ACADEMIC REGULATIONS
COURSE STRUCTURE AND SYLLABI

M.TECH.
POWER SYSTEM CONTROL AND
AUTOMATION
(Department of Electrical and Electronics Engineering)

2013 – 2014

GAYATRI VIDYA PARISHAD
COLLEGE OF ENGINEERING
(AUTONOMOUS)

Accredited by NAAC with A Grade with a CGPA of 3.47/4.00
Affiliated to JNTUK-Kakinada
MADHURA WADA, VISAKHAPATNAM – 530 048
VISION

To evolve into and sustain as a Centre of Excellence in Technological Education and Research with a holistic approach.
MISSION

To produce high quality engineering graduates with the requisite theoretical and practical knowledge and social awareness to be able to contribute effectively to the progress of the society through their chosen field of endeavor.

To undertake Research & Development, and extension activities in the fields of Science and Engineering in areas of relevance for immediate application as well as for strengthening or establishing fundamental knowledge.
Two batches of students have successfully completed the M.Tech. programme under autonomous status, which gave us a lot of satisfaction and encouragement. In the light of changing scenario of accreditation process globally, to upkeep the quality of education further, a major revision in the curriculum has been taken up with an objective to provide outcome based education.

As the college is getting funds under TEQIP-II, S.C.1.2 for up-scaling P.G education and research, two more P.G programmes in the thrust areas are being introduced from this academic year leading to a total of 13 programmes.

We could execute these changes only with the help of the commendable academicians, enthusiastic representatives from Industry and support from the representatives of affiliating University JNTU-K present in the Boards of Studies, Academic Council and Governing Body.

It is hoped that the new regulations and curriculum will enhance the all-round ability of students so that they can technically compete at global level with native ethical standards.

PRINCIPAL
MEMBERS ON THE BOARD OF STUDIES
IN
ELECTRICAL AND ELECTRONICS ENGINEERING

Prof. N.K. Kishore,

Sri M.V.R. Krishna Rao,
AGM (ETL), Electro-Technical Lab., IADRS Building, Visakhapatnam Steel Plant, Visakhapatnam – 530 031.

Dr. C. Radhakrishna,

Dr. K. Shanti Swarup,
ESB 349B, Department of Electrical Engg., IIT Madras, Chennai.

Dr. Ch. Sai Babu,
Professor in Electrical Engg., & Director, Academic & Planning, JNT University, Kakinada – 533 003.

Dr. M. Sydulu,
Professor in Electrical & Electronics Engg., National Institute of Technology (NIT), Warangal – 506 004.

Prof. K. A. Gopala Rao,
Principal, GVP College of Engg. for Women, Madhurawada, Visakhapatnam.

Sri T. Srinivas Kishore,
Assistant Professor, Department of E.E.E., G.M.R.I.T., Rajam.

All the Faculty Members of the Department
M.TECH. ACADEMIC REGULATIONS  
(Effective for the students admitted into first year from the Academic Year 2013 - 14)

The M.Tech. Degree of Jawaharlal Nehru Technological University Kakinada shall be recommended to be conferred on candidates who are admitted to the program and fulfill all the following requirements for the award of the Degree.

1.0 ELIGIBILITY FOR ADMISSION:
Admission to the above program shall be made subject to the eligibility, qualifications and specialization as per the guidelines prescribed by the APSCHE and AICTE from time to time.

2.0 AWARD OF M.TECH. DEGREE:
   a. A student shall be declared eligible for the award of the M.Tech. degree, if he pursues a course of study and completes it successfully for not less than two academic years and not more than four academic years.

   b. A student, who fails to fulfill all the academic requirements for the award of the Degree within four academic years from the year of his admission, shall forfeit his seat in M.Tech. Course.

   c. The duration of each semester shall normally be 20 weeks with 5 days a week. A working day shall have 7 periods each of 50 minutes.

3.0 STRUCTURE OF THE PROGRAMME:

<table>
<thead>
<tr>
<th>Semester</th>
<th>No. of Courses per Semester</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory + Lab</td>
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</tr>
<tr>
<td>I</td>
<td>(5 +1*) + 1</td>
<td>20</td>
</tr>
<tr>
<td>II</td>
<td>(5+1*) + 1</td>
<td>20</td>
</tr>
<tr>
<td>III</td>
<td>Seminar</td>
<td>02</td>
</tr>
<tr>
<td>III, IV</td>
<td>Project Work</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td>82</td>
</tr>
</tbody>
</table>

*Elective
4.0 ATTENDANCE:
   The attendance shall be considered subject wise.
   a. A candidate shall be deemed to have eligibility to write his end semester examinations in a subject if he has put in at least 75% of attendance in that subject.
   b. Shortage of attendance up to 10% in any subject (i.e. 65% and above and below 75%) may be condoned by a Committee on genuine and valid reasons on representation by the candidate with supporting evidence.
   c. Shortage of attendance below 65% shall in no case be condoned.
   d. A student who gets less than 65% attendance in a maximum of two subjects in any semester shall not be permitted to take the end-semester examination in which he/she falls short. His/her registration for those subjects will be treated as cancelled. The student shall re-register and repeat those subjects as and when they are offered next.
   e. If a student gets less than 65% attendance in more than two subjects in any semester he/she shall be detained and has to repeat the entire semester.

