COURSE STRUCTURE & SYLLABUS OF
MASTER OF TECHNOLOGY (M.TECH)

In

Electrical Engineering

Course Structure

First Year

First Semester

Paper Code	Subject
MFE1	Machine Drives
MFE2	Power Electronic Converter
MFE3	Control System
MFE4	EHV Transmission

Syllabus

MFE1 : MACHINE DRIVES –I

1. **CHARACTERISTICS OF THE ELECTRIC MOTORS**
   Introduction, Characteristics Of Dc Motors, Characteristic Of Three-Phase Induction Motor , Variation Of Applied Voltage, Pole Change Motors, Slip Power Recovery Schemes, Characteristics Of Synchronous Motors
2. **DYNAMICS OF ELECTRIC DRIVES**
   Introduction, Classification Of Electric Drives, Basic Elements Of An Electric Drive, Dynamic Conditions Of A Drive System, Stabili1y Considerations Of Electrical Drives
3. **CONVERTERS FOR FEEDING ELECTRIC MOTORS**
   A General Survey Of Converters For Feeding Electric Motors, Phase Controlled Line Commutated Converters
4. **CONTROL OF ELECTRIC MOTOR**
   Induction motor drives, synchronous motor drives, dc drives.
5. **CONTROL TECHNIQUES**
   Introduction, block diagram representation of drive systems, signal flow graph representation of the systems, transfer functions, transient response of closed loop drive systems, frequency response approach

MFE2 : POWER ELECTRONICS CONVERTERS - I

1. **POWER SEMICONDUCTOR DIODES**
   Introduction, Diode Characteristics, Reverse Recovery Characteristics, Power Diode Types, Effects Of Forward And Reverse Recovery Time, Series-Connected Diodes, Parallel-Connected Diodes.

2. **THYRISTORS**
   Introduction, Thyristor Characteristics, Two-Transistor Model Of Thyristor, Thyristor Turn-On, *Di/Dt* Protection, *Dv/Dt* Protection, Thyristor Turn-Off, Thyristor Types, Series Operation Of Thyristors, Parallel Operation Of Thyristors, Thyristor Firing Circuits, Unijunction Transistor, Programmable Unijunction Transistor

3. **CONTROLLED RECTIFIERS**
   Introduction, Principle Of Phase-Controlled Converter Operation, Single-Phase Semiconverters, Single-Phase Full Converters, Single-Phase Dual Converters, Single-Phase Series Converters, Three-Phase Half-Wave Converters, Three-Phase Semiconverters, Three-Phase Full Converters, Three-Phase Dual Converters

4. **THYRISTOR COMMUNICATION TECHNIQUES**
   Introduction, Natural Commutation, Forced Commutation, Commutation Circuit Design, Dc Thyristor Spice Model, Commutation Capacitors

5. **POWER TRANSISTORS**
   Introduction, Bipolar Junction Transistors, Power Mosfets, Sits, Igbts, Series And Parallel Operation, *Di/Dt* And *Dv/Dt* Limitations, Isolation Of Gate And Base Drives

6. **DC CHOPPERS**
   Introduction, Principle Of Step-Down Operation, Principle Of Step-Up Operation, Performance Parameters, Chopper Classification, Switching-Mode Regulators, Chopper Circuit Design

7. **PROTECTION OF DEVICES AND CIRCUITS**
   Introduction, Cooling And Heat Sinks, Snubber Circuits, Reverse Recovery Transients, Supply- And Load-Side Transients, Voltage Protection By Selenium Diodes And Metal-Oxide Varistors, Current Protections

MFE3 <u>CONTROL SYSTEM</u>

1 : INTRODUCTION TO CONTROL SYSTEM

1.1 Classification Of Systems
1.2 Open-Loop Control System
1.3 Closed-Loop Control Systems
1.4 Elements Of Automatic Or Feedback Control System
1.5 Requirement Of Automatic Control Systems

2 : MATHEMATICAL MODELS OF CONTROL SYSTEM

2.1 Representation Of a Control System
2.2 Description Of Some Of Typical Physics System
2.3 Tachnogenerators
2.4 Potentiometers, LVDT and Synchros
2.5 Synchros
2.6 Hydraulic Actuation

3: BASIC PRINCIPLES OF FEEDBACK CONTROL

3.1 The Control Objectives
3.2 Feedback Control System Characteristics
3.3 Proportional Mode Of Feedback Control
3.4 Integral Mode Of Feedback Control
3.5 Derivatie Mode Of Feedback Control

4 : TIME DOMAIN ANALYSIS AND FREQUENCY RESPONSE

4.1 Standard Test Signals
4.2 Static Accuracy
4.3 Computation Of Steady State Errors
4.4 Transient Response: First Order System
4.5 Transient Response: Second Order System
4.6 Transient Response Specification
4.7 Conclusion
4.8 Frequency Response
4.9 Frequency Domain Specifications
4.10 Magnitude And Phase Angle Characteristics Plot
4.11 Frequency Response Specification
4.12 Representation Sinusoidal Transfer Function

5. CONCEPTS OF STABILITY AND THE ROUTH STABILITY CRITERION

5.1 Bounded-Input Bounded-Output Stability
5.2 Zero-Input Stability
5.3 The Routh Stability Criterion

6: NYQUIST STABILITY CRITERION

6.1 Stability Margin
6.2 Phase Margin

7: BODE PLOTS

8: ROOT LOCUS

8.1 The transfer function of a second order control system
8.2 GENERAL RULES

MFE4 : <u>EXTRA HIGH VOLTAGE (EHV) TRANSMISSION</u>

1. **HVDC POWER FLOW**
   Subscripts and symbols, Thyristor principle and control, Power conversion principle, Direct Voltage Ud1 and Ud2, Power at Rectifier-end Pd1, Power at Inverter-end Pd2, Power loss in DC system, Power in middle of HVDC line, Power at sending end, Power at receiving end, General equations, Solved Numerical examples on Pd and Ud, Summary and Questions.

2. **CONVERTER CONNECTIONS, RECTIFIER AND INVERTER WAVEFORMS**
   Rectifier Bridge Connections and Waveforms on AC and DC side, Six Pulse Bridge (Graetz Bridge), 12-Pulse Bridge, Phase Control and Delay angle, Effect of Phase control on DC Voltage, Valve Voltage, Inversion, Connections of Converter Bridge, Commutating Reactance, Angle of Overlap Extinction Angle, Significance of Delay Angle and Extinction Angle, Control of DC Voltage, Configuration of Bipolar 2T HVDC System, Valves and Converters, Summary and Questions.

3. **REACTIVE POWER COMPENSATION IN HVDC SUBSTATIONS**
   Reactive Power requirements of HVDC Converters, P.Q.S., Reactive Power Q required by converter, and HVDC Substation, Reactive power equations, Effect of delay angle and Extinction angle, Short Circuit Ratio (SCR), Impedance of AC Network, Equivalent short circuit ratio, SCR in Planning of HVDC. Transient Voltage Rise, Summary and Questions.

4. **MULTI-TERMINAL HVDC SYSTEMS**
   Two pole HVDC with earth return, substation poles in different locations, MTDC System with series connected convertors, MTDC System with parallel connected converters, Control of Parallel connected HVDBC System, Reversal of power in a terminal of HVDC System, Three TDC System with parallel tapping , Two pole reversal in 3 TDC System, HVDC Breakers in MTDC System, Applications of MTDC Systems, Worlds First Commercial 3 TDC System, World's first 5 TDC System, Configuration and Type of HVDC System, Summary and Questions.

