Kalinga University Atal Nagar (C.G.)

SCHEME OF EXAMINATION

& SYLLABUS

of

M.Tech Electrical Engineering

UNDER

Faculty of Engineering and Technology

w.e.f. Session 2021-22

Kalinga University, Raipur

M.Tech Electrical Engineering

W.e.f 2021-22 Session

Semester –I					
Code No.	**Paper**	**Credits**	**End Semester Exam**	**Internal Marks**	**Total Marks**
MTELE101	Power System Analysis and Design	4	100	50	150
MTELE102	Advanced Power Electronics	4	100	50	150
MTELE103	Advanced Electrical Machines	4	100	50	150
MTELE104	Load and Energy Management	4	100	50	150
MTELE105	**Elective-1**	4	100	50	150
MTELE105A	Intelligent Techniques and Applications				
MTELE105B	Industrial Drives and Automation				
MTELE105C	High Voltage Engineering and Test Techniques				
MTELE106-P	Electrical Lab-I	2	30	20	50
	Total	**22**	**530**	**270**	**800**
Semester -II					
Code No.	**Paper**	**Credits**	**End Semester Exam**	**Internal Marks**	**Total Marks**
MTELE201	Digital Control System	4	100	50	150
MTELE202	Power System Operation and Control	4	100	50	150
MTELE203	Advanced Relaying and Protection	4	100	50	150
MTELE204	Modeling and Dynamics of Electrical Machines	4	100	50	150
MTELE205	**Elective-2**	4	100	50	150
MTELE205A	Special Electric Machines				
MTELE205B	Microprocessor and Microcontroller				
MTELE205C	Real Time Instrumentation				
MTELE206-P	Electrical Lab-II	2	30	20	50
	Total	**22**	**530**	**270**	**800**

Semester -III					
Code No.	**Paper**	**Credits**	**End Semester Exam**	**Internal Marks**	**Total Marks**
MTELE301	Power System Transients	4	100	50	150
MTELE302	Power System Planning	4	100	50	150
MTELE303	**Elective-3**	4	100	50	150
MTELE303A	Energy Efficient Machines				
MTELE303B	Power System Dynamics and Stability				
MTELE303C	EHVAC and HVDC Transmission System				
MTELE304	Preliminary work on Dissertation	9	100	50	150
MTELE305	Seminar Based on Dissertation	1	100	50	150
	Total	**22**	**500**	**250**	**750**
Semester -IV					
Code No.	**Paper**	**Credits**	**End Semester Exam**	**Internal Marks**	**Total Marks**
MTELE401	Dissertation	18	300	200	500
	Total	**18**	**300**	**200**	**500**

SEMESTER-I

MTELE101

Power System Analysis and Design

OVERVIEW: Review of modeling of power system components, formulation and modifications of the Impedance and Admittance matrices, storage techniques.

Unit-I

OPTIMAL POWER FLOW: Review of load flow with and without tap changing and phase shifting transformer, Solution of OPF by Gradient method, Newton's method, LP method, Security constrained OPF, Continuation power flow, Sparse matrix techniques for large scale system problems

Unit-II

FAULT STUDIES: Three Phase Networks, Three Phase Network Elements, Balanced Network, Transformation Matrices, Three Phase Unbalanced network Elements, Algorithm formation of Three Phase Bus Impedance Matrix, Modification of Three Phase Bus Impedance Matrix for changes in the Network.

Unit-III

NETWORK FAULTS AND CEONTINGENCY ANALYSIS: Fault computation using Z – Bus, Short Circuit Calculation for Three Phase Network using z-bus, Contingency analysis for power system.

Unit-IV

POWER SYSTEM SECURITY: Factors affecting security, Contingency analysis, Network sensitivity using load flow, correcting the generation dispatch by using sensitivity method and linear programming.

Unit-V

STATE ESTIMATION IN POWER SYSTEMS: Method of least-squares, State estimation of AC network, Detection and identification of bad measurements, Network observability and pseudo measurements, Application of power system state estimation.

Reference Books:

1. Grainger J.D., Power System Analysis, McGraw-Hill, Inc, Singapore.
2. Wood A.J. and Wollenberg B.F., Power Generation, Operation and Control, John Wiley and Sons, New York, USA.
3. Glover J.D. and Sarma, Power System Analysis and Design, PWS Publishing Company, Boston, USA.
4. Stagg G. W. and Elabiad A. H., Computer Methods in Power System Analysis, McGraw Hill, New York.
5. Pai M. A., Computer Techniques in Power System Analysis, Tata McGraw Hill Publishing Co. Ltd.
6. Kusic G.L., Computer Aided Power System Analysis, Prentice Hall (India)
7. Arrillaga J., Arnold C.P. and Harker S.J. , Computer Modeling of Electrical Power Systems, John. Willey and Sons 1983.
8. Elgard O.I., Electric Energy Systems An Introduction, Tata McGraw Hill, 1971.

