MAHATMA GANDHI UNIVERSITY

SCHEME AND SYLLABI

FOR

M. Tech. DEGREE PROGRAMME

IN

ELECTRICAL AND ELECTRONICS ENGINEERING

WITH SPECIALIZATION IN

POWER ELECTRONICS AND CONTROL

(2011 ADMISSION ONWARDS)
SCHEME AND SYLLABI FOR M. Tech. DEGREE PROGRAMME IN ELECTRICAL AND ELECTRONICS ENGINEERING WITH SPECIALIZATION IN IN POWER ELECTRONICS AND CONTROL

SEMESTER - I

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course No.</th>
<th>Subjects</th>
<th>Hrs/week</th>
<th>Evaluation Scheme (Marks)</th>
<th>Credit (C)</th>
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Elective – I (MEEPC 105)

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<th>Course No.</th>
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<tr>
<td>MEEPC 105 - 1</td>
<td>Process Control Instrumentation</td>
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<td>MEEPC 105 - 2</td>
<td>Optimization Techniques</td>
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<td>MEEPC 105 - 3</td>
<td>Artificial Neural Networks and Fuzzy System</td>
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<td>MEEPC 105 - 4</td>
<td>Data Acquisition and Signal Conditioning</td>
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Elective – II (MEEPC 106)

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<th>Course No.</th>
<th>Subjects</th>
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<tr>
<td>MEEPC 106 - 1</td>
<td>Power Semiconductor Devices &amp; Modeling</td>
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<tr>
<td>MEEPC 106 - 2</td>
<td>Optimal and Adaptive Control Theories</td>
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<td>MEEPC 106 - 3</td>
<td>Embedded Controllers</td>
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<td>MEEPC 106 - 4</td>
<td>Biomedical Instrumentation</td>
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L – Lecture, T – Tutorial, P – Practical

TA – Teacher’s Assessment (Assignments, attendance, group discussion, Quiz, tutorials, seminars, etc.)

CT – Class Test (Minimum of two tests to be conducted by the Institute)

ESE – End Semester Examination to be conducted by the University

**Electives:** New Electives may be added by the department according to the needs of emerging fields of technology. The name of the elective and its syllabus should be submitted to the University before the course is offered.
## SEMESTER - II

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course No.</th>
<th>Subjects</th>
<th>Hrs/week</th>
<th>Evaluation Scheme (Marks)</th>
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### Elective – III (MEEPC 205)
- MEEPC 205 - 1: Digital Simulations of Power Electronics Systems
- MEEPC 205 - 2: SCADA Systems and Applications
- MEEPC 205 - 3: Special Electrical Machines and Drives
- MEEPC 205 - 4: Estimation Theory

### Elective – IV (MEEPC 206)
- MEEPC 206 - 1: Flexible AC Transmission Systems
- MEEPC 206 - 2: DSP and Applications
- MEEPC 206 - 3: Industrial Control Electronics
- MEEPC 206 - 4: Robotics and Automation

L – Lecture, T – Tutorial, P – Practical

TA – Teacher’s Assessment (Assignments, attendance, group discussion, Quiz, tutorials, seminars, etc.)

CT – Class Test (Minimum of two tests to be conducted by the Institute)

ESE – End Semester Examination to be conducted by the University

**Electives:** New Electives may be added by the department according to the needs of emerging fields of technology. The name of the elective and its syllabus should be submitted to the University before the course is offered.
### SEMESTER – III

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<th>Sl. No.</th>
<th>Course No.</th>
<th>Subject</th>
<th>Hrs / Week</th>
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* TA based on a Technical Report submitted together with presentation at the end of the Industrial Training and Mini Project

** Evaluation of the Industrial Training and Mini Project will be conducted at the end of the third semester by a panel of examiners, with at least one external examiner, constituted by the University.