5. **INSULATION REQUIREMENT OF EHV – AC AND HVDC EQUIPMENT AND TRANSMISSION LINES**
   Classification : Self restoring and Non-self restoring insulation, Insulation Design Aspects, Stresses on Insulation , Tests, Causes of Flashover through Air and Gases, Insulation withstand characteristics of Air Gaps, Leakage Distance or Creepage Distance of AC Insulators, Leakage Distance or Creepage Distance of DC Insulators Line Insulator Design with respect to Creepage Distance, Voltage Grading Rings (Collector Rings) to reduce pollution, Grease or Petroleum Jelly to reduce flashovers, Electrolytic Action affecting pin type DC Insulators. Effect of Wetting and contamination on leakage currents, Clearances (Insulation Distance) for AC and HVDC, Clearances in HVDC Substations, Choice of Clearance based on impulse withstand level, summary and questions.

6. **ENGINEERING ASPECTS OF EHV – AC TRANSMISSION AND TRANSMISSION PLANNING**

Electrical, Mechanical and Thermal Design Aspects, Engineering Aspects of EHV AC Transmission system, Transmission Planning and its co-relation with Generation Planning, Distribution Planning, Why 400 kV AC was selected in India, Recent advances, Summary and Questions.

7. ELECTROSTATIC FIELD AT GROUND LEVEL AND BIOLOGICAL EFFECTS (EHV –AC AND HVDC)

Basic principles and terms in Electromagnetic Field theory, Significance of Electric Field Intensity (Negative of Potential Gradient) at ground level, Electric field intensity of 3 phase AC line at ground level beneath the conductors and at the edge of Row, Charging of Objects, Vehicles and Human Body, Biological effects on Human Beings, Shock Effects of Electric Field, Contact Currents, Limiting Values of 50 Hz Contact Currents, Summary and Questions.

8. CORONA AND CORONA LOSSES (EHV – AC AND HVDC)

Principle of Corona, Emperical Formulae for Ec and Ecr, Terms and Definitions, Corona of AC Overhead Lines, Factors affecting Corona, Conclusion of Research on Bad Weather Corona, Corona Losses in AC Transmission, Variation in Corona Loss during one year, factors affecting Corona Losses, Notations of terms in Derivations, Critical Surface Gradient, Peek's Law, Critical Disruptive Voltage and

Critical Electric Stress for Visual Corona, Corona Phenomenon with HVDC, Critical HVDC Voltage and Corona, Bipolar Corona Loss, Influence of Weather on DC Corona Loss, Summary and Questions.

9. RADIO INTERFERENCE, TV INTERFERENCE AND AUDIBLE NOISE (EHV – AC & HVDC) RADIO INTERFERENCE

Units of Measurement of RI, Generation of RI, propagation and Attenuation of RI, Attenuation of RI waves, Radio Interference Field Strength against Distance, RI Design Criterion for EHV AC Line, Signal to Noise Ratio (SNR), Broadcast Signal Strength, RI Lateral Attenuation with Distance, RI at Edge of Row, Minimising RI and TVI, Bundled Conductor for reducing Corona and RI, Evaluation of RI by Comparison Method & Semi Analytical Method.

TV Interference : Comparison Formula for TVI Calculation of AC Lines RI and TVI Calculation of AC Lines RI and TVI in HVDC Overhead Lines, Elimination of DC Harmonics, RI from Bipolar HVDC Line, Comparision of RI from HVDC line and EHV AC line TVI from HVDC Line.

Audible Noise : Terms and Defintions of Acoustics, Fundamentals of Sound, Measurement of AN and weighting curves, Attenuation of Sound Pressure Level, Acceptable Level of Audible Noise, Causes of AN in substation and Transmission Line, Audible Noisein Transformers and reactors, Audible Noise in Transmission Lines, Limits of AN, Transmission Line Design based on AN, Steps in Evaluating RN, Day and night equivalent of AN, Calculation and Estimated AN of Transmission line, Sound Level of Transmission line, AN of HVDC line, Summary and Questions.

COURSE STRUCTURE & SYLLABUS OF
MASTER OF TECHNOLOGY (M.TECH)

In

Electrical

Course Structure

First Year

Second Semester

Paper Code	Subject
MFE5	Electrical Engg. & Practices
MFE6	Power Electronics
MFE7	Electrical Design, Estimating & Costing
MFE8	Computer Aided Analysis of E.P.S.

Syllabus

MFE5 ELECTRICAL ENGINEERING & PRACTICES

1. ELECTRICAL SUBSTATION:

General Background , Functions of a Substation, Substation Layouts, Busbar Schemes, Voltage Levels in AC Substations and HVDC Substations, Types of Substations, Essential Features of a Substation, Substation Equipment, Substation Earthing System: (Grounding System), Insulation Co-ordination and Surge Arresters, Protective Systems in Substations, Clearances (Insulation Distance) and Creepage Distance(Leakage Distance), Power Line Carrier Communication (PLCC), Substation Structure,Busbar design, Clamps and Connectors, Special Requirements of EHV AC Substations and HVDC Substations, Voltage Control Equipment and Reactive Power Compensation Equipment in Substation, Project Planning, Testing and Commissioning at Site , Operation and Control, Protection , Monitoring and Control by Microprocessors and Computers, Scope of the Subject.

2. BUSBAR SYSTEMS AND LAYOUTS

Introduction, Configuration Concept, Requirements of a Busbar System, Technical Requirements , Busbar Systems, Technical Requirements, Busbar Systems (Busbar Layouts) Single Busbar Scheme , Single Sectionalized Busbar, Double Busbar Scheme, (Duplicate Bus) Bus-coupler, Duplicate Bus Scheme with Double Circuit –breaker, Breaker and a half scheme (1 1/2 Breaker Scheme) Duplicate Bus and a Transfer Bus: (Two main and one transfer bus) Ring Bus (Mesh Scheme) Three Switch Busbar System for a Through Feeder, Basis of Comparison of Busbar Schemes, Use of Load Break Switches, Use of Load Break Switches, Outage- Possibility Factor(OPF) Selection of Busbar Schemes, Recommended Busbar System,

Busbar System not Preferred for Large Substations , Evaluation of Outage Possibility Factor (OPF) Layout of Indoor Metal –clad Switchgear Substations, Civil Drawings.

3. INSULATION CO-ORDINATION AND SURGE ARRESTERS:

Introduction, Over voltages and their Significance, Standard Voltage Levels, Insulation Level of an Equipment, Insulation Co-ordination of a Substation, Terms and Definitions, Lighting Over voltages and Protection of Substation Equipment, Switching Over voltages in EHV Substations, Switching Over voltage in Medium Voltage Substations, Surge Arresters (Lightning Arrester)Rated Voltage of Surge Arrester, Rating of Surge Arrester, Calculation of Discharge Current for Shielded Substations, Installation as Surge Arresters, Protection of Substation Transformers by Surge Arresters , Overhead Shielding Screen, Protective Angle , Insulation Coordination between New Z O Arresters and old Gapped Sic Arresters in Adjacent Substations.

4. SUBSTATION EARTHING SYSTEMS:

Introduction, Functional Requirements of Earthing System, Description Earthing System, Equipment Earthing (Body Earthing), Neutral Point Earthing, Substation Earthing System, Dimensioning of Earth Conductors, Step Potential and Touch Potential, Earth Mat, Resistance of Earthing System, Values of Soil Resistivity, Fencing, Procedure of Laying Earthing – Mat , Measurement of Earthing Resistance.