MTELE102

Advanced Power Electronics

Unit-I

REVIEW OF SEMICONDUCTOR DEVICES: Conduction Process in semiconductors, pn Junction, Charge control description, Avalanche breakdown, Power diodes, Thyristors, Gate Turn Off thyristor (GTO), VI characteristics, Dynamic characteristics, ratings, protection, heat transfer by conduction, radiation and convection, heat sink design, driving circuits.

Unit-I I

POWER MOSFET AND IGBT: Basic structure, I-V Characteristic, Physics of device operation, switching characteristics, operating limitation and safe operating area.

Unit-III

EMERGING DEVICES AND CIRCUITS: Power junction Field effect transistor (FET), Integrated Gate-Commutated Thyristor (IGCT), Field Control Thyristor, Metal oxide semiconductor (MOS) Control Thyristor etc. Power ICs, New semiconductor materials.

Unit-IV

SNUBBER CIRCUITS: Types of Snubber circuits, needs of Snubber circuit with diode, thyristor and transistors, Turn-off Snubber, over voltage snubber, turn on snubber, Snubber for bridge circuit configurations, GTO Snubber circuit.

Unit-V

GATE AND BASIC DRIVE CIRCUITS: Design Consideration, De-coupled drive circuits, Electrically isolated drive circuits, cascade connected drive circuits, Power device protection in drive circuits, circuit layout considerations.

Reference Books:

1. Mohan, Undeland and Robbins, *Power electronics: converters, Applications and Design*, John Wiley and Sons.

2. Rashid M.H., *Power Electronics Handbook*, Elsevier Press (Academic Press Series).

3. Finney D., *The Power Thyristor and its Applications*, McGraw Hill, New York.

4. Lander C. W. *Power Electronics*, McGraw Hill Book Co., U.K.

5. Rashid M.H., *Power Electronics* - Circuits, Devices and Applications, PHI, India.

MTELE103

Advanced Electrical Machines

Unit-I

POLYPHASE SYNCHRONOUS MACHINES: Mathematical: Basic Synchronus machine parameters, Voltage, Flux linkage and inductance relations, Park's transformation – its physical concept, equations of performance

BALANCED STEADY STATE ANALYSIS: Phasor equations and phasor diagrams, Power-angle characteristics, Cylindrical rotor and Salient pole machines, Short circuit ratio.

Unit-II

TRANSIENT ANALYSIS: Three phase short-circuits, Armature and field transients, Transient torque, Sudden reactive loading and Unloading. Transient Analysis - a qualitative approach, Reactances and Time – Constants from equivalent circuits, Measurement of Reactances, Transient Power – angle characteristics.

SYNCHRONOUS – MACHINE DYNAMICS: The basic electromechanical equation, Linearized Analysis, Large Angular/oscillation, Non-linear analysis.

Unit-III

TRANSFORMERS: Multi-Circuit Transformers: General theory, Equivalent circuits, Three winding transformer as a multi-circuit transformers, Determination of parameters.

EXCITATION PHENOMENA IN TRANSFORMERS: Hamonics in Single – phase transformers, Harmonics in three-phase transformers, Disadvantages of harmonics, Suppression of harmonics.

Unit-IV

TRANSFORMER TRANSIENTS: In-rush current phenomena, Qualitative approach, Analytical approach, In-rush current in 3-phase transformers.

Unit-V

UNBALANCED OPERATION OF THREE-PHASE TRANSFORMERS : Single-phase load on three-phase transformers, Single – Phasing in 3-phase transformers, Effect of using tertiary winding.

Reference Books:

1. Edikins B. ,*Generalized theory of electrical Machines*,
2. Concordia, *Synchronous machines*.
3. E.W. Kimbark , *Power System Stability*, Vol. III., Wiley
4. Fitzgerald A.E., Kingsley C. and Umans S.D., *Electric Machinery*, 6th Edition, McGraw Hill
5. Bimbra, P.S.,*Generalized theory of electrical Machines*, Khanna Publications
6. Draper A, *Electrical Machines,* Longman London, 1972
7. MIT Staff , *Magnetic Circuits and Transformer.*.
8. Daniels A. R., *Introduction to Electrical Machines*" MacMillan, London 1976.

MTELE104

Load and Energy Management

Unit-I

LOAD FORECASTING: Classification and characterization of loads, Approaches to load forecasting, Forecasting methodology, Energy forecasting, Peak demand forecasting, Non-weather sensitive forecast and Weather sensitive forecast, Total forecast, Annual and monthly peak demand forecasts. Applications of state estimation to load forecasting.

Unit-II

LOAD MANAGEMENT: Introduction to Load management. Electric energy production and delivery system structure (EEPDS). Design alternatives for EEPD systems. Communication/control techniques for load management. Tariff structure and load management, principles of macro and microeconomics and energy pricing strategies, Assessing the impacts of load management.

Unit-III

ENERGY DEMAND FORECASTING: Static and dynamic analysis of energy demand, elements of energy demand forecasting, methodologies and models for energy demand forecasting, techno-economic approach in energy demand forecasting.

Unit-IV

TRENDS AND CASE STUDIES: Energy management strategy, symbiotic relation between information, energy models and decision making,

Unit-V

Case studies case studies like industrial energy forecasting, transportation energy forecasting, residential, commercial and agricultural energy forecasting.