5.0 EVALUATION:
   The performance of the candidate in each semester shall be evaluated subject-wise with 100 marks for each theory subject and 100 marks for each practical, on the basis of Internal Evaluation and External End-Semester Examination.
   The question paper of the external end semester examination shall be set externally and valued both internally and externally. If the difference between the first and second valuations is less than or equal to 9 marks, the better of the two valuations shall be awarded. If the difference is more than 9 marks, the scripts are referred to third valuation and the corresponding marks are awarded.
   a. A candidate shall be deemed to have secured the minimum academic requirement in a subject if he secures a minimum of 40% of marks in the End Semester Examination and aggregate minimum of 50% of the total marks of the End Semester Examination and Internal Evaluation taken together.
b. For the theory subjects, 60 marks shall be awarded based on the performance in the End Semester examination and 40 marks shall be awarded based on the Internal Evaluation. One part of the internal evaluation shall be made based on the average of the marks secured in the two internal examinations of 30 marks each conducted one in the middle of the Semester and the other immediately after the completion of instruction. Each mid-term examination shall be conducted for a duration of 120 minutes with 4 questions without any choice. The remaining 10 marks are awarded through an average of continuous evaluation of assignments / seminars / any other method, as notified by the teacher at the beginning of the semester.

c. For practical subjects, 50 marks shall be awarded based on the performance in the End Semester Examinations, 50 marks shall be awarded based on the day-to-day performance as Internal marks. A candidate has to secure a minimum of 50% in the external examination and has to secure a minimum of 50% on the aggregate to be declared successful.

d. There shall be a seminar presentation during III semester. For seminar, a student under the supervision of a faculty member(advisor), shall collect the literature on a topic and critically review the literature and submit it to the Department in a report form and shall make an oral presentation before the Departmental Committee. The Departmental Committee shall consist of the Head of the Department, advisor and two other senior faculty members of the department. For Seminar, there will be only internal evaluation of 50 marks. A candidate has to secure a minimum of 50% to be declared successful.

e. In case the candidate does not secure the minimum academic requirement in any subject (as specified in 5.a to 5.c), he has to reappear for the End Examination in that subject. A candidate shall be given one chance to re-register for each subject provided the internal marks secured by a candidate in that subject is less than 50% and he has failed in the end examination. In such a case, the candidate must re-register for the subject(s). In the event of re-registration, the internal marks and end examination marks obtained in the previous attempt are nullified.
f. In case the candidate secures less than the required attendance in any subject(s), he shall not be permitted to appear for the End Examination in those subject(s). He shall re-register for the subject(s) when they are next offered.
g. Laboratory examination for M.Tech. subjects must be conducted with two Examiners, one of them being Laboratory Class Teacher and second examiner shall be other than the Laboratory Teacher.

6.0 EVALUATION OF PROJECT / DISSERTATION WORK:
Every candidate shall be required to submit the thesis or dissertation after taking up a topic approved by the Departmental Research Committee (DRC).

a. A Departmental Research Committee (DRC) shall be constituted with the Head of the Department as the Chairman and two senior faculty as Members to oversee the proceedings of the project work from allotment of project topic to submission of the thesis.
b. A Central Research Committee (CRC) shall be constituted with a Senior Professor as Chair Person, Heads of the Departments which are offering the M.Tech. programs and two other senior faculty members from the same department.
c. Registration of Project Work: A candidate is permitted to register for the project work after satisfying the attendance requirement of all the subjects (theory and practical subjects.)
d. After satisfying 6.0 c, a candidate has to submit, in consultation with his project supervisor, the title, objective and plan of action of his project work to the DRC for its approval. Only after obtaining the approval of DRC the student can initiate the Project work.
e. If a candidate wishes to change his supervisor or topic of the project he can do so with the approval of the DRC. However, the Departmental Research Committee shall examine whether the change of topic/supervisor leads to a major change in his initial plans of project proposal. If so, his date of registration for the Project work shall start from the date of change of Supervisor or topic as the case may be whichever is earlier.
f. A candidate shall submit and present the status report in two stages at least with a gap of 3 months between them after satisfying 6.0 d. The DRC has to approve the status report, for the candidate to proceed with the next stage of work.

g. The work on the project shall be initiated in the beginning of the second year and the duration of the project is for two semesters. A candidate shall be permitted to submit his dissertation only after successful completion of all theory and practical subject with the approval of CRC but not earlier than 40 weeks from the date of registration of the project work. For the approval by CRC the candidate shall submit the draft copy of the thesis to the Principal through the concerned Head of the Department and shall make an oral presentation before the CRC.

h. Three copies of the dissertation certified by the Supervisor shall be submitted to the College after approval by the CRC.

i. For the purpose of adjudication of the dissertation, an external examiner shall be selected by the Principal from a panel of 5 examiners who are experienced in that field proposed by the Head of the Department in consultation with the supervisor.

j. The viva-voce examination shall be conducted by a board consisting of the supervisor, Head of the Department and the external examiner. The board shall jointly report the candidate’s work as:

   A. Excellent
   B. Good
   C. Satisfactory

k. If the adjudication report is not favorable, the candidate shall revise and resubmit the dissertation, in a time frame prescribed by the CRC. If the adjudication report is unfavorable again, the dissertation shall be summarily rejected and the candidate shall change the topic of the Project and go through the entire process afresh.

7.0 **AWARD OF DEGREE AND CLASS:**

A candidate shall be eligible for the degree if he satisfies the minimum academic requirements in every subject and secures satisfactory or higher grade report on his dissertation and viva-voce.
After a student has satisfied the requirements prescribed for the completion of the program and is eligible for the award of M.Tech. Degree, he shall be placed in one of the following three classes.

<table>
<thead>
<tr>
<th>% of Marks secured</th>
<th>Class Awarded</th>
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<tbody>
<tr>
<td>70% and above</td>
<td>First Class with Distinction</td>
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<tr>
<td>60% and above but less than 70%</td>
<td>First Class</td>
</tr>
<tr>
<td>50% and above but less than 60%</td>
<td>Second Class</td>
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</table>

The grade of the dissertation shall be mentioned in the marks memorandum.

8.0 WITHHOLDING OF RESULTS:
If the candidate has not paid any dues to the college or if any case of indiscipline is pending against him, the result of the candidate shall be withheld and he will not be allowed into the next higher semester. The recommendation for the issue of the degree shall be liable to be withheld in all such cases.

