

EE-701 – Power System Analysis & Control

Unit-I

General - Problems associated with modern interconnected power Systems, deregulation, power systems restructuring, distributed generation, congestion, available transfer capacities, pricing of energy and transmission services.

Unit-II

Power flow studies - Formulation of static power flow equations and solutions using Gauss-Seidel, Newton Raphson and FDLF methods, comparison of these methods, Economic operation of power system - Economic dispatch, Emission dispatch, line loss, ITL, economic dispatch using lagrangian multiplier method.

Unit-III

MW Frequency control- Coherency, control area, modeling of speed control mechanism, load damping, block diagrammatic representation of single and two area interconnected system, static and dynamic response, optimum parameter adjustment.

Unit-IV

MVAR Voltage control Problem- Difference in control strategy over MW – f control, characteristics of an excitation system, DC AC and static excitation system, General block diagram representation of voltage regulators.

Unit-V

Power System Stability - Steady state, dynamic and transients stability, Swing equation , equal area criterion, solution of swing equation using step by step method modified Eulers method and Rnge-Kutta method, methods of improving transient stability.

Reference Books :

- 1.Modern Power Sdystem Analysis-by I.J. Nagrath & D.P. Kothari Tata Mc Graw - Hill Publication Company Ltd 2ⁿ edition.
- 2 A Chakrawarti Power System Analysis:Operation and Control PHI Learning 3rd edition
3. Electrical Power Systems-by C.L. Wadhwa New Age International (P) Limited Publishers, 2nd edition 1998.
- 4.Weedy B.M."Electric Power System" John Wiley and Sons,3rd edition.
5. Reactive power Control in Electric Systems-by T.J.E. Miller, JohnWiley & Sons.
6. T.K. Nagsarkar, M.S. Sukhiza, -"Power System Analysis", Oxford University Press.
7. Elgerd O.I., "Electric Energy Systems Theory",TMH, New Delhi,Second Edition 1983.
8. Prabha Kundur, "Power system stability and control", Mc-Graw Hill Inc, New York, 1993.
9. Taylor C.W., "Power System Voltage Stability", Mc-Graw Hill Inc, New York, 1993.
10. Nagrath IJ, Kothari D.P., "Power System Engineering", Tata Mc-Graw Hills, New Delhi 1994.
11. P.S.R. Murthy, "Power System Operation and Control", B S Publication -

List Of Experiments:

1. To develop a program in Matlab for information of Y-bus matrix for N bus system.
2. Load flow solution for 3-bus system using Gauss- Seidel, Newton Raphson and FDLF methods up to 3 iteration.
3. Load flow solution for IEEE 6-bus and 30-bus system in Matlab using Newton Raphson method.
4. Assessment of transient stability of a single machine system.
5. Effect of compensation on voltage profile of IEEE 6-bus system.
6. Study of any software tools (PSCAD, EDSA, Mi POWER, ETAP etc).

EE-702 – Utilization of Electrical Energy

UNIT I ILLUMINATION ENGINEERING

Nature of light, units, sensitivity of the eye, luminous efficiency, glare. Production of Light; Incandescent lamps, arc lamps gas discharge lamps- fluorescent lamps-polar curves, effect of voltage variation on efficiency and life of lamps, Distribution and control of light, lighting calculations, solid angle, inverse square and cosine laws, methods of calculations, factory lighting, flood lighting and street lighting, Direct diffused and mixed reflection & transmission factor, refractors, light fittings.

UNIT II HEATING, WELDING AND ELECTROLYSIS

Electrical heating-advantages, methods and applications, resistance heating, design of heating elements, efficiency and losses control. Induction heating: core type furnaces, core less furnaces and high frequency eddy current heating, dielectric heating: principle and special applications, arc furnaces: direct arc furnaces, Indirect arc furnaces, electrodes, design of heating elements, power supply and control.

Different methods of electrical welding, resistance welding, arc welding, energy storage welding, laser welding, electrobeam welding, and electrical equipment for them.

Arc furnaces transformer and welding transformers.

Review of electrolytic principles., laws of electrolysis, electroplating, anodising- electro-cleaning, extraction of refinery metals, power supply for electrolytic process, current and energy efficiency.