Reference Books:

1. Martino J., *Technological Forecasting for Decision Making*, Elsevier Press, New York.
2. Gellings C.W. and Penn Well P.E., *Demand Forecasting in the Electric Utility Industry*, Fairmount Press.
3. Makridakis S., *Forecasting Methods and Applications*, Wiley

Elective-1

MTELE105A

Intelligent Techniques and Applications

Unit-I

ARTIFICIAL INTELLIGENCE: Definition, problem solving methods, searching techniques, knowledge representation, reasoning methods, predicate logic, predicate calculus, multivalue logic.

Unit-II

FUZZY LOGIC: Concepts, fuzzy relations, membership functions, matrix representation, de-fuzzification methods

Unit-III

ARTIFICIAL NEURAL NETWORK: Introduction, multi-layer feed forward networks, back propagation algorithms, radial basis function and recurrent networks.

Unit-IV

EVOLUTIONARY TECHNIQUES: Introduction and concepts of genetic algorithms and evolutionary programming, Differential Evolution

Unit-V

HYBRID SYSTEMS: Introduction and Algorithms for Neuro-Fuzzy, Neuro-Genetic, Genetic-Fuzzy systems

AI APPLICATIONS IN POWER SYSTEMS: Load flow, economic load dispatch, load forecasting, transient stability and power system stabilizers

Reference Books:

1. Rajasekaran S. and Pai G.A.V., *Neural Networks, Fuzzy Logic And Genetic Algorithm Synthesis and applications*, PHI New Delhi.
2. Lin C. and Lee G., *Neural Fuzzy Systems*, Prentice Hall International Inc.
3. Goldberg D.E. *Genetic Algorithms in Search Optimization and Machine Learning*, Addition Wesley Co., New York.
4. Kosko B., *Neural Networks and Fuzzy Systems A dynamical systems approach to machine intelligence*, Prentice Hall of India.
5. Taylor C.W., *Power System stability* Mc-Graw Hill, New York.
6. Shivnandam S.N., *Principle of soft computing,* Wiley.
7. RajshekaranS. and Pa G.A.V.i, *Neural Network , Fuzzy logic And Genetic Algorithm, PHI.*
8. Zurada Jack M., *"Introduction to Artificial Neural Network System"* JAICO Publication.
9. Ross Timothy J.*, "Fuzzy logic with Engineering Applications",* McGraw-Hills

MTELE105B

Industrial Drives and Automation

Unit-I

INTRODUCTION: Definition, Types of loads, steady state and transient stability of Drive, state of art of power electronics and drives, selection of motor rating.

Unit-II

D.C. DRIVES: Review of braking and speed control of D.C. motors, multi-quadrant operation, loss minimization in adjustable speed drives. Mathematical modeling of dc drives, stability analysis, modern control techniques: variable structure, adaptive control.

Unit-III

INDUCTION MOTOR DRIVES: Review of braking and speed control of induction motors. Constant V/F, constant air gap flux, controlled voltage, controlled current and controlled slip operation, vector control, Mathematical modeling of induction motor drives, transient response and stability analysis Introduction to cycloconverter fed induction motor drive.

Unit-IV

SYNCHRONOUS MOTOR DRIVES: Adjustable frequency operation, voltage fed drive, current fed self-controlled drive.

Unit-V

AUTOMATION USING DRIVES: Introduction, various components of automation, different sensors used in automation, PLC introduction and ladder programming, industrial application of automation, sensor less vector control and DTC drive, Recent trends in automation and case studies.

Reference Books:

1. Dubey G.K., *Power Semiconductor Controlled Drive*, Prentice Hall, New Jersey.
2. Sen P.C., *Thyristor Controlled DC Drives*, Wiley, New York.
3. Murphy J.M.D. and Turnbull F.G., *Power Electronics Control of AC Motors*, Franklin Book Co.
4. Bose B.K., *Power Electronics and AC Drives*, Prentice Hall, New Jersey.
5. Bose B.K., *Power Electronics and Variable Frequency Drives-Technology and applications*, IEEE Press.

MTELE105C

High Voltage Engineering and Test Techniques

Unit-I

INTRODUCTION: Power Systems Development and High Voltage Engineering; Contents of High Voltage Engineering; Applications of High Voltage Technology.

TRAVELING WAVES: Transient and traveling waves; Effects of Line Terminations; Junction of several lines; Bewley Lattice Diagram; Traveling wave in transformer and generator.

Unit-II

LIGHTNING IN POWER SYSTEMS: Lightning formation; Lightning overvoltages (strike and backflashover) in power systems; Lightning overvoltages protection devices in power systems; Lightning protection system of high buildings.

SWITCHING OVER VOLTAGES: Types of internal overvoltages; The importance of switching overvoltages; Causes of various internal overvoltages; Control of switching overvoltages; EMTP and its applications.

Unit-III

ARRESTERS AND INSULATION COORDINATION: Surge arresters (MOA) and its performances; Voltage-Time Characteristics and coordination; Surge arresters selection and location in power systems; Principles of insulation coordination; Statistical and conventional insulation coordination.