9.0 TRANSITORY REGULATIONS:
a. A candidate who has discontinued or has been detained for want of attendance or who has failed after having studied the subject is eligible for admission to the same or equivalent subject(s) as and when subject(s) is/are offered, subject to 4.0 d, e and 2.0.
b. Credit equivalences shall be drawn for the students readmitted into 2013 regulations from the earlier regulations. A Student has to register for the substitute / compulsory / pre-requisite subjects identified by the respective Boards of Studies.
c. The student has to register for substitute subjects, attend the classes and qualify in examination and earn the credits.
d. The student has to register for compulsory subjects, attend the classes and qualify in examination.
e. The student has to register for the pre-requisite courses, attend the classes for which the evaluation is totally internal.
10.0 GENERAL

1. The academic regulations should be read as a whole for purpose of any interpretation.

2. In case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Chairman, Academic Council is final.

3. The College may change or amend the academic regulations and syllabus at any time and the changes amendments made shall be applicable to all the students with effect from the date notified by the College.

4. Wherever the word he, him or his occur, it will also include she, hers.

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# COURSE STRUCTURE

## SEMESTER - I

<table>
<thead>
<tr>
<th>Course Code</th>
<th>THEORY/LAB</th>
<th>L</th>
<th>P</th>
<th>C</th>
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<tbody>
<tr>
<td>13EE2101</td>
<td>Power Generation, Operation and Control</td>
<td>4</td>
<td></td>
<td>3</td>
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<tr>
<td>13EE2102</td>
<td>Advanced Power System Protection</td>
<td>4</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>13EE2103</td>
<td>Real Time Control of Power Systems</td>
<td>4</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>13EE2104</td>
<td>Power Electronic Applications to Power Systems</td>
<td>4</td>
<td></td>
<td>3</td>
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<tr>
<td>13EE2105</td>
<td>Distribution Automation</td>
<td>4</td>
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<td>3</td>
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<td>13EE2106</td>
<td>Elective – I</td>
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<tr>
<td>13EE2107</td>
<td>1. Modeling &amp; Simulation of Power Electronic Systems</td>
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<tr>
<td>13EE2108</td>
<td>2. Advanced Digital Control Systems</td>
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<td>3. Power System Reliability</td>
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<td></td>
<td>Power System &amp; Simulation Lab-I</td>
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<td>Power System Control &amp; Stability</td>
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<td>13EE2111</td>
<td>Power Quality Management</td>
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<td>13EE2112</td>
<td>Power System Optimization</td>
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<td>13EE2113</td>
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<td>13EE2114</td>
<td>Restructured Power Systems</td>
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<td>13EE2115</td>
<td>Elective – II</td>
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<tr>
<td>13EE2116</td>
<td>1. Distributed Generation</td>
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<tr>
<td>13EE2213</td>
<td>2. Real Time Concepts of Embedded Systems</td>
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<tr>
<td>13EE2117</td>
<td>3. Dynamics of Electrical Machines</td>
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<tr>
<td></td>
<td>Power System &amp; Simulation Lab-II</td>
<td>-</td>
<td>3</td>
<td>2</td>
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<td><strong>TOTAL</strong></td>
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### SEMESTER – III

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<th>Course Code</th>
<th>SEMINAR/ PROJECT WORK</th>
<th>CREDITS</th>
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<td>SEMINAR</td>
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<td>13EE2119</td>
<td>PROJECT WORK (Contd..)</td>
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### SEMESTER – IV

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<td>13EE2119</td>
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</table>
POWER GENERATION, OPERATION AND CONTROL

Course Code: 13EE2101


Course Educational Objectives:
1. To introduce Unit Commitment problem, its constraints and solutions using optimization techniques.
2. To explain load frequency control and estimate the frequency deviation through modeling and reducing the error through control system design for single area as well as interconnected systems.
3. To identify various methods of voltage control and study the reactive power compensation of transmission system.
4. To explain power system security and analyze the same using contingency analysis and introduce state estimation concepts for real-time control applications.
5. To obtain optimal power flow solution using Gradient method and Newton’s Method.

Course Outcomes: At the end of the course, the student will be able to
1. Solve Unit Commitment problem using simple priority list scheme and dynamic programming technique for a given power system.
2. Estimate the frequency deviation for a given change of load and design control systems for making steady-state frequency error to zero.
3. Select appropriate voltage control techniques for improving voltage profile in a transmission system.
4. Estimate system security level using contingency analysis and understand state estimation.
5. Solve optimal power flow problem using Gradient Method and Newton’s Method.

UNIT-I
UNIT-II
CONTROL OF ACTIVE POWER
UNIT-III
CONTROL OF REACTIVE POWER
UNIT-IV
POWER SYSTEM SECURITY AND STATE ESTIMATION
UNIT-V
OPTIMAL POWER FLOW

TEXT BOOKS:

REFERENCES:
ADVANCED POWER SYSTEM PROTECTION

Course Code: 13EE2102 L P C 4 0 3

Pre requisites: Switchgear and Protection.

Course Educational Objectives:
1. To study different types of static over current and distance relays characteristics.
2. To study principles and algorithms of digital relaying for protection of power systems.

Course Outcomes: At the end of the course, the student will be able to have knowledge in
1. Static relays and comparison of static and electromagnetic relays.
2. Various types of static distance relays and characteristics.
3. Protection of alternator and transformer.
4. Various types of microprocessor based protective relays.
5. Various types of DSP based protective relays.

UNIT-I STATIC RELAYS:
Basic construction of static relays, Classification of protective schemes, Comparison of Static relays with electromagnetic relays, Amplitude comparator, Phase comparator, Principle of Duality.

AMPLITUDE AND PHASE COMPARATORS (2-INPUT):
Rectifier bridge circulating and opposed Voltage type- Averaging -phase splitting type -Sampling type of amplitude Comparison. Block spike type-Phase splitting type- Transistor integrating type- Rectifier bridge type- Vector product type Phase comparison.

UNIT-II
STATIC OVER CURRENT RELAYS:
Instantaneous- Definite time – Inverse time- Directional- IDMT- Very inverse Time-Extremely inverse time over current relays. Time current characteristics of over current relays-applications.

DISTANCE PROTECTION:
UNIT-III PILOT RELAYING SCHEMES:
Wire pilot protection: circulating current scheme-balanced voltage scheme-translay scheme-half wave comparison scheme- Carrier current protection: phase comparison type-carrier aided distance protection-operational comparison of transfer trip and blocking schemes-optical fiber channels.