UNIT III TRACTION

Special features of Traction motors, Different system of electric traction and their Advantages and disadvantages, diesel electric locomotives. Mechanics of train movement: simplified speed time curves for different services, average and schedule speed, tractive effort, specific energy consumption, factors affecting specific energy consumption, acceleration and braking retardation, adhesive weight and coefficient of adhesion.

UNIT IV TRACTION MOTORS

DC motors, single phases and three phases motors, starting and control of traction motors, braking of traction motors: plugging, rheostatic and regenerative braking, Modern 25 KV a.c.

single phase traction systems: advantages, equipment and layout of 25 KV, line and current selection,

single phase power frequency A.C. traction.

UNIT V

ELECTRIC DRIVES

Individual and collective drives- electrical braking, plugging, rheostatic and regenerative braking load equalization use of fly wheel criteria for selection of motors for various industrial drives, calculation of electrical loads for refrigeration and air-conditioning, intermittent loading and temperature rise curve.

References:

- Tailor, E.O., Utilization of Elect. Energy.
- H. Pratap, Art and Science of Utilization of Electrical Energy.
- Gupta, J.B., Utilization of Elect. Energy
- Garg, G.C., Utilization of Elect. Power and Elect. Traction.
- N V Suryanarayan, Utilization of Elect. Power including Electric Drives and Elect. Traction, New Age International.
- Hancock N N, Electric Power Utilisation, Wheeler Pub.

EE-703 – Electrical Drives

Unit I

Basic Concepts of Electric Drives

Elements of drive systems, Requirement of electric drives, Rating & Selection of drives, groups and individual drives, Constant power and Constant torque drives.

Motor Mechanism dynamics

Review of Characteristics of AC & DC motors, load characteristic, load-drive speed torque characteristics, quadrant speed torque characteristics. Mechanical Systems Stability of Electric drives, referred moment of inertia and torque of motor load combination, load equalization.

Unit II

DC Drives

Starting & Braking of conventional, Phase controlled and chopper controlled drives, Transient & Steady state analysis, Energy recovery systems.

Unit III

Induction Motor Drives

Conventional method of Starting braking and speed control, PWM, (VSI) Voltage source Inverter and Current Sources (CSI) fed IM drives, cyclo converter fed drive, Vector control drives.

Slip Controlled IM Drives

Review of Conventional methods & converter controlled-Crammers & Scherbius drives; rotor impedance control.

Unit IV

Synchronous Motors Drives

VSI and CSI fed; self-controlled-Brush less &. commutatorless dc & ac motor drives.

Unit V

Special Drives :Fundamentals of Switched reluctance motors, Stepper Motors, Permanent Magnet Motor Introduction to vector control; Digital control of drives.

Case Studies Electric traction, steel & cements plants, textile & paper mills, machine tool drive and CNC, electric cars.

List of Experiments:

1. Study the starting and running characteristics of converter fed DC traction motor.
2. To study the energy recovery systems and braking of a DC drive.
3. To study the braking Methods of a three-phase induction motor.
4. To study the performance of VSI fed three-phase induction motor using PWM technique.
5. To control the speed of a three phase slip ring Induction motor using rotor impedance control.
6. To study the performance of Vector Controlled three phase Induction motor drive.
7. To Study frequency Controlled Synchronous motor drive.

8. To study the control & performance Characteristics of switched Reluctance motor.
9. To study the performance & control of a Stepper motor.
10. To Study the Performance of a permanent magnet Brushless dc motor drive.

References:

- Pillai S. K. "A first course on Electrical Drives", Second edition, Wiley Eastern.
- Ned Mohan Electrical Machine Drive WILEY INDIA
- Dubey G. K., "Power Semiconductor Controlled Drives", PHI,
- Dubey G. K. , "Fundamentals of Electrical Drives". Narosa Publishing House.
- Bose B. K., "Power Electronics and AC Drives", PHI Learning.
- Murphy M. D., and Tumbuli F., "Power Electronic Control of AC Motors", Pergamon Press, Oxford University Press.
- P.V. Rao, "Power semiconductor Drives", BS Publications
- S.Shiva Nagaraju power semiconductor drive PHI learning

Elective-I (EE-7101 – Computer Aided Design of Electrical Machines)

Unit-I

Design of Synchronous Machine

Features of construction of low speed and medium speed Machine, design consideration of turbo and water wheel alternators, output coefficient and choice of main dimensions, design of stator winding, design of field systems, regulation, losses and efficiency, cooling systems.