HIGH VOLTAGE CABLES: Configuration and design features of high voltage cables; Testing of high voltage cables; Diagnostics of high voltage cables.

Unit-IV

AIR AND SF6 BREAKDOWN: Fundamental aspects of air and SF6 breakdown, U-curve and gap factor; Sparkover characteristics; SF6 gas insulation performance.

GAS INSULATED SUBSTATION: Gas Insulated Substation (GIS) and its importance; Configuration and design features of GIS; Prospects of GIS.

Unit-V

HIGH VOLTAGE TEST OF ELECTRICAL APPARATUS: Nondestructive insulation testing; Destructive insulation testing: AC, DC, and Impulse testing of apparatus; New high voltage measurement technology; Safety in high voltage lab. Applications of high voltages technology in other area.

Reference Books:

1. Khalifa M., *High-Voltage Engineering*, Theory and Practice, Marcel Dekker, Inc.
2. Ryan H.M., *High Voltage Engineering and Testing*, lEE Press.
3. Gonen T., *Electric Power Distribution System Engineering*: Analysis and Design, McGraw Hill Book Co.

MTELE106-P

Electrical Lab-I

List of Experiments:

- Ratio Test of a C.T and determination of error.
- Determination of knee point voltage of a CT.

3 Summation Transformer characteristics.

- Study of CT Connection for E/F protection.
- Study of Open delta PT Connection for earth fault indication.
- Protection of 3 ph. Alternater (simulation study).
- Protection of 3 ph. Induction Motor (simulation study).
- Over current / under voltage / Negative seq Relay Characteristics (simulation study).
- Simulation of Transmission line protection.
- Study of differential protection of transformer (simulation study)

SEMESTER II

MTELE201

Digital Control System

Unit-I

SIGNAL PROCESSING IN DIGITAL CONTROL: Digital control, Configuration of the basic Digital control scheme, Principles of signal conversion, Basic Discrete-Time signals, Time-Domain Models for Discrete Time Systems, Transfer function Model, Stability in the Z-Plane and Jury stability criterion, Sampling as impulse modulation, Sampled spectra and Aliasing, Filtering, Practical aspects of the choice of sampling rate, Principles of Discretization, The Routh stability Criterion.

Unit-II

MODELS OF DIGITAL CONTROL DEVICES and SYSTEMS: Z – Domain, Description of Sampled continuous – Time Plants, Z- Domain Description of Systems with Dead Time, Implementation of Digital Controllers, Digital temperature Control System, Digital Position Control System, Stepper motors and their control.

Unit-III

DESIGN OF DIGITAL CONTROL ALGORITHMS: Z-Plane specifications of control system design, Digital Compensator Design using frequency response plots, Digital Compensator design using root locus plots, Z – Plane Synthesis.

Unit-IV

CONTROL SYSTEM ANALYSIS USING STATE VARIABLE METHODS: State Variable representation, Conversion of state Variable models to Transfer functions, Conversion of Transfer functions to Canonical state Variable models, Eigen values and Eigen Vectors, Solution of state equations,

Unit-V

Concepts of Controllability and Observability, Equivalence between transfer function and State Variable Representation, Multivariable systems. State descriptions of Digitals Processors, State description of Sampled continuous – Time Plants, State description of Systems with dead Time.

Reference Books:

1. Raven, F.H., *Automatic Control Engg.* , McGraw Hill Book Company.
2. Shinners, S.M., *Modern Control System Theory and Design*, John Wiley and Sons.
3. Kuo, B.C., *Automatic Control System*, Prentice Hall.
4. Ogata, K., *Modern Control Engineering*, Prentice Hall.
5. Nagrath, I.J., and M. Gopal, *Control Systems Engg.* John Wiley and Sons.

MTELE202

Power System Operation and Control

Unit-I

INTRODUCTION: Characteristics of power generation units(thermal, nuclear, hydro, pumped hydro), variation in thermal unit characteristics with multiple valves, Economic dispatch with and without line losses, lambda iteration method, gradient method, Economic dispatch without line losses, economic dispatch with line losses, lambda iteration method, gradient method, Newton's method, base point and participation factors.

Unit-II

TRANSMISSION LOSSES: Coordination equations, incremental losses, penalty factors, B matrix loss formula (without derivation), methods of calculating penalty factors.

UNIT COMMITMENT: constraints in unit commitment, priority list method, Dynamic programming method and Lagrange relaxation methods.

Unit-III

HYDRO THERMAL CO-ORDINATION: Introduction to long range and short range hydro scheduling, Types of short range scheduling problem, Scheduling energy. The short term hydro-thermal scheduling problems and its solution by Lambda-Gamma iteration method and gradient method

Unit-IV

GENERATION WITH LIMITED ENERGY SUPPLY: take or pay fuel supply contract, composite generation production cost function, gradient search techniques.

Unit-V

AUTOMATIC VOLTAGE REGULATOR: load frequency control, single area system, multi-area system, tie line control.