*** The marks will be awarded by a panel of examiners constituted by the concerned institute

### SEMESTER – IV

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course No.</th>
<th>Subject</th>
<th>Hrs / Week</th>
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<td>Grand Total of all Semesters</td>
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* 50% of the marks to be awarded by the Project Guide and the remaining 50% to be awarded by a panel of examiners, including the Project Guide, constituted by the Department

** Thesis evaluation and Viva-voce will be conducted at the end of the fourth semester by a panel of examiners, with at least one external examiner, constituted by the University.
Module 1: Complex Variables and Partial Differential Equations

Cauchy’s integral formula, Poisson's integral formula, Lioivilli’s Theorem, Conformal Transformation, Schwarz-Christoffells transformation, Partial differential equation-Laplace equation in two dimension (Cartesian and polar), Boundary Value Problems, Green’s Theorem

Module 2: Functional Analysis


Module 3: Random Processes


Module 4: Introduction to Mathematical Programming


References:

4. Simmons D M, Non Linear Programming for Operations Research, PHI.
Module 1: Overview of Devices:

Ideal and Real switches, static and dynamic performance, loss calculation and selection of heat sink. Power diodes, Power Transistors, Power MOSFETS, IGBTs, Thyristor, GTO- Static and Dynamic Performance, Driver circuits., Turn on; Turn off and over voltage Snubbers for switching devices.


Module 2: DC Choppers


Module 3: AC voltage controllers and Cycloconverters


Module 4: Inverters

References:

Module 1: Introduction
Unified approach to the analysis of electrical machine – basic two-pole machine – Kron’s primitive machine – voltage, power and torque equation – linear transformation from 3-phase to 2-phase - transformation from rotating axes to stationary axes – power invariance – park’s transformation for 3-phase synchronous and induction machines.

Module 2: DC machines

Module 3: Polyphase synchronous machines

Module 4: Induction machines
References:


2. Krauss, Wasyncsuk and Sudholf, Analysis of Electrical Machines and Drive Systems, John Wiley


4. Adkins and Harey, General Theory of AC Machines

5. Bimal K Bose, Modern Power Electronics & AC Drives, Pearson Education
Module 1
State variable representation of system - concept of state - Equilibrium points – Stability - Solution of state equation - eigen values - eigen vectors – modes - modal decomposition - eigen value and stability - State space representation of discrete time systems - Discretization of continuous time state equation

Module 2

Module 3
Concepts of controllability and observability - controllability and observability tests for continuous time and discrete time systems - controllability and observability studies based on canonical forms of state model - effect of state feedback on controllability and observability - pole placement by state feedback for continuous and discrete time systems - Design of full order and reduced order observer for continuous time and discrete time systems

Module 4

References:
1. Thomas Kailath, Linear systems, Prentice Hall Inc
3. Ogata K, Discrete time control systems, P.H.I
5. Gopal M., Modern Control System Theory
7. Richard C. Dorf and Bishop R.T., Modern Control System, P.H.I publishers
Module 1: Process Modeling
Introduction to Process control and process instrumentation-Hierarchies in process control systems-Theoretical models-Transfer function-State space models-Time series models-Development of empirical models from process data-chemical reactor modeling-. Analysis using MATLAB & SIMULINK

Module 2: Feedback & Feed forward Control
Feedback controllers-PID design, tuning, trouble shooting-Control system design based on Frequency response Analysis-Direct digital design-Feed forward and ratio control-State feedback control- LQR problem- Pole placement -Simulation using MATLAB & SIMULINK-Control system instrumentation-Control valves- Codes and standards- Preparation of P&I Diagrams.

Module 3: Advanced process control
Multi-loop and multivariable control-Process Interactions-Singular value analysis-tuning of multi loop PID control systems-decoupling control-strategies for reducing control loop interactions- Real-time optimization-Simulation using MATLAB & SIMULINK.

Module 4: Model predictive control-Batch Process control-Plant-wide control & monitoring
Plant wide control design- Instrumentation for process monitoring-Statistical process control- Introduction to Fuzzy Logic in Process Control-Introduction to OPC-Introduction to environmental issues and sustainable development relating to process industries. Comparison of performance different types of control with examples on MATLAB and SIMULINK

References:
Module 1: Linear programming

Module 2: Unconstrained dimensional optimization techniques
Necessary and sufficient conditions-search methods(unrestricted Fibonacci and golden)-Interpolation methods(Quadratic, Cubic and direct root method).Direct search methods-Random search-pattern search and Rosen Brock’s hill climbing method-Descent methods-Steepest descent, conjugate gradient, Quasi Newton and DFE method.

Module 3: Constrained optimization techniques & dynamic programming

Module 4: Recent developments in optimization techniques
Rosenbrocks Rotating Coordinate Method-Tabu search-Simulated Annealing-Genetic Algorithm-Particle Swarm Optimization –Ant colony Optimization-Bees Algorithm.