Unit-II

Design of 3 Phase Induction Motor

Design consideration of ac motors, calculation of main dimensions, design of stator winding, effect of air gap on performance.

Rotor Design:

Design of slip ring and squirrel cage rotor, components of leakage reactance, calculation of leakage reactance and its effect on the performance.

Unit-III

Design of single phase Induction motor

Calculation of main dimensions of stator, complete design of stator with its punching details, design of main and auxiliary winding, design of rotor, performance calculation of designed rotor and performance by equivalent circuit approach.

Unit-IV

Design of Electrical Equipments

Design of choke, DC motor starter, Lifting magnets and other electro magnetic devices.

Unit-V

Computer Aided Design

Philosophy and economics of computer aided design, advantages limitations, analysis and synthesis methods, and selection of input data and design variables, flow charts for design of induction motor and synchronous machine. Optimization of design constrained and unconstrained optimization problem

References:

1. Deshpandey M.V., "Design of Electrical Machines" PHI Learning
2. Veinot Cyril G., "Computer Aided Design of Electrical Machinery", MIT Press, London, UK.
3. Say M.G., "Performance Design of AC Machinery"
4. Clayton, "Performance Design of DC Machine"
5. Sharanugasundaram A., Gangadharan G., & Palani R., "Electrical Machine Design Data Book", Wiley Eastern Ltd., New Delhi.
6. Veinolt Cyril.G., "Theory & Design of Small Induction Motors", McGraw-Hill Book Company, Inc..
7. Rama Moorthy, "Computer Aided Design of Electrical Equipment", Affiliated East-West Press, New Delhi.

Elective-I (EE-7102 – Soft Computing Techniques & Application)

UNIT-1

Review of probability theory: Random variable, distribution functions , function of random variable. generation of random digit, and random variants from various distribution function, Monte Carlo simulation, sampling distributions station evolution using MCS, confidence interval, coefficient of variation.

UNIT-2

Evolution of ANN, Artificial neurons activation functions general network structure g - rule, and back propagation rule of training, RBF and FLN network.

UNIT-3

Draw back of classical optimization techniques, genetic algorithm; binary and real parameter GA, constraints handling in GA.

UNIT-4

Evolution strategies(ES), two members non-recombinative ES, multi member ES, recombinative ES. Optimization based on swarm intelligence particle, swarm optimization and its variants .

UNIT-5

Application of soft computing techniques to problem of electrical engg. e.g. economic dispatch, reliable optimization, ANN training using evolutionary algorithms.

References:

1. R.Y. Rubinstein Simulation and the Monte Carlo method, John Wiley & sons 1st Edition.
2. Paul. L. Mayer-Introducing probability and statical application, Addition Wesley.
3. Rajasekaran and pai- Neural Network, Fuzzy logic & Genetic Algorithms. PHI Learning
4. LiMin. Fu, Neural Networks in Computer Intelligence, 9th Reprint TMH
5. Multi objective optimization using evolutionary algorithm- Kalyanmoy Deb John Wiley Sons Ltd.
6. Probability and Random processes for Electrical Engineering , Alberto Leon Garcia Ind Pearson .
7. Principles of soft computing- S N Shivanandan, S N Deepa Wiley India (P) Ltd, I edition 2007.
8. Hand book of genetic algorithm- Rajaserkharans, vijaya laxmi pai.
9. PSO Tutorial- Kennedy Ebuehart.
10. Sivanandam & Deepa- An Introduction to Neural Networks using Matlab 6.0 1st ed., TMH
11. M.Amirthavalli, Fuzzy logic and neural networks, Scitech publications.

Elective-I (EE-7103 – SCADA Systems and Applications)

Unit I

Introduction to SCADA and PLC: SCADA: Data acquisition system, evaluation of SCADA, communication technologies, monitoring and supervisory functions. PLC: Block diagram, programming languages, Ladder diagram, Functional Block diagram, Applications, Interfacing of PLC with SCADA.