Reference Books:

1. Kothari D.P. and Dhillon J.S., *Power System Optimization*, Prentice-Hall of India Pvt. Ltd. New Delhi
2. G L.K .Kirchmayer, *Economic Operation of Power Systems*, John Willey and Sons,N.Y.
3. Wood A.J, Wollenberg B.F , *Power generation operation and control.*
4. Kothari D.P. and Nagrath I.J., *Modern Power System Analysis* ,Tata Mc Graw-Hill Publishing Company Ltd., New Delhi

MTELE203

Advanced Relaying and Protection

Unit-I

PROTECTIVE RELAYING: Relay terminology, Definitions, Classification, electromechanical, static and digital-numerical relays. Design-factors affecting performance of a protection scheme for various faults, Instrument transformers for protection.

Unit-II

RELAY SCHEMATICS AND ANALYSIS: Over Current Relay- Instantaneous/Inverse Time –IDMT Characteristics; Directional Relays; Differential Relays- Restraining Characteristics; Distance Relays: Types- Characteristics.

Unit-III

PROTECTION OF POWER SYSTEM EQUIPMENTS: Generator, Transformer, Transmission Systems, Busbars, Motors; Pilotwire and Carrier Current Schemes.

Hardware Organisation In Integarted Systems: The nature of hardware issues, Computers for relaying, The substation environment, Industry environmental standards, Countermeasures against EMI, Supplementary equipment, Redundancy & backup, Servicing, training & maintenance.

SYSTEM GROUNDING: Ground faults and protection; Load shedding and frequency relaying; Out of step relaying; Re-closing and synchronizing.

Unit-IV

BASIC ELEMENTS OF DIGITAL PROTECTION: Digital signal processing – Digital filtering in protection relay – digital data transmission – Numeric relay hardware – relay algorithm – distance relays – direction comparison relays – differential relays – software considerations – numeric relay testing –concept of modern coordinated control system.

Unit-V

INTEGRATED AND MULTIFUNCTION PROTECTION SCHEMES: SCADA based protection systems, Testing of Relays.

Reference Books:

1. John A T and Salman A K, *Digital protection for power systems-IEE power series-15*, Peter Peregrines Ltd,UK,1997
2. Mason C.R., *The art and science of protective relaying*, John Wiley &sons, 2002
3. Reimert Donald, *Protective relaying for power generation systems*, Taylor & Francis-CRC press 2006
4. Gerhard Ziegler,*Numerical distance protection*, Siemens, 2nd ed, 2006
5. Warrington A.R., *Protective Relays*, Vol .1&2, Chapman and Hall, 1973
6. T S.Madhav Rao, *Power system protection static relays with microprocessor applications*, Tata McGraw Hill Publication, 1994
8. Badri Ram , D.N. Vishwakarma, *Power*

MTELE204

Modeling and Dynamics of Electrical Machines

Unit-I

INTRODUCTION: Challenges in computer simulations, Mechanics of simulation, solution techniques for time domain analysis, introduction of widely used circuit- oriented simulators like Pspice, MATLAB, PSIM, equation solvers, simulation of power electronics circuits and converters,

Unit-II

DYNAMIC CONDITIONS: Concept, constraints and considerations; modeling and performance simulation methods, concept of reference frame, generalized transformation, formulation of dynamic equations of a generalized machine in arbitrary reference frame.

Unit-III

D.C. MACHINES DYNAMICS: Ideal machine; dynamic equation; transfer function and block diagram; linear analysis of D.C. generators; effects of saturation; analysis and performance under disturbances. Switching and surge voltage transients in transformers.

Unit-IV

INDUCTION MACHINES: Transients and dynamics; basic electro mechanical equations; linearized and non-linearized analysis; operation on harmonic supplies; unbalanced operation.

Unit-V

SYNCHRONOUS MACHINE TRANSIENTS: Coupled circuit viewpoint; approximate physical picture; equivalent circuit under transient conditions and its applications; synchronous motor operation with variable/fixed load torque and excitation; equal-area criterion for the study of transient stability.

Reference Books:

1. Krause P.C., *Electric Machinery*, McGraw Hill.
2. Kimbark E.W., *Power System Stability* Vol 3 Synchronous Machine, John Wiley and Sons.
3. Concordia C., *Synchronous machines*, Theory and Performance, John Wiley and Sons.
4. Adkins B. and Harley R. G., *The General theory of Alternating Current Machines*, Chapman and Hall.
5. Ong Chee Mun, *Dynamic Simulation of Electric Machinery using MatLab and Simulink*, Pentice Hall (India), New Jersey

Elective-2
MTELE205A

Special Electric Machines

Unit-I

SPECIAL AC MACHINES: Constructional aspects, design and analysis of reluctance, shaded pole, hysteresis, printed circuit, claw motors, Servomotors and A.C. tacho-generators, Introduction of permanent magnet materials. Angled field and axial field devices; cross-field machines, special forms of rotating amplifiers. Electromagnetic clutches, coupling and brakes, Eddy current devices.

