation of SMIB system with different generator models in steady state

2. Simulation of SMIB system method with and without AVR (With different generator models)

3. Eigen-analysis of SMIB with different generator models

4. Simulation of SMIB system to verify eigen-analysis for small disturbance.

5. Simulation of SMIB system for different large disturbances and different generator models

6. Simulation of multi-machine system and verification of eigen-analysis for small disturbances.

Other simulations can be designed based on the examples given in text books.

Elective-3 (Flexible AC Transmission Systems) – Power Group:

Suggested List of Practical:

1. Few simulations for performance of uncompensated transmission line
2. Simulations for performance of mid point shunt compensated transmission line
3. Simulation for performance of series compensated transmission line
4. Simulation of a transmission line with a FC-TCR at receiving end with firing control
5. Simulation of transmission line with a SVC at receiving end with firing control
6. Simulation of transmission line with a TCSC with firing control scheme

Elective-2 (DIGITAL CONTROL SYSTEMS) – Control Group:

1. Digital control tutorial using MATLAB
2. Obtain the Z-transform and Inverse Z-transform using MATLAB
3. Obtain transient response (Step and Ramp input) for the given digital control system using MATLAB.
4. Design of digital PID controller for digital DC motor position control using MATLAB
5. Design of digital PID controller for digital pendulum system
6. Design digital state feedback controller for the DC motor speed control using MATLAB.
7. Design digital state feedback controller for the pendulum using MATLAB.
8. Design of digital state feedback controller for digital bus suspension Control using MATLAB
9. Designing digital pitch controller for an aircraft using pole placement technique with MATLAB

Elective-3 (MODELLING AND SIMULATION OF DYNAMIC SYSTEMS) – Control Group:

1. The instructor can give various electrical, mechanical and hydraulic systems for modeling and simulation in MATLAB based on the syllabus topics

Elective-2 & 3(Power Quality& Advanced Power Converters) – Power Electronics Group:

1. Introduction to fourier and powergui block and their use in the measurement of harmonics and analyzing harmonic spectrum in power electronic applications.

2. Study of harmonic elimination techniques in the output voltage waveform of the bridge inverter scheme through simulation
   (i) Using two series connected inverters having phase shifted but similar outputs.
   (ii) Using two series connected inverters having different output waveforms: one with two-level and another with three levels.

3. Write a code to determine the switching positions of the single phase bridge inverter so that the output voltage waveform is free from 3^{rd}, 5^{th} and 7^{th} harmonics.

4. Using SIMULINK/MATLAB design and simulate the space vector control for operating a 3-phase bridge inverter. Study the effects of variation in the modulation index and the switching frequency on the output waveform and its harmonic contents.

5. Simulate and study the performance of a three-level multi-level inverter. Observe the output voltage waveform and also the voltage waveform across each device of the inverter. Compare these waveforms with those obtained with the two-level inverter.

6. Getting familiar with Harmonic Analyzers and its use (Connections of 1-element, 3-element meters, Connections for 1-phase, 3-phase 3-wire, 3-phase 4-wire, Connection of CTs, PTs and the related settings) for power quality measurement.

7. Obtain and study the harmonic spectrum of input voltage and current of the equipments like Television, Computer (or a group of computers), Electronic Voltage stabilizers etc.

8. Understanding the principle of Phase Locked Loop and its significance in power electronic applications. Hence, simulate a three phase PLL in SIMULINK/MATLAB.

9. Modeling and simulation of static var compensator for voltage regulation and to study its dynamic performance and its steady-state V-I characteristics.

10. Design a 48-pulse converter using four 3-phase, 3-level inverters and four phase-shifting transformers. Hence study the performance of a 48-pulse converter and the harmonic contents in the output voltage and current waveform.

Elective-2 (Digital Image Processing) – Micro Group:

Laboratory

(A). Assignments

1. What do you mean by image processing? With the help of examples explain what is the need for image processing? State and explain advantages of Image Processing
2. Discuss various applications of image processing
3. State and explain Color models used in Image Processing
4. List and explain fundamental steps carried out in the image processing.
5. Draw a schematic block diagram of a general purpose image processing system. Explain Significance and function of each block.
6. What is a pixel? Define and explain the basic relationships between the pixels in an image.
7. With the help of suitable examples, explain need for processing on histogram of an image. Differentiate between the equalization and specification processes carried out on histograms on an image.
8. What do you mean by the term histogram of an image? Explain use of histogram in image processing. Explain the method of histogram equalization

considering histogram to be continuous. What is the difference if the histogram is discrete?

9. What do you mean by the term noise in an image? Specify the different type of noise which may be present and their effect on in an image?
10. Explain the terms:
    - Contrast Stretching
    - Image Negative
    - Global Intensity Transforms
    - Digital Image representation
    - RGB Color Model and Model conversions
    - Adaptive median filtering
    - Power Law transformation
    - Gamma Correction
    - Bit Plane Slicing
    - Homomorphic Filtering
    - Image Enhancement Operations

(B). MATLAB Programming:

Develop MATLAB functions for the following Image processing Operations

1. Discrete Cosine Transform (DCT) of an (m,n) Image
2. Inverse DCT of an (m,n) Image
3. Circular Convolution by a casual Filter
4. Circular Convolution by time revrsal of Casulal Filter
5. 2-D Circular convolution by casual filter
6. 2-D Circular convolution by time reversal of casual filter
7. Computation of analysis and synthesis scaling Wavelet function from Bi orhtogonal filter Bank
8. Computation of analysis and synthesis scaling Wavelet function from orhtogonal filter Bank
9. Generation of Gaussian Window, Hamming Window, Rectangular Window, Triangular Window
10.

Elective-3 (EMBEDDED SYSTEM DESIGN) – Micro group

Reference Laboratory Resources

1] ARM7 and ARM9 Target Systems

2] ARM7 IDE

3] Central Computing System with Pre-installaed Linux and development environment for ARM9

4] Interfacing kits for LED, LCD, Key, Keyboard, 7-segment LED, GSM Modem, Finger Print, Graphic LCD, RFID etc

5] Documentation in the form of Laboratory Workbooks with more than 50 examples along with the source code

LAB EXERCISE

- Integrated Development Environment Overview
  (Project creation, down load & debug)

- Study of JTAG Debugger/on-board debugger-emulator.
- List of Practicals for ARM7 Target

GROUP - A

1) Writing basic C-programs for I/O operations
2) C-Program to explore timers/counter
3) C-programs for interrupts
4) Program to demonstrate UART operation

GROUP - B

5) Program to demonstrate I2C Protocol.
6) Program to demonstrate CAN Protocol.

GROUP - C

7) Program to interface LCD
8) Program to interface Keyboard and display key pressed on LCD
9) Program to interface stepper motor

GROUP - D

10) Program to demonstrate RF communication
11) Program to implement AT commands and interface of GSM modem
12) Implementation of USB protocol and transferring data to PC.
13) Implementation of algorithm /program for the microcontroller for low power modes.