5. POWER CABLES AND CONTROL CABLES:

Introduction, Power Cables, Types of Conventional Power Cables, Laying of Power Cables, Field Quality Tests on Power Cables, Control Cables, Principles of Control Cable Installation, The Sensitivity of Various Loads to interference , Definitions, Laying of Control Cables and Measuring Cables , Grounding of Cable Trays, Ducts, Electrical Noise, Protection of Static Relay Circuit and Control Circuits, Techniques of Protecting Sensitive Measuring, Protection and Control Equipment from Over-voltages, Pre- commissioning Checks.

6. PROTECTION , CONTROL AND AUTOMATION IN SUBSTATIONS:

Introduction , Control Room and Control Panels, Protective Relaying in Substations, Power Transformer Protection, Bus Zone Protection, Protection of Transmission Lines, Carrier Assisted Distance Protection, Introduction to Substation Control, Programmable Equipment for Protective Relaying Measurements and Control (PPRMC), Microprocessor Based Relays & Integrated Protection, Control and Automation, Fault Dignostics, Expert Systems.

7. HVDC SUBSTATIONS:

Introduction, Typical Bipolar HVDC Link, Layout of a HVDC Substation, A.C.Switchyard, A.C. Harmonic Filter Area, Convertor- transformers, Valve Hall and Control Room, HVDC Yard, D.C.Smoothing Reactors, Earth Return, D.C, Breaker and Load –Break Switches, Operating Modes of HVDC Transmission System , Electrical and Mechanical Auxiliaries, Auxiliary Power, Operating Principle of a HVDC Transmision Link, Control of a HVDC Link, Convertor Characteristics, Convertor Valves, Thyristors, and their Functioning, Protection and Control in HVDC Substations, Surge Arrester Protection, Control of HVDC Tranmission System, Hierarchical Levels in Control System , Merits of HVDC Transmission

System, HVDC Back –to-Back Coupling Stations, HVDC Simulator, Power Flow Modulation for AC Network Damping, Load- Frequency Control.

8. ENGINEERING ASPECTS OF EHV-AC SUBSTATION:

Introduction, Busbars for Outdoor Yards, Corona Rings, and Corona Bells, Mechanical Stresses and Factor of Safety for Support Insulators, Clamps and Connectors for EHV Conductors, Bundled Conductors , Pollution Behaviour of Insulators, Insulation Levels, Clearance , Station Earthing System, Earthed Screens, Power Transformers, Shunt Reactors , Compensation of Reactive Power, Additional Compensating Equipment in EHV- AC Substations, Configuration of EHV-AC Transmission System ,Corona , Audible Noise, Electric Field at Working Level, Circuit Breakers, Present and Future.

9. PROJECT PLANNING INSTALLATION , COMMISSIONING AND SAFETY PROCEDURES:

Project Planning, Preparation, Documentation, Receiving and Storage at Site, Civil Activities, Installation (Erection)Safety Procedures, Installation of Earthing System, Erection of Yard Equipment, Installation of outdoor Circuit Breakers, Installation of Transformers, Drying of Electrical Equipment, Measurement of Insulation Resistance and Polarization Index of transformers ,Commissioning of Substations, Commissioning Tests, Equipment Tests, Sub-Systems, Tests, Tests on Protection Systems, Phasing Tests, On load Test, Handling – Over to the Customers Operating Staff.

10. MAINTENANCE OF EHV-AC AND HVDC SUBSTATIONS AND ELECTRICAL EQUIPMENT:

Introduction, Breakdown, Maintenance Versus Preventive Maintenance, Inspection , Servicing, Overhaul, Maintenance Schedule, Skilled Personnel for Maintenance, Preventive Maintenance of Substations, Maintenance of Power Transformer, Maintenance of Switchgear, Maintenance of Circuit Breakers, Insulation Resistance Measurement, Maintenance of SF Circuit – Breakers, Maintenance of SF CB in G.I.S. Maintenance of Air-Blast Circuit Breakers, Maintenance of Vacuum Circuit Breaker, Maintenance of Oil Circuit Breaker(BOCB, MOCB) Maintenance of Dielectric Oil, Drying out of Power Transformers, Preventive Maintenance of HVDC Substation and Equipment, Live Line (Hot Line) Maintenance.

MFE6 POWER ELECTRONICS

1. PHASE CONTROLLED RECTIFIES:

Principle of Phase Control: Single –Phase Half –wave Circuit With RL Load; Single – phase Half – wave Circuit With RL Load And Freewheeling Diode; Single –phase Half-wave Circuit With RLE Load, Full- Wave Controlled Converters, Single- phase Full-wave Converters, Single-phase Full wave Bridge Coverters; Single –phase Full Converter, Single –phase Semi converter, Analysis of Two –pulse Bridge Converter With Continuous Conduction, Single – phase Two – pulse Converters With Discontinuous Current, Single-phase Full Converter With Discontinuous Load Current, Single –phase Semi converter With Discontinuous Current, Three-phase Converter Systems using Diodes, Three-phase Thyristor Converter Circuits: Three –phase Full Converters, Three –phase Full Semi converters, Effects of Source

Impedance on the Performance of Converters, Single- phase full Converter, Three-phase Full Converter Bridge, Dual Converters, Ideal Dual Converter , Practical Dual Converter, Some Worked Examples.

2. CHOPPERS:

Principle of Chopper Operation, Control Strategies; Constant Frequency System, Variable Frequency Systems, Step –up Choppers, Types of Chopper Circuits, First –quadrant, or Type – A, Chopper, Second-quandrant, or Tpye-B, Chopper, Two-quandrant Type-a Chopper, or Type-C Chopper,Two-quandrant Type –b-Chopper, or Type-D Chopper, Four –quadrants Chopper, or Type-E Chopper, Steady State Time – domain Analysis of Type-A Chopper , Steady State Ripple, Limit of Continuous Conduction, computation of Extinction Time tx, Fourier Analysis of Output Voltage, Thyristor Chopper Circuits, Voltage – commutated Chopper, Current-commutated Chopper, Load- commutated Chopper, Multiphase Choppers.

3. INVERTERS:

Single –phase Voltage Sources Inverters : Operating Principle: Single –phase Bridge Inverters, Steady –state Analysis of Single –phase Inverter, Fourier Analysis of Single-phase Inverter Output Voltage, Force-commutated Thyristor Inverters, Modified McMurray Half-bridge Inverter, Modified McMurry Full-bridge Inverter, Modified McMurry-Bedford Half-bridge Inverter, Modified McMurry-Bedford Full –bridge Inverter, Three Phase Bridge Inverters, Three-phase 180 Degree Mode VSI; Three –phase 120 Degree Mode VSI , Voltage Control In Single –phase Inverters, External Control of AC Output Voltage, External Control of DC Input Voltage, Internal Control of Inverter, Pulse –width Modulated Inverters; Single-pulse Modulation, Multiple-pulse Modulation, Sinusoidal –Pulse Modulation (sin M), Realization of PWM in Single –Phase Bridge Inverters, Reduction of Harmonics in the Inverters Output Voltage, Harmonic Reduction By PWM, Harmonic Reduction by Transformer Connections, Harmonic Reduction by Stepped –wave Inverters, Current Source Inverters, Single-phase CSI With Ideal Switches, Single-phase Capacitor- commutated CSI With R-Load, Single –phase Auto –sequential Commutated Inverter(1-Phase ASCI), Series Inverters, Basic Series Inverter Analysis of Basic Series Inverter, Single–phase Parallel Inverter. Analysis of Parallel Inverter.