Unit-II

LINEAR MACHINES: Linear devices and actuators, Linear electric machines: Classification, application, constructional aspects, design and method of analysis of various types, Goodness factor.Transverse-edge, entry-end, exit end, short primary, short secondary effects in linear electric motors

Unit-III

Force, energy and power LEM's for low speed medium speed and high speed applications. Electromagnetic levitation and guidance schemes-attraction, repulsion

Unit-IV

ADVANCED MOTORS AND DRIVE SYSTEMS: Principle, construction, operation and drive application of Square wave Permanent Magnet (PM) brushless motor drives, sine wave PM brushless motor drives

Unit-V

PM and synchronous reluctance based motors, switched reluctance motors, Energy efficient motors.

Reference Books:

1. Bose B.K., *Power Electronics and variable frequency drives,* Prentice Hall, New Jersey.
2. Miller T.J.E., *Brushless permanent magnet and reluctance motor drives*, Oxford University Press, UK
3. Nasar S.A., *Linear induction motor*, John Wiley, New York
4. Andreas J.C., *Energy Efficient Motors*, Marcel Dekker
5. Murphy J.M.P., *Power Electronics control of AC Drives,* Pergamon Press

MTELE205B

Microprocessor and Microcontroller

Unit-I

MICROPROCESSOR: 8086 Internal Architecture, Addressing modes, program development steps, 8086 instruction set, Assembler directives, Assembly language, program development tools.

Unit-II

PROGRAMMING OF 8086: Simple sequence programs, jumps, flags, conditional Jumps, IF-THEN, IF-THEN-ELSE, Multiple IF-THEN-ELSE, WHILE-DO, REPEAT-UNTIL, Instruction Timing and delay loops, strings, procedures, Macros.

Unit-III

PERIPHERAL INTERFACING: Parallel versus serial transmission, synchronous and asynchronous serial data transmission. Interfacing or hexadecimal keyboard and display unit, parallel, serial interface Standards.

Unit-IV

MICROPROCESSOR APPLICATIONS TO POWER ENGINEERING: Protective Relaying: over-current, impedance, MHO, reactance, bi-directional relays.

Unit-V

MEASUREMENTS: Frequency, power angle and power factor, Voltage and Current, kVA, kW, and kVAR, maximum demand. Resistance, Reactance, Temperature Controls.

Microcontroller: PICi8 family- Microcontroller, architecture, Addressing Modes, Timers, Counters, Interrupts, Serial Communication, Instruction Set and Programming Concepts and applications to Electric Drive Systems

Reference Books:

1. Rafiquzzaman, *M. Theory and Applications*, Prentice Hall (India) Publications 1993.
1. Ram B, *Fundamentals of Microprocessors and Microcomputers*, Dhanpat Rai and Sons,
2. Hall, Douglas V. *Microprocessors and interfacing: Programming and Hardware*, Tata McGraw Hill
3. Brey, Barry B., *The INTEL Microprocessors 8086/88, 80186, 286, 386, 486, Pentium Pro Processors, Architecture, Programming and Interfacing*, 4th Edition, Prentice Hall (India)
4. Ray A.K. and Bhurchandi K.M., *Advanced Microprocessors and Peripherals*, Tata McGraw Hill.
5. Mazidi M.A. et. al. *The PIC- Micro-controller and Embedded Systems,* Pearson Publication
6. Gaonkar R. S., *Fundamentals of Microcontrollers and Applications in Embedded Systems with PIC*, Thomson learning

MTELE205C

Real Time Instrumentation

Unit-I

INTRODUCTION: Static and Dynamic characteristics, Error analysis; transducers and sensors; their characteristics and parameters; role of instrumentation in monitoring, control and industrial automation.

Unit-II

SIGNAL CONDITIONING: Amplifiers, multiplexers and dividers, timer multiplexers, Signal converters, ADC and DAC, Signal conditioning, digital signal conditioning, transmission of digital signals, Telemetry methods and errors, PLCC, AM, FM, PAM, PWM, PCM Techniques.

Unit-III

DATA ACQUISITION SYSTEM: Role of dedicated computers, analog and digital control, computer systems for real time applications, distributed and supervisory control, SCADA and its organization and structure, centralized, hierarchical and decentralized control schemes, man machine interface, energy management system.

Unit-IV

REAL TIME CONTROL APPLICATIONS: Instrumentation and conditioning of drive signals, data acquisition of drive system, energy management system for AGC, VAR Control

Unit-V

ESTIMATION and POWER SYSTEM: state estimation, security monitoring, economic dispatch, on line load management. Power system digital relaying, Power plant instrumentation.

Reference Books:

1. Torsten Cegrell, *Power System Control Technology*, PHI, India.
2. Kusic C. L., *Computer Aided Power System Analysis*, TMH, New Delhi.
3. Wood A. J. and Wollenberg B., *Power generation operation and control*, John Wiley.
4. Cerni R.H and Foster L.E., *Instrumentation for Engineering Management*, John Wiley and Sons.

MTELE206-P

Lab-II

1. DC SPEED CONTROL SYSTEM

(a) To study D.C. speed control system on open loop and close loop.
(b) To study of Transient performance, another time signal is added at the input of control Circuit.
(c) To study how eddy current breaking is being disturbance rejected by close and open loop.

2. DC MOTOR POSITION CONTROL

(a) To study of potentiometer displacement constant on D.C. motor position control.
(b) To study of D. C. position control through continuous command.
(c) To study of D.C. position control through step command.
(d) To study of D.C. position control through Dynamic response.