Unit II

SCADA system components: Schemes, Remote Terminal Unit, Intelligent Electronic Devices, Communication Network, SCADA server.

Unit III

SCADA Architecture-Various SCADA Architectures, advantages and disadvantages of each system, single unified standard architecture IEC 61850 SCADA / HMI Systems.

Unit IV

SCADA Communication-Various industrial communication technologies- wired and wireless methods and fiber optics, open standard communication protocols.

Unit V

Operation and control of interconnected power system-Automatic substation control, SCADA configuration, Energy management system, system operating states, system security, state estimation, SCADA applications Utility applications, transmission and distribution sector operation, monitoring analysis and improvement. Industries oil gas and water. Case studies, implementation, simulation exercises.

Reference Books:

1. Stuart A Boyer: SCADA supervisory control and data acquisition.
2. Gordan Clark, Deem Reynders, Practical Modem SCADA Protocols.
3. Sunil S. Rao, Switchgear and Protections, Khanna Publication.

Elective-II (EE-7201 – High Voltage Engg.)

Unit - I

Breakdown in gases

Mechanisms of breakdown in gases, various related ionization processes. Townsends and streamer theories. Paschen's law, Breakdown in Non-uniform fields. Effect of wave shape of impressed voltage on the breakdown strength. Breakdown of sphere gap and rod gap.

Unit - II

Breakdown in liquid and solids

Mechanisms of breakdown in liquids, suspended particle, suspended water, cavitation and bubble and electronic breakdown theories. Mechanisms of breakdown in solids; intrinsic electro-mechanical, erosion, surface, thermal and streamer, Relation between electric strength of solids and time, intrinsic breakdown strength.

Unit - III

Impulse Generator

Specifications of an impulse voltage Wave, standard impulse, reasons for adopting the particular shape, Analysis and control of simple circuit of impulse generator. Multistage impulse generator (Marx circuit) circuit working, earthing and tripping. Techniques to observe wave front on C.R.O.

Generation of High Voltage

Methods of generation of power frequency high voltage cascade transformers and resonance methods, Generation of high voltage d.c., voltage stabilization. Tesla coil.

Unit - IV Measurement of High Voltage

Potential dividers-resistive, capacitive and mixed dividers for high voltage. Sphere gap; construction, mounting, effect of nearby earthed objects, humidity and atmospheric conditions, effect of irradiation and polarity, Electrostatic voltmeter; principle and classification, constructional details of an absolute electrostatic voltmeter. Oscilloscopes and their applications in high voltage measurement.

Unit - V

High Voltage Testing

Measurement of insulation resistance of cables. Wet and dry flashover test of insulators. Testing of insulators in simulated polluted conditions. Testing of transformers and rotating machines. Measurement of breakdown strength of oil. Basic techniques of non-destructive testing of insulators; measurement of loss angle, High Voltage Schering bridge, and partial discharge measurement techniques.

Over Voltage and Insulation Coordination

Lighting, Switching and temporary over voltages, BIL, SIL, methods of insulation coordination.

References:

- L. V. Bewley, "Traveling Waves on Transmission Systems", Wiley New York. M. S. Naidu and V. Kamaraju, "High Voltage Engineering", Tata McGraw Hill.
- D.V. Razevig: "High Voltage Engineering", translated by Dr.M.P. Chourasia, Khanna Publisher
- Kuffel & Zingal, High Voltage Engg.
- Kuffel & Abdullah, High Voltage Engg.

Elective-II (EE-7202 – Calibration and Testing of Electrical Equipments)

Unit - I

Electricity Rules: Indian Electricity Rules, Indian Electricity Act, Electricity Supply Act.

Unit - II Standards: Study of Various Indian Standards codes for various important electrical equipments.

Unit - III

Installation & Commissioning : Installation & Commissioning of out door Indoor electrical equipments like transformer, Motors, Switchgears, Panels, Relays, CT, PT, Earthing etc.