UNIT-IV AC MACHINES AND BUS ZONE PROTECTION:

UNIT-V MICROPROCESSOR AND DSP BASED PROTECTIVE RELAYS:
MP based: Introduction-over current relays-impedance relay-directional relay-reactance relay.
Numerical Protection: Introduction, numerical relay, Comparison of Numerical relays with static relays Data acquisition System, Numerical relaying algorithms- Mann-Morrison technique, differential equation technique, Discrete Fourier transform technique:

Text Books:

Reference Books:
REAL TIME CONTROL OF POWER SYSTEM

Course Code: 13EE2103

Pre requisites: Power system operation and control.

Course Educational Objectives:
1. To familiarize with SCADA.
2. Understand the operation of power system.
3. To apply real time software for power system control.

Course Outcomes: At the end of the course, the student will be able to
1. Learn various activities of operator.
2. Understand about Supervisory control and data acquisition.
3. Real time software and state estimation.

UNIT-I
Power system control-operation, operator activities, control center, elements of computer control system Supervisory and control functions – data acquisition, monitoring and event processing, control functions

UNIT-II
Time tagged data, disturbance data collection and analysis, reports and calculations. Man-machine communication – operators console, VDU display, operator dialogs, mimic diagrams, printing facilities

UNIT-III
Real time software – Classification of programs, Structure of real time programs, construction techniques and tools, Programming language requirements for process control

UNIT-IV
Computer control of power systems – Evolution, time scale of system control, online control, Software for state estimation, Generation and load control, security analysis, Software coordination
UNIT-V
Application functions- real time network modeling, security management: system security, security analysis functions, security modeling; production control: load prediction, local control, automatic generation control, economic dispatch, training simulators.

TEXT BOOKS:

POWER ELECTRONICS APPLICATIONS TO POWER SYSTEMS

Course Code: 13EE2104

L P C
4 0 3

Pre requisites: Power Electronics & Power Systems

Course Educational Objectives:
The students shall be exposed to application of power electronics, to High Voltage Direct Current (HVDC) and FACTS (Flexible AC Transmission Systems) in the power transmission area.

Course Outcomes: After Completion of this Course, the Student will be able to
1. Analyze the Operation of the Graetz circuit.
2. Design the Filter for respective Harmonics
3. Analyze the Harmonics
4. Understand the operations of various FACTS Devices

UNIT-I: BASIC CONCEPTS
Introduction, Comparison of AC and DC Transmission (Economics of power transmission, Technical performance and Reliability), Application of DC transmission, Description of DC transmission system (Types of DC links and Converter station), Planning for HVDC transmission, Modern trends in HVDC technology.

UNIT-II: ANALYSIS OF HVDC CONVERTERS
Introduction, Analysis of Graetz circuit – with grid control but no overlap-with grid control and overlap less than $60^\circ$-relationship between AC and DC quantities-equivalent circuit of rectifier, Inversion-equation of average direct current and voltage in terms of $\beta$ and $\gamma$ – equivalent circuit of inverter, 12 Pulse converters-relations between AC and DC quantities-modified equivalent circuit.

UNIT-III
HVDC SYSTEM CONTROL & HARMONICS AND FILTERS:
Basic means of control-desired features of control-actual control characteristics-constant minimum ignition angle control-constant current
control-constant extinction angle control-tap changer control-power control and current limits, System control hierarchy, firing angle control-IPC-EPC. Introduction, Generation of harmonics (Characteristics and Non characteristics harmonics), Design of AC filters (design and types of filters), Passive AC- filters, DC filters (Criteria of Design and Passive DC Filters), Active Filters.

UNIT-IV
FACTS CONCEPTS & STATIC SHUNT COMPENSATION: Transmission interconnections power flow in an AC system, loading capability limits, Dynamic stability considerations, importance of controllable parameters, basic types of FACTS controllers, Benefits from FACTS controllers. Objectives of Shunt Compensation, midpoint voltage regulation voltage instability prevention, Improvement of transient stability, Power oscillation damping, Methods of controllable VAR generation, variable impedance type static VAR generators switching converter type VAR generators hybrid VAR generators.

UNIT-V
STATIC SERIES COMPENSATORS: Concept of series capacitive compensation, Improvement of transient stability, power oscillation damping, subsynchronous oscillation damping. Functional requirements of GTO Thyristor controlled series capacitor (GCSC), Thyristor switched series capacitor (TSSC), and thyristor controlled series capacitor (TCSC) control schemes for GCSC TSSC and TCSC.

TEXT BOOKS:

REFERENCES:


DISTRIBUTION AUTOMATION

Course Code: 13EE2105  

Pre requisites: Basic knowledge of electrical power distribution systems.

Course Educational Objectives:
1. To gain the awareness of the problems and challenges of the present day distribution sector
2. To gain the knowledge of Principles of Distribution Automation (DA)
3. To gain the knowledge of various communication technologies available for DA
4. To clearly understand the Technical Benefits of automation of distribution system
5. To gain the knowledge of principles of various Economic Evaluation Methods of DA.

Course Outcomes: At the end of the course, the student will be able to
1. Select appropriate Communication Technology for various parts of Distribution System for their automation.

UNIT-I
DISTRIBUTION AUTOMATION AND THE UTILITY SYSTEM:
Introduction to Distribution Automation (DA), Control System Interfaces, Control and Data Requirements, Centralized (Vs) Decentralized Control, DA System (DAS), DA Hardware, DAS Software.

UNIT-II DISTRIBUTION AUTOMATION FUNCTIONS:
UNIT-III COMMUNICATION SYSTEMS FOR DA:

UNIT-IV TECHNICAL BENEFITS:

UNIT-V ECONOMIC EVALUATION METHODS:

Text Book:

Reference Books:


MODELING AND SIMULATION OF POWER ELECTRONIC SYSTEMS
(ELECTIVE-I)

Course Code: 13EE2106               L  P  C
                                4  0  3

Pre requisites: This course requires Knowledge of different Power Semiconductor Devices and Power Converters and should possess an in-depth understanding of operational aspects of dc/ ac rotating machines.

Course Educational Objectives:
It is to help understand the modeling analysis and performance of electric drive systems fed from PE converters as per system design concepts.