3. AC MOTOR POSITION CONTROL

(a) To study of A.C. motor position control through continuous command.
(b) To study of error detector on A.C. motor position control through step command.
(c) To study of A.C. position control through dynamic response.

4. MAGNETIC AMPLIFIER

(a) To study Input / Output characteristic of a magnetic amplifier in mode (i) Saturable Reactor, (ii) Self Saturable Reactor.

5. SYNCHRO TRANSMITTER / RECEIVER

(a) To study of Synchro Transmitter in term of Position v/s Phase and voltage magnitude with respect to Rotor Voltage Magnitude/Phase.

To study of remote position indication system using synchro transmitter/receiver

SEMESTER III

MTELE301

Power System Transients

Unit-I

ORIGIN AND NATURE OF TRANSIENTS AND SURGES: Surge parameters of plant. Equivalent circuit representations. Lumped and distributed circuit transients.

Unit-II

LINE ENERGIZATION AND DE-ENERGIZATION TRANSIENTS: Earth and earth wire effects. Current chopping in circuit breakers. Short line fault condition and its relation to circuit breaker duty. Trapped charge effects. Effect of source and source representation in short line fault studies. Control of transients.

Unit-III

LIGHTNING PHENOMENON: Influence of tower footing resistance and earth resistance. Traveling waves in distributed parameter multi-conductor lines, parameters as a function of frequency. Simulation of surge diverters in transient analysis. Influence of pole opening and pole re-closing.

Unit-IV

INSULATION CO-ORDINATION: Over voltage limiting devices, dielectric properties, breakdown of gaseous insulation, tracking and erosion of insulation, high current arcs, and metallic contacts.

Unit-V

COMMUNICATION LINKS: PLCC, Microwave, Telephone line, Satellite, Fibre optic. Requirements of' various communication equipments used in power systems. Computer networking in power systems.

Reference Books:

1. Vanikov V.A., *Transients in Power System*, Mir Publications, Moscow.
2. Bewley; L.V., *Traveling Waves on Transmission Lines*, Dover Publications Inc., New York.
3. Arora Ravindera and Mosch Wolfgang, *High Voltage Insulation Engineering*, New Age International Publishers Limited.
4. Greenwood A., *Electrical Transients in Power Systems*, John Wiley & Sons,
5. Stallings William , *Data and Computer Communication* , PHI, 1994.
6. Gowar John,*Optical Communications Systems* , PHI, 1993.
7. R.E. Collin ,*Foundations of Microwave Engineering*.
8. Theodore S. Rappaport, *Wireless communication, Principles and Practice*, IEEE Press; PTR 1996

MTELE302

Power System Planning

Unit-I

INTRODUCTION: Power System planning, objective, stages in planning and design, Key indices of power system reliability and their calculations, Linkage between reliability and capacity planning.

Unit-II

GENERATING SYSTEM CAPABILITY PLANNING: Probabilistic models of generating units, growth rate, Rate of generation capacity, Outage performance and system evaluation of loss of load and loss of energy indices, Power supply availability assessment.

Unit-III

INTERCONNECTED SYSTEMS: Multi area reliability analysis, Power pool operation and power exchange energy contracts, quantification of economic and reliability benefits of pool operation.

Unit-IV

DEMAND/ENERGY FORECASTING: Electricity consumption pattern, Peak demand and energy forecasting by trend and economic projection methods.

Unit-V

POWER SYSTEM EXPANSION PLANNING: Formulation of least cost optimization problem involving capital, operation and maintenance costs of candidate units of different types.

INVESTMENT PLANNING MODELS: Traditional generation expansion planning models, integrated resource planning models, production cost simulation models.

Reference Books:

1. Wallach Y., *Power System Planning*, McGraw Hill International.
2. Sullivan P., *Power System Planning*, McGraw Hill International.
3. Dasari, S., *Electric Power System Planning*, IBT Publishers, New Delhi.
4. Billinton R., *Power System Reliability Calculation*, MIT Press, USA.
5. Endreyni, *Reliability Modeling in Electric Power System*, John Wiley, New York.
6. McDonald J.R., *Modern Power system Planning*, McGraw Hill International.

Elective-3
MTELE303A

Energy Efficient Machines

Unit-I
INTRODUCTION: Energy efficient machines, energy cost and two part tariff, energy conservation in industries and agricultural sector -a necessity, introduction to energy management and energy audit system. Review of induction motor characteristics.

Unit-II
ENERGY EFFICIENT MOTORS: Standard motor efficiency, energy efficient motor, efficiency determination methods, Direct Measurement method, Loss segregation method, Comparison, motor efficiency labeling, energy efficient motor standards.

Unit-III
POWER FACTOR: The power factor in sinusoidal systems, power factor improvement, power factor with nonlinear loads, Harmonics and the power factor

Unit-IV
APPLICATION OF ELECTRIC MOTORS: Varying duty applications, Voltage variation, Voltage Unbalance, over motoring, Poly-phase induction motors supplied by adjustable frequency power supplies.