Unit - IV

Testing: Testing of new & Old electrical installation as per IS of the following. Transformer, Cables, Insulating Oil, Protective relays, Circuit Breakers, CT, PT, Meters, Energy Meters, PVC insulated cables, High voltage Testing & Routing Test, Type test on above.

Unit - V

Calibration : Calibration of meters, Energy meters, Relays, Circuit breakers, & other equipments as per IS specification.

References:

- M. Subbarao, Installation Commissioning & testing of Electrical Engineering Equipments, Khanna Pub.
- Jagdishlal, Hanbook of Electricity Laws, Delhi Law House.
- I.S. Codes, Indian Standard codes, Indian Standard Institution, Nanak Bhavan, New Delhi.

IS	9283	-	Submersible Motor
IS	325	-	Induction Motor
IS	2071	-	High Voltage Testing
IS	3156	-	Potential Transformer
IS	2705	-	Current Transformer
IS	1255	-	Cables
IS	2026	-	Power Transformer
IS	1866	-	Transformer Oil
IS	694	-	PVC insulated Cables

Elective-II (EE-7203 – Generalised Theory of Electrical Machines)

Unit-I

Review : Primitive machine, voltage and torque equation.

Concept of transformation change of variables & m/c variables and transform variables.

Application to D.C. machine for steady state and transient analysis, and equation of cross field commutator machine.

Unit-II

Induction Machine : Voltage, torque equation for steady state operation, Equivalent circuit, Dynamic performance during sudden changes in load torque and three phase fault at the machine terminals. Voltage & torque equation for steady state operation of 1- ϕ induction motor & scharge motor.

Unit-III

Synchronous Machine : Transformation equations for rotating three phase windings, Voltage and power equation for salient and non salient alternator, their phasor diagrams, Simplified equations of a synchronous machine with two damper coils.

Unit-IV

Operational Impedances and Time Constants of Synchronous Machines: Park's equations in operational form, operational impedances and $G(P)$ for a synchronous machine with four Rotor Windings, Standard synchronous machine Reactances, time constants, Derived synchronous machine time constants, parameters from short circuit characteristics.

Unit-V

Approximate Methods for Generator & System Analysis : The problem of power system analysis, Equivalent circuit & vector diagrams for approximate calculations, Analysis of line to line short circuit, Application of approximate method to power system analysis.

References:

- P.C.Krause, Analysis of Electric Machinery, Wiley India.
- B.Adkins, The General theory of Electrical Machines.
- B.Adkins & R.G.Harley, The General theory of AC Machines.
- P.S.Bhimbra, Generalised theory of Electrical m/c
- White & Woodson, Electro Mechanical Energy Conversion.

EE-706 – Major Project –I(Planning & Literature Survey)

The Major Project Work provides students an opportunity to do something on their own and under the supervision of a guide. Each student shall work on an approved project, which may involve fabrication, design or investigation of a technical problem that may take design, experimental or analytical character or combine element of these areas. The project work involves sufficient work so that students get acquainted with different aspects of manufacture, design or analysis. The students also have to keep in mind that in final semester they would be required to implement whatever has been planned in the Major Project in this semester. It is possible that a work, which involves greater efforts and time may be taken up at this stage and finally completed in final semester, but partial completion report should be submitted in this semester and also evaluated by an external examiner. At the end of semester, all students are required to submit a synopsis.

EE-707 – Industrial Training**SCHEME OF STUDIES**

Duration: 2 weeks after the VI semester in the summer break, Assessment in VII semester.

SCHEME OF EXAMINATION

For the assessment of industrial training undertaken by the students, following components are considered with their weightage.

(a) Term work

In Industry	Marks allotted
1. Attendance and General Discipline	05
2. Daily diary Maintenance	05
3. Initiative and participative attitude during training	05
4. Assessment of training by Industrial Supervisor/s	05
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TOTAL	20

(b) Practical/Oral Examination (Viva-Voce)

In Institution	Marks allotted
1. Training Report	10
2. Seminar and cross questioning (defense)	20
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TOTAL	30

Marks of various components in industry should be awarded to the students, in consultations with the Training and Placement Officer/Faculty of Institute, Who must establish contact with the supervisor/Authorities of the organisation where, students have taking training to award the marks for term work and I/c of training from Industry. During training students will prepare a first draft of training report in consultation with section in-charge. After training they will prepare final draft with the help of T.P.O./Faculty of the institute. Then they will present a seminar on their training and they will face viva-voce on training in the institute.