Course Outcomes: At the end of the course, the student will be able to get
2. Knowledge in Power Electronic Converter fed DC & AC drives system and their application to different Industrial needs.

UNIT-I
INTRODUCTION AND REVIEW OF MODELING OF POWER ELECTRONIC DEVICES:
Overview and modeling of Power Electronic (PE) devices: Diodes, Thyristors, IGBTs, MOSFET; Comparison of switching characteristics of various devices, Transient and Steady state behaviour of PE devices.

COMPUTER SIMULATION OF PE CONVERTERS:
Challenges in Computer Simulation; Solution techniques for time domain simulation; widely used circuits and / or system oriented simulators. Choice of a simulator

UNIT-II
SIMULATION OF AC/ DC CONVERTERS:
Modeling of controlled and uncontrolled ac/ dc converters; single-phase & 3- phase ac/dc converters; other topologies for ripple current minimization and power factor improvement.
SWITCH-MODE DC / DC POWER SUPPLIES:
Modeling & Simulation of dc/dc converters such as Buck, Boost, Buck-Boost, Cuk and Full bridge dc/dc Converters.

UNIT-III
MODELING & SIMULATION OF DC MOTOR DRIVE SYSTEMS:
Equivalent circuits for DC motors, DC motors with a separately excited field winding, DC servo drives and their control, Adjustable speed dc drives, Effect of discontinuous current, Field weakening effects.

UNIT-IV
MODELING & SIMULATION OF INDUCTION DRIVE SYSTEMS:
Induction motor characteristics at rated frequency and rated voltage, simulation of variable frequency voltage source square wave / PWM drives, CSI drive simulation

UNIT-V
MODELING & SIMULATION OF SYNCHRONOUS MOTOR DRIVE SYSTEMS:
Principles of synchronous motor operation; Brushless dc motor drive operation, synchronous motor servo drive simulation, Load commutated synchronous motor drive.

TEXT BOOKS:
2. V. Rajagopalan, “Modeling & Simulation of PE systems”, Marcel Dekkar Inc.

REFERENCES:
ADVANCED DIGITAL CONTROL SYSTEMS
(ELECTIVE-I)

Course Code: 13EE2107

L P C
4 0 3

Pre requisites: Mathematics, Networks, Control Systems.

Course Educational Objectives:
1. To study the State Space and stability analysis of digital control system.
2. To equip the basic knowledge about the design of digital control systems for different Engineering models using Conventional Techniques.
3. To equip the students with the basic knowledge about Pole placement techniques.
4. To equip the students with the basic knowledge about state observers.
5. To equip the students with the basic knowledge about Linear Quadratic Regulators – Riccati Equation.
6. To equip the students with the basic knowledge of State Estimation Using Kalman Filter.
7. To equip the students with the basic knowledge about adaptive control.
8. To equip the students with the basic knowledge of digital simulation and DSP Processors.

Course Outcomes:
1. This course provides a foundation in discrete-time linear control system theory.
2. Analyzing, design, and synthesize digital control systems using transform techniques (root locus and frequency response) and state-space methods (pole-assignment and state estimation).
3. Analyzing and understanding the challenges to interface digital computing devices with the Analog dynamics of most real-world systems.
4. Evaluating and setting the necessary specifications for analog systems that are to be controlled by digital computing devices.
5. Designing digital devices to satisfy given specifications and to achieve desired system-behavior.
6. Understanding the Basic Concepts of Microprocessor control of control systems and custom designed chips like Galil DMC-105
UNIT-I
STATE SPACE ANALYSIS
State space representation of discrete time systems, pulse transfer function matrix, solving discrete time state space equations, state transition matrix and its properties methods for computation of state transition matrix, discretization of continuous time state-space equations

STABILITY ANALYSIS
Stability analysis of closed loop systems in the Z-plane, Jury stability criterion test-Stability analysis by use of the bilinear transformation and routh stability criterion. Stability analysis using liapunov theorems

UNIT-II
DESIGN OF DISCRETE TIME CONTROL SYSTEM BY CONVENTIONAL METHODS
Design of digital control systems based on Root locus techniques-Design of digital control based on the frequency response methods-Bilinear transformation and design procedure in the w-plane, lead, lag and Lead-lag compensators and digital PID controllers. Design digital control through dead beat response methods.

UNIT-III
STATE FEEDBACK CONTROLLERS AND OBSERVERS
Concept of controllability and observability-Design of state feedback controller through pole placement-Necessary and sufficient conditions, Ackerman’s formula, State observers-Full order and Reduced Order observer

UNIT-IV
LINEAR QUADRATIC REGULATORS
Min/Max principle, Linear Quadratic Regulators, Kalman Filters, State Estimation through kalman Filters, Introduction to adaptive controls

UNIT-V
DIGITAL SIMULATION
MICROPROCESSOR AND DSP CONTROL

TEXT BOOKS:


REFERENCES:


POWER SYSTEM RELIABILITY
(ELECTIVE-I)

Course Code: 13EE2108

Pre requisites:
1. Student is assumed to have knowledge in Power Generation, Transmission and Distribution.
2. Student is assumed to have knowledge in basic probability methods.

Course Educational Objective:
1. The course is aimed at exposing the student to understand Basic probability methods, Composite Generation and Transmission Systems.
2. Student will also have exposure to Operating and failure states of system components, application of Monte Carlo Simulation.

Course Outcomes: At the end of the course, student will be able to
1. Analyse the reliability of the Composite Generation and Transmission Systems using Basic probability methods.
2. Learn how to implement Monte Carlo Simulation.
3. Learn System Expansion studies, Load Forecast Uncertainty.
4. Learn Reliability Evaluation Techniques of distribution systems.
5. Learn De-rated States and Auxiliary Systems.

UNIT – I : INTRODUCTION
Probabilistic Reliability Criteria, Statistical and probabilistic measures, absolute and relative measures, methods of assessment, concept of adequacy and security, system analysis, reliability cost and reliability worth.