4. VOLTAGE CONTROLLERS:

Types of AC Voltage Controllers, Integral Cycle Control, Single-phase Voltage Controller With R. Load, Single –phase Voltage Controller With RL Load, Sequence Control of AC Voltage Controllers (Transformer Tap Changers), Two –stage Sequence Control of Voltage Controllers, Multistage Sequence Control of Voltage Controllers, Single –phase Sinusoidal Voltage Controller.

5. CYCLOCONVERTERS:

Principle of Cycloconverter Operation: Single –phase to Single- phase Circuit –step-up Cycloconverter, Mid-point cycloconverter. Bridge-type Cycloconverter, Single-phase to Single –phase Circuit-step-down Cycloconverter, Mid-point Cycloconverter, Bridge-type Cycloconverter,Three-phase Half-wave Cycloconverters, Three-phase to Single –phase Cycloconverters, Three –phase to Three-phase Cycloconverters, Output Voltage Equation for a Cycloconverters, Load-commutated Cycloconverter.

6. SOME APPLICATION:

Switched Mode Power Supply (SMPS),Fly back Converter, Push-pull Converter, Half-bridge Converter, Full-bridge Converter, Uninterruptible Power Supplies, High Voltage Dc Transmission, Types of HVDC Link, Bipolar HVDC System, Control of HVDC Converters, Static Switches, Single –phase AC Switches, DC Switches ,Design of Static Switches, Static Circuit Breakers; Static AC Circuit Breakers, Static DC Circuit Breakers, Solid State Relays, DC Solid State Relays, AC Solid State Relays, Resonant Converters, Zero-Current Switching Resonant Converters ,L-type ZCS Resonant Converter, M-type ZCS Resonant Converter, Zero –Voltage – Switching Resonant Converters, Comparison between ZCS and ZVS Converters.

7. ELECTRIC DRIVES:

Concept of Electric Drive, DC Drive : Basic Performance Equations of DC Motors, Single-phase DC Drive: Single-phase Half-wave Converter Drives, Single-phase Semi converter Drives, Single –phase Full Converter Drives, Single-phase Dual Converter Drives, Three-phase DC Drives: Three-phase half-wave converter drives, Three-phase Semi converter Drives, Three-phase Full –converter Drives, Three-phase Dual Converter Drives, Chopper Drives, Power Control of Motoring Control, Regenerative – Braking Control , Two-quadrants Chopper Drives, Four-quadrant Chopper Drives, A.C.Drives, Speed Control of Three-phase Induction Motors, Stator Voltage Control, Stator Frequency Control, Stator Voltage and Frequency Control, Stator Current Control, Slip-Power Recovery Schemes, Cylindrical Rotor Motors, Salient-pole Motors, Reluctance Motors, Permanent , magnet Motors.

MFE7 <u>ELECTRICAL DESIGN, ESTIMATING AND COSTING</u>

1. ELEMENTS OF ESTIMATING:

Introduction ,Purpose of Estimating and Costing:, Qualities of a good Estimator, Essential Elements of Estimating and Costing, Tender, Guidelines for Inviting Tenders, Quotation, Other Important Factors of Estimating and Costing, Brief Questions with Answers.

2. CONVENTIONAL SYMBOLS:

Differential Types of Symbols.

3. WIRES, WIRE JOINTS, TERMINATION AND WIRING TOOLS:

Introduction, Wire and Cable, Choice of Conductor, Conductor Materials, Insulating Materials ,Types of Wires used for Internal Wiring, Wire Splicing and Termination.

4. TYPES OF HOUSE WIRING:

Cleat Wiring, Wooden Casing and Capping Wiring, PVC Casing and Capping Wiring, Tough Rubber Sheathed Wiring or Batton Wiring, Lead Sheathed or Metal Sheathed Wiring, Conduit Wiring System, Conduit Accessories and Fitting, Advantages and Disadvantages of Conduit Wiring Systems.

5. WIRING MATERIALS:

Domestic Wiring Accessories , Miniature Circuit Breaker, Residual Current Circuit Breaker or Earth Leakage Circuit Breaker, Components used for Protection Against Earth Leakage Current, Characteristics, Working and Construction of ELCB or RCCB; Load Change, Over Switches

6. TESTING OF INSTALLATION:

General , Insulation Resistance Test between Installation and Earth, Testing of Insulation Resistance Test between Conductors, Testing of Polarity of Single Pole Switches, Earth Continuity, How to Measure Earth Resistance , Merger Earth Tester, Voltmeter Method of Testing Earth.

7. PROTECTION AGAINST OVERLOAD, SHORT CIRCUIT AND EARTH FAULTS.

General , Main Features of Good Protective Devices, Protective Relays, Essential Fundamental Elements of Relay, Description of Relays, Buchholz Relay Protection, Electromagnetic Attraction Type Relays, Induction Type Over Current Relay, Induction Type Reverse Power Relay, Moulded Case Circuit Breakers.

8. EARTHING, ELECTRIC SHOCK , ELECTRIC FIRE, FIRE FIGHTING EQUIPEMENT:

Earthing, Purpose of Earthing, IS Specification Regarding Earthing of Electrical Installation, Definitions, Different Methods of Earthing , Brief Question- Answers, Electric Shock Factors on which Intensity of Electric Shock Depends, Cure of Electric Shock, Brief Questions Answers, Electrical Fire-fighting, Fire fighting Teams.

9. DOMESTIC ELECTRICAL INSTALLATION AND ESTIMATES:

General , Definitions, Drawing , Definition and Measurements of Points and Wiring, Electric Sub- station and Wiring Installation, Electric Installation in Building , Control at Commencement of Supply, Types of SB's Capacity of Circuit Internal Wiring Estimates, Sequence to be followed in Carrying out the Estimates, Definition and Positioning of Equipment , Arrangement of Apparatus, Locations of Various Outlets in House Wiring, Selection of Wires. Sub-circuits , Selection Rating and Installation of Necessity Equipment on the Main Switch Board.

10. MOTOR (CONTACTOR)CONTROL CIRCUITS:

General, Definitions of Equipments, Contactor Control Circuit Components, Contactor Control Circuits and Diagrams, Design Guidelines , Motor Control Circuits, Sequence Starting of Motors Manually/ Automatically, Automatic Sequence Control of Two and Three Motors with Time Delay, Motor Operated from Two Alternative Sources of Supplies , Starting of Two speed Squirrel Cage Induction Motor, Star Delta Starters.

11. THREE PHASE FOUR WIRE DISTRIBUTION SYSTEM:

General, Transmission Systems from Sub- station, Comparison between D.C. and A.C . Supply System, Components of Distribution Overhead Line, Determination of Size of Conductor for Overhead Transmission Line. Insulators ,Various Types of Insulators, Methods of Tieing, Conductor with Insulator, Lightning Arrester, Earthing of Transmission , Stay Tightners,

12. UNDERGROUND CABLES, INSTALLATION, ESTIMATES AND STREET LIGHTING:

General , Planning the Route for Cable Laying, Laying of Cable, Precautions of Excavation of Trenches, Procedures for Drawing in Cables, Classification of Cables, Underground Cables for Street Lighting , Laying of Cables, Street Light Poles.