1.1 OBJECTIVE OF INDUSTRIAL TRAINING

The objective of undertaking industrial training is to provide work experience so that student's engineering knowledge is enhanced and employment prospects are improved. The student should take this course as a window to the real World of Work and should try to learn as much as possible from real life experiences by involving and interacting with industry staff. Industrial training also provides an opportunity to students to select an engineering problem and possibly an industry guide for their Major Project in final semester.

Industrial training of the students is essential to bridge the wide gap between the classroom and industrial environment. This will enrich their practical learning and they will be better equipped to integrate the practical experiences with the classroom learning process.

1.2 LEARNING THROUGH INDUSTRIAL TRAINING

During industrial training students must observe following to enrich their learning:

- Industrial environment and work culture.
- Organisational structure and inter personal communication.
- Machines/ equipment/ instruments - their working and specifications.
- Product development procedures and phases.
- Project planning, monitoring and control.
- Quality control and assurance.
- Maintenance system.
- Costing system.
- Stores and purchase systems.
- Layout of Computer/ EDP/MIS centres.
- Roles and responsibilities of different categories of personnel.
- Customer services.
- Problems related to various areas of Work etc.

Faculty and TPO are supposed to plan industrial training in such a manner that students get exposure on most of the above arena in the field (world of work). Students are supposed to acquire the knowledge on above by -

1. Observation,
2. Interaction with officials at the workplace
3. Study of Literature at the workplace (e.g. User Manual, standards, maintenance schedules, etc.)
4. "Hand's on" experience
5. Undertaking / assisting project work.
6. Solving problems at the work place.
7. Presenting a seminar.
8. Participating in-group meeting/ discussion.
9. Gathering primary and secondary data/ information through various sources, Storage, retrieval and analysis of the gathered data.
10. Assisting officials and managers in their working.
11. Undertaking a short action research work.
12. Consulting current technical journals and periodicals in the library.
13. Discussions with peers.

1.3 GUIDANCE TO THE FACULTY/TPO FOR PLANNING AND IMPLEMENTING THE INDUSTRIAL TRAINING

The industrial training programme, which is spread to 2 weeks' duration, has to be designed in consultation with the authorities of the work place, keeping in view the need of the contents. Following are some of the salient points:

- Spelling out the objectives of the industrial training in behavioral terms and same is informed in advance to the 1) students, 2) authorities of the work place and 3) supervising faculty members.
- Discussing and preparing students for the training for which meetings with the students has to be planned.
- Meeting with industrial personnel and orienting them regarding the objective of the training and the expectations of the programme.

- Correspondence with the authorities of the work place.
- Orientation classes for students on how to make the training most beneficial - monitoring daily diary, writing weekly reports, how to interact with various categories of industrial personnel, how to behave and undertake responsibilities, how to gather information from the workplace, ethics etc.
- Guiding students to make individual plans (week wise/ day wise) to undertake industrial training
- Developing a system of maintaining training records, by teachers for every batch of students for convenient retrieval.
- Inviting industrial personnel to deliver lectures on some aspects of training.

1.4 ACTION PLAN FOR PLANNING STAGES AT THE INSTITUTION LEVEL

S.No.	Activity	Commencing	Week	Finishing week	Remarks
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1. Meeting with Principal
2. Meeting with Colleagues
3. Correspondence with work place (Industries concerned)
4. Meeting with authorities of work place
5. Orientation of students for industrial training
6. Scrutinizing individual training plan of students
7. Commencement of industrial training
8. First monitoring of industrial training
9. Second monitoring of industrial training
10. Finalization of Training report
11. Evaluation of performance at Industry level
12. Evaluation of industrial programme in the institution.

1.5 INDUSTRIAL TRAINING

DAILY DIARY

Name of the Trainee:.....College:.....

Industry/Work place:.....Week

No.:.....

Department/Section:.....Date:.....

Dates	Brief of observations made, work done, problem/project undertaken, discussion held, literature-consulted etc.
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