GENERATING CAPACITY – BASIC PROBABILITY METHODS
Introduction, The Generation System Model, Generating Unit Unavailability, Capacity outage probability tables, Comparison of deterministic and probabilistic criteria, recursive algorithm for capacity model building, Loss of load indices, Equivalent forced outage rate, capacity expansion analysis, Evaluation Techniques, Perturbation effects.

UNIT – II
GENERATING CAPACITY – FREQUENCY AND DURATION METHOD
Indices, Individual State Load Model, cumulative State Load Model, Practical System Studies, Base case study, System Expansion studies, Load Forecast Uncertainty.

UNIT–III : COMPOSITE GENERATION AND TRANSMISSION SYSTEM
Introduction, Radial Configurations, Conditional Probability Approach, Network Configurations, State Selection, System and Load Point Indices, Application to practical systems, Data requirements for composite system reliability evaluation, Concepts, deterministic Data, stochastic data.

DISTRIBUTION SYSTEMS – BASIC TECHNIQUES AND RADIAL NETWORKS

UNIT – IV : SUBSTATION AND SWITCHING STATIONS
Introduction, Effect of Short Circuits and Breaker Operation, Operating and Failure states of system components, Open and Short Circuit Failures, Active and Passive Failures. Malfunction of normally closed breakers, numerical analysis of Typical Substation.

PLANT AND STATION AVAILABILITY

UNIT – V  APPLICATION OF MONTE CARLO SIMULATION

Text Book:

Reference Books :
POWER SYSTEM & SIMULATION LAB – I

Course Code: 13EE2109

Pre requisites: Power System Analysis, Power System Operation & Control

Course Educational Objectives:
1. To design and conduct experiments on various power system components-analyze and interpret data.
2. To give hands on experience in using modern software tools for simulation of various power system controls.

Course Outcomes: At the end of this lab, the student will be able to
1. Analyze and interpret data on various power system components.
2. Simulate the characteristics of various power system control using modern software tools.

LIST OF EXPERIMENTS

1. Develop a program to solve Swing Equation.
2. Determination of Sub-Transient Reactance of a Salient Pole Machine.
3. Study and testing of over current and over voltage relay in Generator protection system with IDMT relay characteristics.
4. Develop a Simulink model for a single area load frequency problem and simulate the same.
5. Write a program to find Y-bus & Z-bus
7. Simulate a transmission line and find I.Ferranti effect, II. Efficiency
8. Transient Stability analysis of a typical power system by using MiPower.
9. Design a PID controller.
10. Fault Analysis of 3 phase alternator
   i) LG Fault
   ii) LL Fault
   iii) LLG Fault
   iv) LLLG Fault

Text Books:


POWER SYSTEM CONTROL AND STABILITY

Course Code: 13EE2110  L P C
4 0 3

Pre requisites:
1. Student is assumed to have knowledge in synchronous machine, power system operation and control.
2. Student is assumed to have knowledge in stability of synchronous machine.

Course Educational Objectives: At the end of the course, the student will be able to
1. Analyze the steady state performance, dynamic performance of synchronous machine.
2. Do Modeling of Excitation system and Prime mover controllers and analyse sub-synchronous resonance.

Course Outcome: At the end of the course, the student acquires knowledge in
1. Park’s Transformation
2. Simulation of Dynamics of synchronous generator connected to infinite bus.
3. Methodology of analyzing multi machine power system.
4. Design and application of power system stabilizers in power system

UNIT-I : MODELING OF SYNCHRONOUS MACHINE:

EXCITATION AND PRIME MOVER CONTROLLERS:
Excitation System, Excitation System Modelling, Excitation Systems-Standard Block Diagram System Representation by State Equations, Prime-Mover Control System.

UNIT-II : TRANSMISSION LINES, SVC AND LOADS :
DYNAMICS OF A SYNCHRONOUS GENERATOR CONNECTED TO INFINITE BUS:

UNIT-III : ANALYSIS OF SINGLE MACHINE SYSTEM:
Small Signal Analysis with Block Diagram Representation, Characteristic Equation (CE) and Application of Routh-Hurwitz Criterion, Synchronizing and Damping Torques Analysis, Small Signal Model: State Equations.

UNIT – IV : APPLICATION OF POWER SYSTEM STABILIZERS
Introduction, Basic concepts in applying PSS, Control Signals, Structure and tuning of PSS, Field implementation and operating experience, Examples of PSS Design and Application.

ANALYSIS OF MULTI-MACHINE SYSTEM
A Simplified System Model, Detailed Models: Case-I, Detailed Model: Case-II, Inclusion of Load and SVC Dynamics, Modal Analysis of Large Power Systems, Case Studies

UNIT-V : ANALYSIS OF SUB-SYNCHRONOUS RESONANCE:

TEXT BOOKS:

REFERENCES:
POWER QUALITY MANAGEMENT

Course Code: 13EE2111

Pre requisites: Basic knowledge in Electrical Networks, Machines, Power Electronics.

Course Educational Objectives:
To study and understand the definitions, various power quality problems and their mitigation and measuring techniques.

Course Outcomes:
At the end of the course, the student will be able to acquire knowledge in
1. Basic concepts of power quality issues.
2. Causes, effects of long and short interruptions.
3. Sags and phase angle jumps in different types of faults.
4. Various equipment behavior with voltage sags.
5. Various interfacing devices between system and equipment to mitigate the sags and interruptions

UNIT-I: INTRODUCTION AND HARMONICS:
Introduction of the Power Quality (PQ) problem, Terms used in PQ: Voltage Sag Swell, Surges, Harmonics, over voltages, spikes, Voltage fluctuations, Transients, Interruption, overview of power quality phenomenon.
Harmonics: Definition, causes of voltage and current harmonics, individual and total harmonic distortion, effect of harmonics on power system devices, guidelines for harmonic voltage and current limitation, harmonic current mitigation.