MSE8 <u>COMPUTER AIDED ANALYSIS OF E.P.S</u>.

1. INTRODUCTION TO ELECTRIC POWER SYSTEM- GENERALISED CIRCUIT CONSTANTS:

Introduction, Classification of Transmission Lines, Short Transmission Lines: Regulation of Transmission Lines; Parallel Operation of Short; Transmission Lines, Medium Transmission Lines: Nominal-*T* Method, Nominal π Method, Phasor Diagrams for *T*ndπ Circuits , Dr. Steinmetz' Split Capacitor, Method for Medium Transmission Lines, Long Transmission Lines, Phase- Modifier for Voltage Control of Transmission System, Equivalent Circuits for Long Lines, Charts for Transmission Lines, Generalized Circuit Constants, General Circuit Equation, Transmission Line with Transformers at Both Ends, Transmission Line with Series Impedance at the Receiving End, Transmission Line with Series Impendence at the Receiving End, Transmission Line with Series Impedance at the Sending End, Generalized Constants of Combined Networks, Interpretation of *ABCD* Constants for Power Systems Studies, Ferranti Effect, Losses in transmission line on open circuit, Tuned power transmission lines.

2. POWER LOCUS DIAGRAMS:

Introduction, Receiving End Power Circle Diagram for Short Lines: Use of Receiving End Power Circle, Diagram for Determination of Phase Modifier Capacity, Incorporation of Displacement Angle in Circle Diagram, Receiving End Power Circle Diagram using ABCD Constants: (Including long lines) Sending End Power Circle Diagram for Short Lines, Sending End Power Circle Diagram using ABCD Constants (Including Long Lines), Receiving and Sending End Charts for Transmission Systems, Universal Power Circle Diagram Exercise.

3. REPRESENTATION OF POWER SYSTEMS AND SOLUTION OF NETWORKS:

Introduction, Single Line Diagram, Per Unit Quantities, Three- winding Transformers, Network Reduction- Star –Delta Transformation, Solution of Network: Power – Angel Relations: Power Flow in a Two Source System, Driving Point and Transfer, Impedances of General Network: General Network Equations, Real Power and Reactive Power Angle Relations, Power Angle Relations in Terms of Admittance Parameters, Loop and Nodal Analysis.

4. LOAD FLOW STUDIES:

Introduction, Power Flow in a Transmission System or Inter Connector, Analytical Formulation of Network Model for Load Flow Studies, Static Load Flow Equation, Data for Load Flow Studies, Power System Equations: Bus Loading and Line Flow Equations, Static Load Flow Equations (SLFE) in General form, Gauss-Iterative Method of Solution using Y

Bus, Load Flow Studies on A.C.Calculating Board or Network Analyser Comparison between Network Analyser and Digital Computers .

5. SYMMETRICAL THREE PHASE FAULTS ON SYNCHRONOUS MACHINES:

Introduction, Synchronous Machine Subjected to Symmetrical Short Circuit, Subtransient, Transient and Synchronous Reactances, General Approach for Symmetrical Fault, Calculations in Case of Loaded Machines under Transient Conditions.

6. SEQUENCE IMPEDANCE AND NETWORKS:

Introduction, Positive, Negative and Zero Phase Sequence Components of Unbalanced Phasors, Special Case with Zero, Sequence Voltage Absent, Unbalanced Three Phase Powers in Terms of Symmetrical Components, Relation between Line and Phase Voltage Sequence Components, Sequence Impedance of Symmetrical Three Phase Circuits: Sequence Impedences of Transmission Circuits, Zero Sequence Current Path , Sequence Impedances of Transformers, SequenceImpendance of Synchronous Machines, Sequence Networks.

7. ASYMMETRICAL FAULTS AND NETWORKS:

Introduction: Symmetrical Component Voltage, Short Circuit Fault Studies: Line to Line Fault , Single Line to Ground Fault(S.L.G.) , Double Line to Ground Fault, Faults Through Impedance: Three phase Fault, Line to Line Short Circuit not involving Ground, Single Line to Ground Fault, Double Line to Ground Fault, Phase Shift is Sequence Quantities in passing Through Transformers, Sequence Impedances of Unbalanced (Asymmetrical Circuits), Sequence Self and Mutual Impedances, Unsysmmetric

COURSE STRUCTURE & SYLLABUS OF
MASTER OF TECHNOLOGY (M.TECH)

In

Electrical Engineering

Course Structure

Second Year

Third Semester

Paper Code	Subject
MSE1	Machine Analysis
MSE2	Optimal Control
MSE3	Advanced Control Theory
MSE4	Power System Protection

SECOND YEAR

IIIrd Semester

MSE1 MACHINE ANALYSIS

1. ELEMENTS OF GENERALIZED THEORY

Essentials Of Rotating Electrical Machines, Conventions, The Basic Two-Pole Machine, The Per Unit System, Transformer With A Movable Secondary, Transformer And Speed Voltages In The Armature, Kron's Primitive Machine, Analysis Of Electrical Machines

R TRANSFORMATIONS IN MACHINES

Invariance Of Power, Transformation From A Displaced Brush-Axis, Transformation From Three Phases To Two Phases (A, B, C To A, β, 0), Transformation From Rotating Axes (α, β, 0) To Stationary Axes (D, Q, 0), Physical Concepts Of Park's Transformations, Transformed Impedance, How To Apply Generalized Theory, Electrical Torque, Restrictions Of The Generalized Theory Of Machines

3. ROTATING ELECTRICAL MACHINES IN QUASI HOLONOMIC REFERENCE FRAME

The Generalised Machine Of The Hirst Kind, Generated Voltage, Impedance Matrix, Impedance

Matrix Of The Synchronous Machine, Inductance And Torque Matrices, The Flux Linkage And The Flux Density Matrices, Rotation Matrix, Electromagnetic Torque, Performance Calculations, Elimination Of Axes, Torque Matrix After Elimination Of Some Axes, Analysis Using Revolving Field Theory, Transformation From The Stationary D-Q Axes To Stationary Real Axes Reference Frame

4. ELECTRICAL MACHINES IN ROTATING REFERENCE FRAMES

Nonholonomic Reference Frame, Equation Of Voltage Along The General Rotating Axes, Torque And Inductance Matrix In Nonholonomic Reference Frame, Holonomic Reference Frame, Equation Of Voltage In Holonomic Reference Frame, Equation Of Torque In Holonomic Reference Frame, Impedance Matrix Of The Second Generalised Machine From The First Generalised Machine, Equation Of Voltage Of The First Generalised Machine From That Of The Second, Equation Of Torque For The First Generalised Machine From The Second One

5. INDUCTION MACHINE

Induction Machine In The Quasi-Holonomic Reference Frame, Two Phase Symmetrical Components, Torque In A Two Phase Induction Machine, Single-Phase Induction Motor, Capacitor Motor, Three Phase Induction Motor

6. SYNCHRONOUS MACHINE

Synchronous Generator In The Quasi Olonomicreference Frame, Power In The Synchronous Machine, Reluctance Machine, Elimination Of The Field And Damper Windings, Synchronous Machine Using Revolving Field Theory, Two Phase Alternator In Holonomic Reference Frame, Transformation To The Real Axes Holonomic Reference Frame, Torque In A Salient Pole Synchronous Machine, Determination Of The D-Axis And Q-Axis Reactances, Synchronous Generator Under Sudden Short Circuit, Synchronous Generator Without Dampers And Resistance, Generator Without Damper But With Field Resistance, Generator With Damper Windings