Unit-V
INDUCTION MOTORS AND ADJUSTABLE DRIVE SYSTEMS: Energy Conservation, adjustable speed systems, Application of adjustable speed systems to fans, pumps and constant torque loads.
ECONOMICS OF ENERGY EFFICIENT MOTORS AND SYSTEMS: Motor life cycle, Direct Savings and pay back analysis, efficiency evaluation factor, present worth method with constant power costs, present worth method with increasing power costs, net present worth method.

Reference Books:
1. Andreas John C., *Energy efficient electric motors*, Marcel Dekker Inc. 1992.
2. Thuman Albert, *Introduction to Efficient Electric System Design*, The Fairmount Press Prentice Hall.
3. Tripathi S.C. , *Electric Energy Utilization and Conservation*, Tata McGraw-Hill 1991.
4. Belove Charles, *Handbook of Modem Electronics and Electrical Engineering*, John Wiley and Sons.

MTELE303B

Power System Dynamics and Stability

Unit-I

OVERVIEW: Angular Stability, Transient stability, steady state stability, dynamic stability, Small Signal, Voltage Stability

Unit-II

MODELING OF POWER SYSTEM COMPONENTS: Generators (Non-linear and linear models using d-q transformation, power capability curve); Excitation System (IEEE standard models); Turbine and Speed governing System; Loads (Induction motors and composite loads);

Unit-III

TRANSIENT STABILITY ANALYSIS: Single Machine - Infinite Bus System; Equal Area Criterion; Multi-machine Stability; Network Reduction and Numerical Integration Methods; Methods of Improvement

Unit-IV

SMALL SIGNAL STABILITY ANALYSIS: Eigen Value and Participation Factor Analysis; Single machine - Infinite Bus and Multimachine Simulation; Effect of Excitation System and AVR; Improvement of Damping - Power System Stabilizer and SVS supplementary controls.

Unit-V

SUB SYNCHRONOUS OSCILLATIONS: Sub Synchronous Resonance (SSR) Phenomenon; Counter measures to SSR problems

VOLTAGE STABILITY: P-V and Q-V curves, Impact of Load and Tap-changer Dynamics; Static Analysis, Sensitivity and Continuation Methods; Dynamic Simulation, Introduction to Bifurcation Analysis; Proximity Indices, Methods to enhance Stability Margin.

Reference Books:

1. Kundur P, *Power System Stability and Control*, McGraw Hill.

2. Taylor C.W., *Power System Voltage Stability*, McGraw Hill.

3. Anderson P.M. and Foud A. A., *Power System Control and Stability*, IEEE Press.

4. Kimbark E., *Power System Stability*, Vol. I, II and III, IEEE Press.

MTELE303C

EHVAC and HVDC Transmission System

Unit-I

OVERVIEW: Comparison of EHV AC and DC transmission, description of DC transmission systems, modern trends in AC and DC transmission.

Unit-II

EHV AC SYSTEMS: Limitations of extra-long AC transmission, Voltage profile and voltage gradient of conductor, Electrostatic field of transmission line, Reactive Power planning and control, traveling and standing waves, EHV cable transmission system.

Unit-III

STATIC VAR SYSTEM: Reactive VAR requirements, Static VAR systems, SVC in power systems, design concepts and analysis for system dynamic performance, voltage support, damping and reactive support.

HVDC SYSTEM: Converter configurations and their characteristics, DC link control, converter control characteristics; Monopolar operation, converter with and without overlap, smoothing reactors, transients in DC line, converter faults and protection, HVDC Breakers.

Unit-IV

CORONA AND INTERFERENCE: Corona and corona loss due to EHV AC and HVDC, Radio and TV interference due to EHV AC and HVDC systems, methods to reduce noise, radio and TV interference.

Unit-V

HARMONIC FILTERS: Generation of harmonics, design of AC filters, DC filters.

POWER FLOW ANALYSIS IN AC/DC SYSTEMS: Component models, solution of DC load flow, per unit system for DC quantities, solution techniques of AC-DC power flow equations, Parallel operation of HVDC/AC systems, Multi terminal systems.

Reference Books:

1. Padiyar K.R., *HVDC Power Transmission Systems*, Wiley Eastern Ltd., New Delhi.
2. Kimbark E., *Direct Current Transmission*, Vol-I, John-Wiley and sons, NY
3. Arrillaga J., *HVDC Transmission*, IEE Press, London.
4. Begamudre R.D., *EHV AC Transmission Engineering*, Wiley Eastern Press.
5. Arrillaga J. and Smith B.C., *AC-DC Power System Analysis*, IEE Press, London

MTELE304

Preliminary work on Dissertation

The student will submit a synopsis at the beginning of the semester for approval from the departmental committee in a specified format. The student will have to present the progress of the work through seminars and progress reports.

MTELE305

Seminar Based on Dissertation

The student will deliver a seminar on the topic chosen by him and approved by Departmental committee for evaluation at the end of semester

SEMESTER IV

MTELE401

Dissertation

The student will submit a detailed Project Report on the topic approved by Departmental committee in a specified format and will also deliver a Presentation on the topic chosen at the end of semester.