References:
2. Pierre, D.A., Optimisation, Theory with Applications, John Wiley & Sons
3. Fox, R.L., Optimisation method for Engineering Design, Addition Wesley
4. Hadely,G., Linear Programming, Addition Wesley
5. Bazaara & Shetty, ‘Non-linear Programming’


9. Recent literature should also be referred
Module 1

Module 2

Module 3
Fuzzy sets and crisp sets - Intersections of Fuzzy sets, Union of Fuzzy sets, the complement of Fuzzy sets. Fuzzy reasoning - Linguistic variables, Fuzzy propositions, Fuzzy compositional rules of inference- Methods of decompositions, Defuzzification.

Module 4
Methodology of fuzzy design - Direct & Indirect methods with single and multiple experts, Adaptive fuzzy control, Rule base design using dynamic response. Fuzzy logic applications to engineering, Fuzzy decision making, Neuro-Fuzzy systems, Fuzzy Genetic Algorithms.

References:
1. Martin T. Hogan, Howard B. Demuth, M, 'Neural network design'
Module 1: Transducers & Signal Conditioning

Module 2: Filtering and Sampling

Module 3: Signal Conversion and Transmission
Module 4: Digital Signal Transmission and Interfacing

References:

4. John Uffrenbeck, "The 80x86 Family ,Design, Programming, And Interfacing",
   Pearson Education, Asia,
Module 1: Power switching devices overview
Attributes of an ideal switch, application requirements, circuit symbols - Power handling capability – SOA - Device selection strategy – On-state and switching losses – EMI due to switching - Power diodes – Types - forward and reverse characteristics - switching characteristics – rating - Schottky Diode

Module 2: Current Controlled Devices
Bipolar Junction Transistors (BJTs) – Construction, Device Physics, static characteristics, switching characteristics; Negative temperature co-efficient and secondary breakdown; Power Darlington - Thyristors – Physical and electrical principle underlying operation - Gate and switching characteristics - converter grade and inverter grade and other types - series and parallel operation - comparison of BJT and Thyristor – steady state and dynamic models of BJT & Thyristor.

Module 3: Voltage Controlled Devices
Power MOSFETs and IGBTs – Principle of voltage controlled devices, construction, types, Device physics, Static and Switching Characteristics- Steady state and dynamic models of MOSFET and IGBTs - Basics of GTO, MCT, FCT, RCT and IGCT.

Module 4: Firing and Protection Circuits
Necessity of isolation, pulse transformer, optocoupler – Gate drives circuit: SCR, MOSFET, IGBTs and base driving for power BJT - Over voltage, over current and gate protections - Design of snubbers.
References:

1. Kassakian J G et al, Principles of Power Electronics, Addison Wesley
2. Williams. B W, Principles and Elements of Power Electronics, University of Strathclyde, Glasgow
Module 1: Calculus of variations

Module 2: Variational approach to optimal control problems

Module 3: Dynamic programming

Module 4: Model Reference Adaptive systems
Model Reference Adaptive systems (MRAS). The need for MRAS - An overview of adaptive control systems - Mathematical description of MRAS - Design hypothesis - Equivalent representation of MRAS - Introduction to design method based on the use of Liapunov function.

References:
3. HSU and Meyer, Modern Control - Principles and Applications, McGraw Hill.
Module 1 C Programming of microcontrollers
Review of 8051 assembly language-Introduction to C51 language-keywords-structures-super loop-timer and interrupt programming-single programs for interfacing LED,LCD display, keyboard and stepper motor control

Module 2: PIC processors

Module 3: DSP architecture
Introduction to DSP architecture- computational building blocks - Address generation unit-Program control and sequencing- Speed issues- Harvard Architecture, Parallelism, Pipelining.

Module 4: TMS 320F2407

References:
1. Mazidi and Mazidi. Embedded system design using 8051 Microcontroller, Pearson- 2005
2. Mazidi,PIC Microcontrollers
3. Scott Mckenzie I,8051 Microcontroller programming,Pearson Education
Module 1: Biopotentials in the Body

Module 2: Medical Assist Devices
Medical thermography - application of thermography - cardiac pace makers - cardiac defibrillators - Hemodialysis machine - function of the kidney - Artificial kidney - dialysers - membranes for hemodialysis - blood pumps. Ventilators. Infant incubators

Module 3: Pulmonary Measurements

Module 4: Lasers and Ultrasounds in Medicine
Lasers in Medicine-X-ray machines-Physiotherapy and Electrotherapy-Short wave diathermy machine- Microwave diathermy machine - Ultrasonic therapy Unit - Pain relief through Electrical Stimulation .physiological effects of electricity. Electrical safety codes and standards

References:
1. .Khandpur R.S Hand Book of Biomedical Instrumentation, -TMH.
3. Biophysical Measurements - Peter Strong, TEKTRONIX.
5. Leslie Cromwel, Biomedical Instrumentation and Measurements, Prentice hall.
6. Wells P.N.R Biomedical Ultrasonic. Academic Press,
7. Cobbold R Transducers for BIOMEDICAL Instruments,. John Wiley and Sons Inc.
8. Guyton A.C., 'Saunders W.B Text Book of Medical Physiology,.".
Objective: To develop practical skills in design of power electronic converters and applications to electric drives

To provide an opportunity to experience the theory portions covered in various subjects in the laboratory

LIST OF EXPERIMENTS

A) HARDWARE
1. Single Phase Semi-converter with R-L load for continuous & discontinuous conduction modes
2. Single Phase Full-converter with R-L load for continuous & discontinuous conduction modes
3. Digital firing circuit
4. Three Phase Full-converter with R-L-E load
5. Controlled and Uncontrolled rectifier with different types of filters - continuous & discontinuous modes of operation
6. Transformer and Inductor design
7. Current & voltage commutated thyristorized chopper
8. MOSFET/ IGBT/Transistor based DC Choppers (Buck & Boost)
9. Half bridge square wave inverter
10. Single-phase Sine triangle PWM inverter
11. Single Phase AC Voltage Controller
12. Transfer function of armature controlled DC Motor
13. Microcontroller and DSP based control of dc-dc converters
14. Study of harmonic pollution by power electronics loads using power quality analyser

B) SIMULATION
1. 3-phase full converter and semi-converter with R, RL and RLE loads
2. 3-phase ac voltage controller
3. Closed loop control of DC-DC converter
4. 3-phase sine PWM inverter
5. Measurement of THD of current & voltage waveforms of controlled & uncontrolled 3-phase rectifiers.
Each student shall present a seminar on any topic of interest related to the core / elective courses offered in the first semester of the M. Tech. Programme. He / she shall select the topic based on the references from international journals of repute, preferably IEEE journals. They should get the paper approved by the Programme Co-ordinator / Faculty member in charge of the seminar and shall present it in the class. Every student shall participate in the seminar. The students should undertake a detailed study on the topic and submit a report at the end of the semester. Marks will be awarded based on the topic, presentation, participation in the seminar and the report submitted.
Module 1: Components of electrical Drives
Electric machines, power converter, controllers - dynamics of electric drive - torque equation - equivalent values of drive parameters- components of load torques types of load - four quadrant operation of a motor — steady state stability - load equalization – classes of motor duty- determination of motor rating

Module 2: DC motor drives

Module 3: Induction motor drives

Module 4: Synchronous motor drives
References:

2. Dubey G.K. Fundamentals of Electrical Drives, Narosa Publishers
3. Dubey G.K., Power Semi-conductor Controlled Drives, Prentice Hall
4. Bimal K Bose, Modern Power Electronics & AC Drives, PHI
6. Elsharkawi, M A Fundamentals of Electrical Drives, Thomson Learning
7. Leohnard W, Control of Electric Drives, Springer
8. Murphy and Turnbill, Power Electronic Control of AC motors, Pergamon Press
9. Vedam Subarhmanian, Electric Drives, TMH
Module 1: Basic concepts in sampled data systems
Discrete time signals-sampling process-effect of sampling-loss of information and noise due to sampling-signal reconstruction-sampling theorem-hold circuits (ZOH,FOH)-z transforms-inverse z transform-difference equations- solution using z transform-system transfer function-poles and zeros-influence of pole location on time response-effect of zeros

Module 2: Analysis in z-domain

Module 3: Digital Controller Design

Module 4: Estimator/Observer Design
Full and reduced order observers-regulator design –case with reference input –separation principle - Case Studies

References:

1. Gene F Franklin, J David Powell, Michael Workman, Digital control of dynamic systems, Pearson education
5. Ogata K, Discrete – Time control systems, Pearson education, Asia
Module 1: Buck, Boost, Buck-Boost SMPS Topologies
Basic Operation- Waveforms - modes of operation - switching stresses - switching and conduction losses - optimum switching frequency - practical voltage, current and power limits - design relations - voltage mode control principles.


Module 2: Voltage Mode Control of SMPS
Loop Gain and Stability Considerations. Shaping the Error amplifier frequency Response. Error Amplifier Transfer Function. Transconductance of Error amplifier. Study of popular PWM Control Ics (SG 3525, TL 494, MC34060 etc.)

Module 3: Modeling of SMPS
Power Circuit Layout for minimum EMI. EMI Filtering at Input and Output Effect of EMI Filter on SMPS Control Dynamics

**Module 4: Resonant Converters**


**References:**

Module 1

Module 2
Harmonics-individual and total harmonic distortion-RMS value of a harmonic waveform-triplex harmonics-important harmonic introducing devices-SMPS-Three phase power converters-arcing devices-saturable devices-harmonic distortion of fluorescent lamps-effect of power system harmonics on power system equipment and loads.
Modeling of networks and components under non-sinusoidal conditions-transmission and distribution systems-shunt capacitors-transformers-electric machines-ground systems-loads that cause power quality problems-power quality problems created by drives and its impact on drives

Module 3

Module 4
Active Harmonic Filtering-Shunt Injection Filter for single phase , three-phase three-wire and three-phase four-wire systems . d-q domain control of three phase shunt active filters uninterruptible power supplies-constant voltage transformers- series active power filtering techniques for harmonic cancellation and isolation . Dynamic Voltage Restorers for sag , swell and flicker problems. Grounding and wiring-introduction-NEC grounding requirements-reasons for grounding-typical grounding and wiring problems-solutions to grounding and wiring problems.
References:

1. Heydt G.T, ELECTRIC Power Quality
2. Math H. Bollen, Understanding Power Quality Problems
5. Selected Topics in Power Quality and Custom Power, Course book for STTP, 2004, Ashok S.
Module 1
Review of numerical methods. Application of numerical methods to solve transients in
D.C. Switched R, L, R-L, R-C and R-L-C circuits. Extension to AC circuits. Modeling of diode in
simulation. Diode with R, R-L, R-C and R-L-C load with ac supply. Modelling of SCR, TRIAC,
IGBT and Power Transistors in simulation. Application of numerical methods to R, L, C circuits
with power electronic switches. Simulation of gate/base drive circuits, simulation of snubber
circuits.

Module 2
State space modeling and simulation of linear systems. Introduction to electrical machine
modeling: induction, DC, and synchronous machines, simulation of basic electric drives, stability
as MEEPCts.

Module 3
Simulation of single phase and three phase uncontrolled and controlled (SCR) rectifiers,
converters with self commutated devices- simulation of power factor correction schemes,
Simulation of converter fed dc motor drives ,Simulation of thyristor choppers with voltage,
current and load commutation schemes, Simulation of chopper fed dc motor.

Module 4
Simulation of single and three phase inverters with thyristors and self-commutated devices,
Space vector representation, pulse-width modulation methods for voltage control, waveform
control. Simulation of inverter fed induction motor drives.

References:

   Math works, USA.
Module 1: Introduction to SCADA
Data acquisition systems, Evolution of SCADA, Communication technologies, Monitoring and supervisory functions, SCADA applications in Utility Automation, Industries

Module 2: SCADA System Components
Schemes- Remote Terminal Unit (RTU), Intelligent Electronic Devices (IED), Programmable Logic Controller (PLC), Communication Network, SCADA Server, SCADA/HMI Systems

Module 3: SCADA Architecture
Various SCADA architectures, advantages and disadvantages of each system - single unified standard architecture - IEC 61850
SCADA Communication: various industrial communication technologies - wired and wireless methods and fiber optics. Open standard communication protocols

Module 4: SCADA Applications
Utility applications- Transmission and Distribution sector - operations, monitoring, analysis and improvement. Industries - oil, gas and water. Case studies, Implementation, Simulation Exercises

References:
1. Stuart A. Boyer: SCADA- Supervisory Control and Data Acquisition, Instrument Society of America Publications, USA, 1999

Module 1: Stepper Motors
Constructional features, principle of operation, modes of excitation, single phase stepping motors, torque production in variable Reluctance (VR) stepping motor, Dynamic characteristics, Drive systems and circuit for open loop control, Closed loop control of stepping motor, microprocessor based controller.

Module 2: Switched Reluctance Motors

Module 3: Permanent Magnet Brushless DC Motors
Commutation in DC motors, Difference between mechanical and electronic commutators, Hall sensors, Optical sensors, Multiphase Brushless motor, Square wave permanent magnet brushless motor drives, Torque and emf equation, Torque-speed characteristics, Controllers-Microprocessor based controller. Sensor less control.

Module 4: Permanent Magnet Synchronous Motors
Principle of operation, EMF, power input and torque expressions, Phasor diagram, Power controllers, Torque speed characteristics, Self control, Vector control, Current control schemes. Sensor less control.

References:
4. Athani V.V. “stepper motors – Fundamentals, Applications &Design” New Age International
   Ali Emadi (Ed), Handbook
Module 1: Elements of Probability Theory
Random variables-Gaussian distribution-stochastic processes-characterizations and properties-Gauss-Markov processes-Brownian motion process-Gauss-Markov models

Module 2: Optimal Estimation for Discrete-time Systems
Fundamental theorem of estimation-optimal prediction

Module 3: Optimal Filtering
Weiner approach-continuous time Kalman Filter-properties and implementation-steady-state Kalman Filter-discrete-time Kalman Filter-implementation-sub-optimal steady-state Kalman Filter-Extended Kalman Filter-practical applications

Module 4: Optimal Smoothing
Optimal fixed-interval smoothing, optimal fixed-point smoothing, optimal fixed-lag smoothing stability-performance evaluation

References: –
Module 1
Reactive power control in electrical power transmission lines - uncompensated line –
Shunt Compensation and Series compensation: Voltage Stability- Improvement of
Transient stability, Power Oscillation damping.
Introduction to FACTS - Basic Types of FACTS controller- Brief description and definitions of
FACTS controllers – Benefits from FACTS technology.

Module 2
Variable impedance type Static Var generators – Switching Converter type Var generators Static
Var Compensator (SVC) and Static Compensator (STATCOM): Principle of operation,
configuration and control – The Regulation Slope- Transient Stability enhancement and Power
Oscillation damping.Comparison between STATCOM and SVC

Module 3
Variable Impedance Type series compensators: Thyristor Switched Series Capacitor (TSSC),
Thyristor Controlled Series Capacitor (TCSC) - Sub synchronous characteristics- Basic NGH
SSR DamperStatic Synchronous Series Compensator (SSSC): Principle of operation,
configuration and control.

Module 4
Unified Power Flow Controller (UPFC): Principle of operation, Conventional Transmission
control capabilities, Comparison of UPFC to Controlled Series Compensators- Control structure.
Interline Power Flow Controller (IPFC) – Basic operating Principles and Characteristics
Generalized and multifunctional FACTS controllers.

References:
1999.

Module 1: Introduction to DSP
Classification of signals, Multichannel and multi dimensional continuous v/s discrete time signals, continuous v/s discrete valued signals, continuous time sinusoidal signal, discrete time sinusoidal signals, sampling of analog signal, sampling theorem, quantification and coding of D/A conversion.

Module 2: Discrete Time Signal and Systems
Discrete time signal, systems, Z-transform & Inverse Z-transform, analysis of discrete time, linear time invariant systems, co-relation of discrete time systems.

Module 3: Frequency Analysis of Signals
Frequency analysis of analog signals, frequency analysis of discrete time signals. Properties of Fourier Transform, Frequency Domain Characteristics, Time Frequency Dualities, Sampling of signals in time and frequency domain, DFT & FFT.

Module 4: Design of Digital Filter

DSP Application - Introduction to digital signal processors chips, case study of different DSP applications. Application of filters to analog & digital signal processor,

References:

1. Stanley W.D., Digital Signal Processing
2. Ashok Ambardar , Analog & Digital Signal Processing
3 Mitra, S. Digital Signal Processing
Module 1
Review of switching regulators and switch mode power supplies-Uninterrupted power supplies-solid state circuit breakers – programmable logic controllers. Analog Controllers - Proportional controllers, Proportional – Integral controllers, PID controllers, Feed forward control

Module 2
Signal conditioners-Instrumentation amplifiers – voltage to current, current to voltage, voltage to frequency, frequency to voltage converters ; Isolation circuits – cabling; magnetic and electro static shielding and grounding.

Module 3
Opto-Electronic devices and control , Applications of opto isolation, interrupter modules and photo sensors – Fibre optics – Bar code equipment, application of barcode in industry.

Module 4

References:
Module 1: Introduction
Geometric configuration of robots – Manipulators – Drive systems – Internal and external sensors— End effectors – Control systems – Robot programming languages and applications – Introduction to robotic vision

Module 2: Robot Arm Kinematics

Module 3: Robot Arm Dynamics

Module 4: Planning of Manipulator Trajectories
General consideration on trajectory planning joint interpolation & Cartesian path trajectories.-Control of Robot Manipulators-PID control computed, torque technique – Near minimum time control – Variable structure control – Non-linear decoupled feedback control – Resolved motion control and adaptive control.

References:
Objective:
To develop practical skills in design of power electronic devices and its control circuit
To provide an opportunity to experience the theory portions covered in various subjects in theory

1. Closed loop control of converter fed DC motor drives
2. Closed loop control of chopper fed DC motor drives
3. VSI fed three phase induction motor drive using V/f control
4. Three phase synchronous motor drive
5. Closed loop control of Brushless DC motors
6. Closed loop control of Switched reluctance motors.
7. Closed loop control of permanent magnet synchronous motors.
8. Use of Microcontrollers, DSP and FPGA for the control of motors.
9. Simulation of sine PWM & space vector PWM
10. Simulation of 3-phase induction motor drive using V/f control
11. Simulation of Vector control of 3-phase induction motor
12. Simulation of Direct Torque Control of 3-phase induction motor
13. Simulation of Brushless DC Motor drive
14. Simulation of STATCOM & DSTATCOM
15. Simulation of Active Power Filter, DVR
16. Simulation of UPQC, UPFC, TCSC
17. Simulation of matrix converter based control of induction motor
Each student shall present a seminar on any topic of interest related to the core / elective courses offered in the second semester of the M. Tech. Programme. He / she shall select the topic based on the references from international journals of repute, preferably IEEE journals. They should get the paper approved by the Programme Co-ordinator / Faculty member in charge of the seminar and shall present it in the class. Every student shall participate in the seminar. The students should undertake a detailed study on the topic and submit a report at the end of the semester. Marks will be awarded based on the topic, presentation, participation in the seminar and the report submitted.
The student shall undergo (1) Industrial training of 3 month duration OR (2) Industrial training of one month duration and a Mini Project of two month duration. Industrial training should be carried out in an industry / company approved by the institution and under the guidance of a staff member in the concerned field. At the end of the training he / she has to submit a report on the work being carried out. He/she should also submit mini project report.

The thesis (Phase - I) shall consist of research work done by the candidate or a comprehensive and critical review of any recent development in the subject or a detailed report of project work consisting of experimentation / numerical work, design and or development work that the candidate has executed.

In Phase - I of the thesis, it is expected that the student should decide a topic of thesis, which is useful in the field or practical life. It is expected that students should refer national & international journals and proceedings of national & international seminars. Emphasis should be given to the introduction to the topic, literature survey, and scope of the proposed work along with some preliminary work / experimentation carried out on the thesis topic. Student should submit two copies of the Phase - I thesis report covering the content discussed above and highlighting the features of work to be carried out in Phase – II of the thesis. Student should follow standard practice of thesis writing. The candidate will deliver a talk on the topic and the assessment will be made on the basis of the work and talks there on by a panel of internal examiners one of which will be the internal guide. These examiners should give suggestions in writing to the student to be incorporated in the Phase – II of the thesis.
In the fourth semester, the student has to continue the thesis work and after successfully finishing the work, he/she has to submit a detailed thesis report. The work carried out should lead to a publication in a National/International Conference. They should have submitted the paper before M.Tech. evaluation and specific weightage should be given to accepted papers in reputed conferences.

MEEPC 402 MASTER’S COMPREHENSIVE VIVA

A comprehensive viva-voce examination will be conducted at the end of the fourth semester by an internal examiner and external examiners appointed by the university to assess the candidate’s overall knowledge in the respective field of specialization.