UNIT-II : INTERRUPTIONS:
Short Interruptions: Definition, origin of short interruptions - basic principle, fuses saving, voltage magnitude events due to re-closing, voltage during the interruption; monitoring of short interruptions - difference between medium and low voltage systems, Multiple events; single phase tripping – voltage and current during fault period, voltage and current at post fault period, stochastic prediction of short interruptions.
UNIT-III: VOLTAGE SAGS – CHARACTERIZATION – SINGLE PHASE AND THREE PHASES:
Voltage sag – definition, causes of voltage sag, voltage sag magnitude monitoring, theoretical calculation of voltage sag magnitude, voltage sag calculation in non-radial systems, meshed systems; voltage sag duration. Three phase faults- single phase, phase to phase, phase to ground faults; phase angle jumps- theoretical calculations; magnitude and phase angle jumps- phase to phase, single phase, two phase to ground; for three phase unbalanced sags, load influence on voltage sags.

UNIT-IV: VOLTAGE SAGS – EQUIPMENT BEHAVIOR:
Voltage tolerance, computers, consumer electronics, adjustable speed AC drives and its operation. Mitigation methods of AC Drives, adjustable speed DC drives and its operation, mitigation methods of DC drives other sensitive loads.

UNIT-V
MITIGATION OF INTERRUPTIONS, VOLTAGE SAGS AND EMC STANDARDS:
Overview and ways of mitigation methods, different events and mitigation methods. System equipment interface – voltage source converter, series voltage controller- basic principle active power injection; shunt controller, combined shunt and series controller. Purpose of standardization, IEC Electromagnetic compatibility standards.

TEXT BOOKS:

REFERENCES:
POWER SYSTEM OPTIMIZATION

Course Code: 13EE2112
L P C
4 0 3

Prerequisites: Optimization techniques, economic load dispatch.

Course Educational Objectives:
1. This course deals with the state of the art techniques in power system planning and forecasting for economic load dispatch.
2. It also imparts knowledge in multi-objective optimization in planning and operation of thermal as well as integrated hydrothermal electric systems.
3. This course finally enlightens the students in the field of power systems.

Course Outcomes: After completion of the course, the student will be able:
1. To solve economic load dispatch problem in power systems.
2. To solve Multi-objective optimization problems of any utility or industry.
3. To use evolutionary programming for solving generation scheduling problem.

UNIT-I
UNIT-II

UNIT-III

UNIT-IV

UNIT-V
EVOLUTIONARY PROGRAMMING FOR GENERATION SCHEDULING: Introduction - Fitness Function - Genetic Algorithm Operators - Random Number Generation - Economic Dispatch Problem - Genetic Algorithm Solution Methodology - Genetic Algorithm

TEXT BOOK:


REFERENCES:


Pre requisites: Basic knowledge of optimization.

Course Educational Objectives:
1. To get introduced to the soft computing concepts and techniques such as Artificial Neural Networks (ANN), Fuzzy Logic (FL), Genetic Algorithms (GA), Particle Swarm Optimization (PSO) which form an alternate paradigm to classical optimization techniques.
2. To recognize the feasibility of applying a soft computing technique to a particular optimization problem
3. To apply soft computing techniques to hard real life optimization problems which cannot be solved with classic techniques.

Course Outcomes:
At the end of the course, the student will be able to
1. Apply neural networks to power engineering optimization problems
2. Apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems
3. Apply genetic algorithms to combinatorial optimization problems
4. Apply particle swarm optimization technique to optimization problems

UNIT-I
ARTIFICIAL NEURAL NETWORKS (ANN) - I : (Fundamentals, Feed forward/Feedback Networks) Introduction, ANN Basic Building Blocks and Terminologies, ANN Models, Learning Rules, Perceptron Networks (Single layer / Multi layer), Feed Forward Networks- Back Propagation Networks (BPN), Feedback Networks - Hopfield Net, Applications.

UNIT-II
UNIT-III  Fuzzy Logic:

UNIT-IV  Genetic Algorithms (GA):

UNIT-V  Particle Swarm Optimization (PSO):
Basic concepts, Swarm intelligence, population, velocity updation, particle- best (pbest), global-best (gbest), velocity initialization, solution, Applications.

Text Books:
1) S. N. Sivanandam, S. Sumathi, S. N. Deepa, “Introduction to Neural Networks using MATLAB 6.0”, TMH, 2006 (Unit-I,II)

Reference Books:
RESTRICTED POWER SYSTEM

Course Code: 13EE2114  L P C  4 0 3


Course Educational Objectives:
1. To provide in-depth understanding of operation of deregulated electricity market systems
2. To examine topical issues in electricity markets and how these are handled world-wide in various Markets
3. To enable students to analyze various types of electricity market operational and control issues using new mathematical models.

Course Outcomes: After the completion of the course, the student will be able to
1. Understand the operation of deregulated electricity market systems.
2. Understand and examine topical issues in electricity markets and how these are handled world-wide in various markets.
3. Analyze various types of electricity market operational and control issues using new mathematical models.

UNIT-I

UNIT-II
Transfer Capability on OASIS – definitions transfer capability issues – ATC – TTC – TRM – CBM calculations – methodologies to calculate ATC.

UNIT-III
UNIT-IV

UNIT-V
The Availability Based Tariff (ABT)
Necessity of ABT?, the mechanism, working of the mechanism, effects of ABT, intra-state ABT, the electricity act 2003, provisions in the generation sector, provisions in the transmission sector, provisions in the distribution sector, power trading, other important changes.

TEXT BOOKS:


REFERENCES:

1. Loi Lei Lai; “Power system Restructuring and Deregulation”, Jhon Wiley & Sons Ltd., England.

DISTRIBUTED GENERATION
(ELECTIVE-II)

Course Code: 13EE2115       L P C
                                      4 0 3

Pre requisites:
Students are assumed to have knowledge in conventional generation, Electrolysis, turbines, Basic Electrical Machines. Students are also assumed to have knowledge in power transmission and distribution.

Course Educational Objectives:
The objective of the course is to expose the student to various DG technologies, siting requirements, operational problems of various DGs, interconnection of DGs, and sizing of generation systems.

Course Outcomes:
At the end of the course, the student acquires knowledge in
1. Various methods of power generation, goals of distributed generation, understand the difference between stand-alone photo voltaic power.
2. Operation, Performance, operational limitations, Temperature limits, and other aspects of Wind Turbine and Fuel cells.
3. Siting requirements, restrictions, and operational limitations of micro turbines.
4. Various inter connected generation systems.