SIS OF TRANSFORMERS

Bucking Impedance Of A Transformer, Steady State Analysis Of A Single Phase Core Type Transformer, Three Phase Δ - Y Transformer, Transient Analysis Of Transformers, Rectifier Transformer, Parallel Operation Of Transformers, Measurement Of Bucking Impedances Of Transformers, State Model Of Single Phase Transformer And Its Transient Analysis

FORMERS IN THE SEQUENCE REFERENCE FRAME

The Sequence Reference Frame, Impedance Matrixin The Sequence Reference Frame, Three Phase Δ-Y Transformer In The Sequence Reference Frame, Measurement Of Positive Sequence

Impedance, Measurement Of The Negative Sequence Impedance, Measurement Of Zero Sequence Impedance, Delta-Star Transformer Under L-L-L Fault, Delta Star Transformer Under L-L Fault, Delta Star Transformer Under L.L.G Fault When The Third Phase Is Open

MSE2 OPTIMAL CONTROL

1. THE STANDARD REGULATOR PROBLEM-1

A Review Of The Regulator Problem, The Hamil Ton-Jacobi Equation, Solution Of The Finite-Time Regulator Problem, Discrete Time Systems

2. THE STANDARD REGULATOR PROBLEM-II

The Infinite-Time Regulator Problem, Stability Of The Time-Invariant Regulator, Summary And Discussion Of The Regulator Probl.Em Results, Cross-Product Terms And Second Variation Theory, Regulator With A Prescribed Degree Of Stability

3. PROPERTIES OF REGULATOR SYSTEMS

The Regulator From An Engineering Viewpoint, Return Difference Equality And Related Formulas Some Classical Control Ideas: Sensitivity , Comple Mentary Sensitivity, And Robustness; Gain Margin, Phase Margin, And Time-Delay Tolerance, Insertion Of Nonlinearities, The Inverse Optimal Control Problem

4. ASYMPTOTIC PROPERTIES AND QUADRATIC WEIGHT SELECTION

Single Input Systems, Mul Tivariable Systems, Further Issues In Q, R Selection

5. STATE ESTIMATOR DESIGN

The Nature Of The State Estimation Problem, Deterministic Estimator Design, Statistical Estimator Design (The Kalman-Bucy Filter)

6. SYSTEM DESIGN USING STATE ESTIMATORS

Controller Design-Basic Versions and Variations, The Separation Theorem And Performance Calculation, Loss Of Passband Robustness With Observers, Loop Recovery, Robustness Improvement Via Residual Feedback

7. FREQUENCY SHAPING

Blending Classical and Linear Quadratic Methods, State Estimate Feedback With Frequency Shaping, Proportional Plus Integral State Feedback, Proportional Plus Integral State Estimate Feedback

MSE3 ADVANCED CONTROL THEORY

1. INTRODUCTION TO CONTROL SYSTEM

What is Control System, Classification Of Systems, Open-Loop Control System, Closed-Loop Control Systems, Elements Of Automatic Or Feedback Control System, Requirement Of

Automatic Control Systems, Representation Of A Control System, Mathematical Models Of Control System

2. TIME DOMAIN ANALYSIS AND FREQUENCY RESPONSE

Introduction, Standard Test Signals, Static Accuracy, Computation Of Steady State Errors, Transient Response: First Order System, Transient Response: Second Order System, Transient Response Specification, Conclusion, Frequency Response, Frequency Domain Specifications, Magnitude And Phase Angle Characteristics Plot, Frequency Response Specification

3. DESIGN AND COMPENSATION TECHNIQUES

Introduction, Luminary Design Considerations, Lead Compensation, Lag Compensation, Lag-Lead Compensation, Tuning Rules for Pid Controllers

4. DESCRIBING-FUNCTION ANALYSIS OF NONLINEAR CONTROL SYSTEMS

Introduction to Nonlinear Systems, Nonlinear Control Systems, Describing Function, Describ1ng-Function Analysis Of Nonlinear Control Systems, Concluding Comments

5. ANALYSIS OF CONTROL SYSTEMS IN STATE SPACE

Introduction, Basic Materials In State-Space Analysis, Transfer Matrix, Controllability, Observability, Obtaining State-Space Equations In Canonical Forms, Liapunov Stability Analysis, Liapunov Stability Analysis Of Linear Time-Invariant Systems, Time-Varying Systems

6. DESIGN OF CONTROL SYSTEMS BY STATE-SPACE METHODS

Introduction, Control System Design Via Pole Placement, Design Of State Observers

MSE4 POWER SYSTEM PROTECTION

1 **INTRODUCTION**

Need for Protective Systems, Nature and Causes of Faults, Types of Faults, Effects of Faults , Fault Statistics, Evolution of Protective Relays, Zones of Protection, Primary and Back-up Protection, Essential Qualities of Protection, Classification of Protective Relays, Classification of Protective Schemes, Automatic Reclosing , Current Transformers for Protection , Potential Transformer , Summation Transformer, Phase-sequence Current-segregating Network, Basic Rely Terminology ,

2 OPERATING PRINCIPLES AND RELAY CONSTRUCTION.

Electromagnetic Relays, Thermal Relays , Static Relays, Microprocessor-based protective Relays

3 OVERCURRENT PROTECTION

Time-current Characteristics, Current Setting, Time Setting , Overcurrent Protective Schemes , Reverse Power or Directional Relay, Protection of Parallel Feeders , Protection of Ring Mains , Earth Fault and Phase Fault Protection, Combined Earth Fault and Phase

Fault Protective Scheme , Phase Fault Protective Scheme , Directional Earth Fault Relay, Static Overcurrent Relays, Microprocessor-based Overcurrent Relays .

4 DISTANCE PROTECTION

Impedance Relay, Reactance Relay, MHO (Admittance or Angle Admittance) Relay, Angle Impedance (Ohm) Relay, Input Quantities for Various Types of Distance Relays, Sampling Comparator, Effect of Arc Resistance on the Performance of Distance Relays, Effect of Power Surges (Power Swings) on the Performance of Distance Relays, Effect of Line Length and Source Impedance on Distance Relays, Selection of Distance Relays, MHO Relay with Blinders, Quadrilateral Relay, Elliptical Relay, Restricted *MHO* Relay, Restricted Impedance Relay, Restricted Directional Relay, Restricted Reactance Relay, Some Other Distance Relay Characteristics, Swivelling Characteristics, Choice of Characteristics for Different Zones of Protection, Compensation for Correct Distance Measurement, Reduction of Measuring Units, Switched Schemes, Auto-reclosing,

5 AC MACHINES AND BUS-ZONE PROTECTION

Protection of Generators, Transformer Protection, Bus-zone Protection, Frame Leakage Protection

6 MICROPROCESSOR AND INTERFACING

Introduction, Microprocessors, Input/Output Devices, Semiconductor Memories, Single Chip Microcomputers, I/O Ports and Programmable Peripheral Interface, Programmable Interval Timer (Intel 8253), IC Elements and Circuits for Interfaces, AID Converter, Analog Multiplexer, *SIR* Circuit

7 MICROPROCESSOR-BASED PROTECTIVE RELAYS

Introduction, Overcurrent Relays, Impedance Relay, Directional Relay, Reactance Relay, Generalised Mathematical Expression for Distance Relays, Measurement of *R* and *X,* Mho and Offset Mho Relays, Quadrilateral Relay, Generalised Interface for Distance Relays, Digital Relaying Algorithms, Differential Equation Technique, Discrete Fourier Transform Technique, Walsh-Hadamard Transform Technique, Rationalised Haar Transform Technique Removal of the dc Offset, Microprocessor Implementation of Digital Distance Relaying Algorithms.

COURSE STRUCTURE & SYLLABUS OF
MASTER OF TECHNOLOGY (M.TECH)

In

Electrical

Course Structure

Second Year

Fourth Semester

SPECIALIZATION 1

Specialization 1	**CONTROL & INSTRUMENTATION**
Paper Code	**Subject**
MSCI 01	Industrial Instrumentation and control
MSCI 02	Digital control and state variable methods
MSCI 03	Electronic Instruments and Systems
MS 04	Project

SPECIALIZATION 1 : CONTROL & INSTRUMENTATION

MSCI 01 : Industrial Instrumentation And Control

Basic Concepts And Qualities Of Measurements, Electrical Measuring Instruments, Displacement Force, Torque And Speed Measurement, Level Measurement, Pressure Measurement, Flow Measurements, Temperature Measurement, Optical And Surveying Instruments, Dimension Measurement, Measurement Of Physical Properties, Electronic Measurement, Magnetic Measurements, Selection, Installation And Commissioning Of Instruments, Process Control And Automatic Controllers, Transmitters, Telemetry Systems And Recorders, Computer Aided Measurement And Control systems, Microcomputer Based Measurement And Control Using Distributed Control System.

MSCI 02 : Digital Control And State Variable Methods

Introduction, Signal Processing In Digital Control, Models Of Digital Control Devices And Systems, Design Of Digital Control Algorithms, Control System Analysis Using State Variable Methods, State Variable Analysis Of Digital Control Systems, Pole Placement Design And State Observers, Lyapunov Stability Analysis, Linear Quadratic Optimal Control, Nonlinear Control Systems, Neural Networks For Control, Fuzzy Control.

MSCI 03 : Electronic Instruments And Systems

Modern Electronic Equipment And Maintenance Concepts, Maintenance Aids And Records, Trouble Shooting And Repair Procedure, Soldering And Desoldering Techniques, Measurement Concepts And Techniques, Measuring Instruments, Passive Components, Active Components, Operational Amplifiers, Digital Circuits, Troubleshooting In Power Supply Units, Troubleshooting In Measuring Instruments, Troubleshooting In Audio Systems, Trouble Shooting In Radio Communication Equipment, Troubleshooting In Video Systems, Troubleshooting In Computes, Home And Office Electronic Systems, Installation And Safety Measures, Preventive Maintenance.

MS 04 : PROJECT

Project Guidelines :

Thinking up a Project

You are expected to come up with your own idea for a project. A wide range of topics is acceptable so long as there is substantial computing content and project is predominantly of a practical, problem-solving nature. You might take up an interest which you already have in your stream of engineering. You may do your project in any reputed organization or a department. Every student is to take up a project individually. The project is a vehicle for you to demonstrate the required level of competence in your chosen field of Masters.

Start thinking about your project right in the beginning. If you want to do the project in industrial environment start your correspondence fairly early to find an organization, which is ready to accept you You must submit an outline of your project (two or three pages) to your guide within one month of start of the project work. This must include the Title, Objective, Methodology (main steps to carry out a project), expected output and organization where you intend to carry out the project.

Arranging a Guide

When you have an idea of your project, even a tentative one, approach a suitable person who has interest and expertise in that area. The Guide may be a person with M.E. / M.Tech with a five-year working experience or a B.E./ B.Tech having a working experience of fifteen years in relevant field.

with the Guide

The Guide's role is to provide support and encouragement to direct the student's attention to relevant literature, to provide technical assistance occasionally, to read and comment on the draft

report and to give guidance on the standard and amount of work required. The Guide is not responsible to teach any new skills and language required for project work or for arranging any literature or equipment. You are expected to meet at least once a month to your Guide. Rest you can workout your own arrangement. The students, who are content to carry out their work largely without supervision, should keep their Guide in touch with what they are doing. A student should not remain silent for months and then appear with a complete project work unknown to supervisor. In such circumstances, the Guide cannot be counted on to give an automatic seal of his approval. If a project produces a piece of software, the Guide would normally expect to see a demonstration of the software in action.

The main purpose of the report is to explain what you did in your project. The reader should be able to see clearly what you set out to do and what you achieved. It should describe the problem addresses and explain why you tackled it in the way you did. It should include your own assessment of how successful the project was.

Resist temptation to include pages of padding. If the project consists of developing an application in area with which a computer scientist would not be familiar – such as chemical testing, stock & shares – it might be necessary to include some explanatory company/ organization profile for whom you have done the work must not appear in chapters and must go to appendix part.

The work that is presented for examiners should be your own. The presentation of another person's work, design or program as though they are your own is a serious examination offence. Direct quotation form the work of others (published or un published) must always be clearly identified as such by being placed in quotation marks, it is essential that reader should be able to see where the other work ends and your begins.

Sometimes a project containing good work is marred by a report, which is turgid, obscure and simply ungrammatical. In such cases, it is very difficult to find out the work done during the project. An examiner cannot be kind enough to look properly on a project that is almost unreadable.

Important points for carrying out a project

- The organizations or companies offer you a placement for project work out of good will or to get some useful work done. Usually the companies do not provide you everything required by you. You must settle this right in the beginning of the project with the business that what will you get from them and what you have to arrange yourself.
- Some times a complication arises due to the fact that some aspect of your project work is considered confidential by the company. If this is so, it is your responsibility to get whatever clearance is necessary from the organization right in the beginning as essential parts like system analysis and design, flow charts etc. can not be missing from a project report.
- Make sure you allow enough time for writing report. It is strongly recommended that do some writing work as you carry out the project rather than leaving write up until the end. You must allow at least a month to finally write the report. There has to be enough time for the supervisor to read and comment on it and for student to make changes (sometimes extensive) on the basis of the comments. You may have to prepare two or three drafts

before the final submission. Remember that it is mainly the project reports that get examined. An external supervisor receives a pile of project reports written by people who he does not know. If a project produced some software he even may not get time to see it running. In most cases he forms his judgment purely on the basis of the report. Please make your report as readable as possible content wise as well as presentation wise.

1. **Introduction:** This must contain background, any previous work done in the area of your project, your objective and other relevant material that may be helpful to further explain your project work.
2. **The existing system:** The study of the present system; problems in existing system.
3. **System design:** The proposed system; Any specific problem encountered at how you handled them.
4. **Implementation of the system:** Implementation issues and their justification.
5. **Conclusions:** Any shortcoming; your assessment of your work; comparison of your work with similar works; silent features of your work any feature modification. Real times applications of your project work.

References must be given at the end following any standard way of giving references.

For example:

Langdrof, 'Theory of Alternating Current Machinery" Tata McGraw Hill, July 2003.

Finally, your project work is your brainchild and nobody knows about it more than you. Be confident to explain your work at the time of viva and be honest to accept any short falls.

The Project Report Details

The report should be prepared with the Word Processing software. They should be printed on A4 size (Executive Bond) paper. A margin of 1.5 inches must be allowed on left hand side for binding. The pages should be numbered. The report should be typed in the 12-font size with vertical spacing of 1.5**. You must submit three copies of your Project Report in between the dates as designated by the University positively** alongwith **a brief Bio –Data of the Supervisor.**

A report should be hard bound (light green cover with golden print on the cover). The title of the project should be clearly visible on the cover.

The cover page should be as figures below. The first page should be title page containing the title, the candidates name, Enrolment Number, Name of Study Centre and University. Second page is a certificate from the supervisor. The 3rd page is for the acknowledgement. Fourth page gives the contents of the project report. Fifth page should be an abstract of the project followed by the chapters. You must ensure that all pages are legible. Where the project has produced

software for a personal computer, you should include a CD inside the back cover of the report, along with instructions in the report how to run it.

COURSE STRUCTURE & SYLLABUS OF
MASTER OF TECHNOLOGY (M.TECH)

In

Electrical

Course Structure

Second Year

Fourth Semester

SPECIALIZATION 2

Specialization 2	**POWER SYSTEM CONTROL**
Paper Code	**Subject**
MSPS 01	Electrical Power System Design
MSPS 02	Power System Analysis and Dynamics
MSPS 03	Power System Reliability
MS 04	Project

SPECIALIZATION 2 : POWER SYSTEM CONTROL

MSPS 01 : Electrical Power System Design

Constants Of Overhead Transmission Lines, Characteristics And Performance Of Transmission Line, Design Of Transmission Lines, Power System Operation And Analysis, Switchgear, Design Of EHV Transmission Lines, High Voltage DC Transmission Lines, Design Of Power System, Power System Control And Line Compensation, Design Of Distribution Systems, Economics Of Distribution Systems, Power System Improvement, Power System Planning.

MSPS 02 : Power System Analysis And Dynamics

Introduction, network formulation, power system components and their representation, short circuit studies, numerical solution of mathematical equations, load flow studies, economic load scheduling of power system, sparsity technique, dynamic analysis and modeling of machines, stability studies, multiphase(6 phase) systems, protective relaying, digital relaying schemes.

MSPS 03: power system reliability

Introduction, review of probability theory and stochastic processes, analytical methods of reliability modeling and calculations, Monte Carlo simulation method, generation system reliability, multiarea system reliability, composite system reliability evaluation, distribution system reliability.

MS 04 : PROJECT

Project Guidelines :

Thinking up a Project

You are expected to come up with your own idea for a project. A wide range of topics is acceptable so long as there is substantial computing content and project is predominantly of a practical, problem-solving nature. You might take up an interest which you already have in your stream of engineering. You may do your project in any reputed organization or a department. Every student is to take up a project individually. The project is a vehicle for you to demonstrate the required level of competence in your chosen field of Masters.

Start thinking about your project right in the beginning. If you want to do the project in industrial environment start your correspondence fairly early to find an organization, which is ready to accept you You must submit an outline of your project (two or three pages) to your guide within one month of start of the project work. This must include the Title, Objective, Methodology (main steps to carry out a project), expected output and organization where you intend to carry out the project.

Arranging a Guide

When you have an idea of your project, even a tentative one, approach a suitable person who has interest and expertise in that area. The Guide may be a person with M.E. / M.Tech with a five-year working experience or a B.E./ B.Tech having a working experience of fifteen years in relevant field.

with the Guide

The Guide's role is to provide support and encouragement to direct the student's attention to relevant literature, to provide technical assistance occasionally, to read and comment on the draft report and to give guidance on the standard and amount of work required. The Guide is not responsible to teach any new skills and language required for project work or for arranging any literature or equipment. You are expected to meet at least once a month to your Guide. Rest you can workout your own arrangement. The students, who are content to carry out their work largely without supervision, should keep their Guide in touch with what they are doing. A student should not remain silent for months and then appear with a complete project work unknown to supervisor. In such circumstances, the Guide cannot be counted on to give an automatic seal of his approval. If a project produces a piece of software, the Guide would normally expect to see a demonstration of the software in action.

The main purpose of the report is to explain what you did in your project. The reader should be able to see clearly what you set out to do and what you achieved. It should describe the problem addresses and explain why you tackled it in the way you did. It should include your own assessment of how successful the project was.

Resist temptation to include pages of padding. If the project consists of developing an application in area with which a computer scientist would not be familiar – such as chemical testing, stock & shares – it might be necessary to include some explanatory company/ organization profile for whom you have done the work must not appear in chapters and must go to appendix part.

The work that is presented for examiners should be your own. The presentation of another person's work, design or program as though they are your own is a serious examination offence. Direct quotation form the work of others (published or un published) must always be clearly identified as such by being placed in quotation marks, it is essential that reader should be able to see where the other work ends and your begins.

Sometimes a project containing good work is marred by a report, which is turgid, obscure and simply ungrammatical. In such cases, it is very difficult to find out the work done during the project. An examiner cannot be kind enough to look properly on a project that is almost unreadable.

Important points for carrying out a project

- The organizations or companies offer you a placement for project work out of good will or to get some useful work done. Usually the companies do not provide you everything required by you. You must settle this right in the beginning of the project with the business that what will you get from them and what you have to arrange yourself.
- Some times a complication arises due to the fact that some aspect of your project work is considered confidential by the company. If this is so, it is your responsibility to get whatever clearance is necessary from the organization right in the beginning as essential parts like system analysis and design, flow charts etc. can not be missing from a project report.

- Make sure you allow enough time for writing report. It is strongly recommended that do some writing work as you carry out the project rather than leaving write up until the end. You must allow at least a month to finally write the report. There has to be enough time for the supervisor to read and comment on it and for student to make changes (sometimes extensive) on the basis of the comments. You may have to prepare two or three drafts before the final submission. Remember that it is mainly the project reports that get examined. An external supervisor receives a pile of project reports written by people who he does not know. If a project produced some software he even may not get time to see it running. In most cases he forms his judgment purely on the basis of the report. Please make your report as readable as possible content wise as well as presentation wise.

6. **Introduction:** This must contain background, any previous work done in the area of your project, your objective and other relevant material that may be helpful to further explain your project work.
7. **The existing system:** The study of the present system; problems in existing system.
8. **System design:** The proposed system; Any specific problem encountered at how you handled them.
9. **Implementation of the system:** Implementation issues and their justification.
10. **Conclusions:** Any shortcoming; your assessment of your work; comparison of your work with similar works; silent features of your work any feature modification. Real times applications of your project work.

References must be given at the end following any standard way of giving references.

For example:

Langdrof, 'Theory of Alternating Current Machinery" Tata McGraw Hill, July 2003.

Finally, your project work is your brainchild and nobody knows about it more than you. Be confident to explain your work at the time of viva and be honest to accept any short falls.

The Project Report Details

The report should be prepared with the Word Processing software. They should be printed on A4 size (Executive Bond) paper. A margin of 1.5 inches must be allowed on left hand side for binding. The pages should be numbered. The report should be typed in the 12-font size with vertical spacing of 1.5**. You must submit three copies of your Project Report in between the dates as designated by the University positively** alongwith **a brief Bio –Data of the Supervisor.**

A report should be hard bound (light green cover with golden print on the cover). The title of the project should be clearly visible on the cover.

The cover page should be as figures below. The first page should be title page containing the title, the candidates name, Enrolment Number, Name of Study Centre and University. Second page is a certificate from the supervisor. The 3rd page is for the acknowledgement. Fourth page gives the contents of the project report. Fifth page should be an abstract of the project followed by the chapters. You must ensure that all pages are legible. Where the project has produced software for a personal computer, you should include a CD inside the back cover of the report, along with instructions in the report how to run it.