UNIT-I

SOLAR PHOTO VOLTAIC SYSTEMS: Introduction, Components, Foundation and Supports, Fixed Arrays, Tracking Arrays, Solar Arrays, Utility Interactive Power Inverter, Operation, Tilting angle of the array, Stand Alone Photo Voltaic Power, Grid Connected Photo Voltaic Power,

UNIT-II

UNIT-III
MICRO-TURBINES: Introduction, Components, Operation, Grid connected operation, stand alone operation, shutdown procedures, paralleling multiple micro turbines, Common output bus, input impedance, Ratings, Installation and siting requirements, emissions, site ratings, ambient temperature, elevation, intake or exhaust restrictions, Zoning ordinances, Operational Limitations.

UNIT-IV

UNIT-V

TEXT BOOK:

REFERENCES:
REAL TIME CONCEPTS OF EMBEDDED SYSTEMS
(ELECTIVE-II)

Course Code: 13EE2116

Pre requisites: Basic Knowledge of Microcontrollers.

Course Educational Objectives: To provide the student with in-depth knowledge of embedded systems including overall system design, interfacing, Operating Systems, Data Acquisition, Communication Protocols, and Real-Time Performance.

Course Outcomes: At the end of the course, the student will be able to
1. Know the Basics of design aspects of Embedded Systems and Applications of 8051 Microcontroller.
2. Learn design aspects of Systems using Real Time Operating Systems.
3. Understand the features of advanced architectures in ARM and SHARC processors.
4. Understand applications of ARM processors in Electrical Engineering and write programs.

UNIT-I
EMBEDDED COMPUTING:

UNIT-II
INTRODUCTION TO REAL – TIME OPERATING SYSTEMS:
Tasks and Task States, Tasks and Data, Semaphores, and Shared Data; Message Queues, Mailboxes and Pipes, Timer Functions, Events, Memory Management, Interrupt Routines in an RTOS Environment.
UNIT-III
BASIC DESIGN USING A REAL-TIME OPERATING SYSTEM:
Principles, Semaphores and Queues, Hard Real-Time Scheduling
Considerations, Saving Memory and Power, An example RTOS like
UC-OS (Open Source); Embedded Software Development Tools: Host
and Target machines, Linker/Locators for Embedded Software, Getting
Embedded Software into the Target System; Debugging Techniques :
Testing on Host Machine, Using Laboratory Tools, An Example
System.

UNIT-IV
INTRODUCTION TO ADVANCED ARCHITECTURES
ARM and SHARC Processor and memory organization and Instruction
level parallelism; Networked embedded systems: Bus protocols, I2C bus
and CAN bus; Internet-Enabled Systems, Design Example-Elevator
Controller.

UNIT-V
ARM PERIPHERALS AND APPLICATION CODING
GPIO, Timers, Counters, PWM, ADC, Serial Communication Channels.
Application Coding Examples- Measurement of time, Frequency, Power
Control.

Text books:
   (Unit I, IV)
   Education, 2011. (Unit II, III)

Reference Books:
1. Jean. J. Labrosse,“Embedded System building blocks”, 2nd edition,
2. Raj Kamal,“Embedded Systems: Architecture, Programming and
   Cenage Learning, 2010.
   2011.
DYNAMICS OF ELECTRICAL MACHINES
(ELECTIVE-II)

Course Code: 13EE2213

Pre requisites: Electrical Machines

Course Educational Objectives:
To impart the students with dynamic modeling, simulation and control theory for electric machinery and associated power electronic drive systems that find a wide range of applications in electric power engineering careers

Course Outcomes: At the end of the course, the student will be able to
1. Understand the principle of control of Induction machine
2. Analyze symmetrical 2 phase induction machine
4. Model a three phase synchronous machine

UNIT-I: MODELING CONCEPTS
Basic Two-pole machine representation of commutator machines, 3-ph synchronous machine with and without damper bars and 3-ph induction machine, Kron’s primitive machine-voltage, current and torque equations. Real time model of a two phase induction machine-transformation to obtain constant matrices-thee phase to two phase transformation- power equivalence.

UNIT-II MODELING OF THREE PHASE INDUCTION MACHINE
UNIT-III
SYMMETRICAL AND UNSYMMETRICAL 2 PHASE INDUCTION MACHINE:

UNIT-IV SYNCHRONOUS MACHINE MODELING

UNIT-V DYNAMIC ANALYSIS OF SYNCHRONOUS MACHINE
Dynamic performance of synchronous machine, three-phase fault, comparison of actual and approximate transient torque characteristics, Equal area criteria- simulation of three phase synchronous machine – modeling of PMSM.

TEXT BOOKS:

REFERENCES:


**POWER SYSTEM & SIMULATION LAB – II**

**Course Code:** 13EE2117

**Pre requisites:** Power System Analysis, Power System Operation & Control

**Course Educational Objectives:**
1. To Design and conduct experiments on various power system components, analyze and interpret data.
2. To give hands on experience in using modern software tools for simulation of various power System controls.

**Course Outcomes:** At the end of the lab, the student will be able to
1. Analyze and interpret data on various power system components.
2. Simulate the characteristics of various power system controls using modern software tools.

**LIST OF EXPERIMENTS**

1. IDMT (Inverse Definite Minimum Time) Relay Characteristics
2. Study and testing of over current and over voltage relays in transformer protection system with IDMT Relay characteristics
3. Design a compensator for a given system for required specifications.
4. Conduct a power flow study on a given power system.
5. Conduct a power flow study on a given power system network using Gauss-Seidel iterative method.
6. Determination of breakdown strength of oil by variable distance electrodes.
7. Develop a Simulink model for a two-area load frequency problem and simulate the same.
8. Determine Power Quality parameters of a given data as per IEEE Standards
9. Design a PID controller for two-area power system and simulate the same.
10. Simulate Transmission line and find:
   a. Transmission line parameter
   b. Surge Impedance loadings

11. Economic load dispatch without and with transmission loss using MiPower

Text Books:


