SRI KRISHNADEVARAYA UNIVERSITY

COLLEGE OF ENGINEERING AND TECHNOLOGY: ANANTAPURAM

ACADEMIC REGULATIONS 2013 FOR M.Tech (Regular) DEGREE COURSE

(Effective for the students admitted into first year from the academic year 2013-2014)

The M.Tech Degree of Sri Krishnadevaraya University College of Engineering and Technology Anantapuram shall be conferred on candidates who are admitted to the program and fulfill all the requirements for the award of the Degree.

1.0 Courses of Study

1.1 The following specializations are offered at present for the M.Tech course of study.

S.No.	Department	Specialization
1	Computer Science and Engineering	Computer Science and Engineering
2	Electronics and Communications Engineering	Embedded Systems and VLSI Design
3	Electrical and Electronics Engineering	Electrical Power Systems

2.0 Eligibility for Admissions

2.1 Admission to the above program shall be made subject to the eligibility, qualifications and specialization prescribed by the University from time to time.

2.2 Admissions shall be made on the basis of merit rank obtained by the qualifying candidate in GATE or PGECET or on the basis of any other order of merit approved by the University, subject to reservations prescribed by the university from time to time.

3.0 Award of Degree

3.1 A student shall be declared eligible for the award of the M.Tech degree, if he/she pursues a course of study and completes it successfully for not less than two academic years (Four Semesters) and not more than four academic years.

3.2 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/her admission, shall forfeit his/her seat in M.Tech course.

4.0 Attendance

4.1 The minimum instruction for each semester is 90 days.

4.2 A candidate shall be deemed to have eligible to write End Semester University examinations if he/she has put in a minimum of 75% of attendance in aggregate of all the subjects.

4.3 Condonation of shortage of attendance up to 10% i.e. 65% and above, and below 75% may be given by the College academic committee.

4.4 Condonation of shortage of attendance shall be granted only on genuine and valid reasons on representations by the candidate with supporting evidence to the college principal.

4.5 A candidate shall not be promoted to the next semester unless he/she fulfills the attendance requirements of the previous semester.

4.6 A stipulated fee shall be payable towards condonation of shortage of attendance.

5.0Evaluation

5.1 The performance of the candidate in each semester shall be evaluated subject-wise, with a maximum of 100 marks for theory subject and 100 marks for Laboratory, on the basis of Internal Evaluation and End Semester University Examination.

5.2 For theory subjects 60 marks shall be awarded based on the performance in the End Semester University Examination and 40 marks shall be awarded based on the Internal Evaluation. The internal evaluation shall be based on two midterm examinations. First midterm examination shall be conducted for the first half of the syllabus in the middle of the semester and second midterm examination shall be conducted for the second half of the syllabus towards the end of the semester. A weightage of 0.75 for better score and 0.25 for the other score will be considered for awarding the sessional marks in both the midterm examinations. Each midterm examination shall be conducted for duration of 120 minutes with 4 questions to be answered out of 4 questions.

5.3 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 performance in Laboratory as Internal assessment.

5.4 Laboratory examination for M.Tech courses must be conducted with two Examiners, one of them being Laboratory Class Teacher and second examiner shall be appointed by the Principal from the panel of examiners submitted by the Head of the Department.

5.5 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 University Examination and a minimum aggregate of 50% of the total marks in the End Semester University Examination and Internal Evaluation taken together.

5.6 In case the candidate does not secure the minimum academic requirement in any subject he has to reappear for the End Semester University Examination in that subject.

5.7 There shall be a seminar presentation at the end of 3rd semester. For seminar, a student under the supervision of a faculty member, shall collect the literature on a relevant 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 consists of Head of the Department, supervisor and two other senior faculty members of the department. For Seminar there will be only internal evaluation of 100 marks. A candidate has to secure a minimum of 50% to be declared successful.

6.0Evaluation of Project Work/Dissertation

6.1 The work on the project shall be initiated in the beginning of 3rd semester and the duration of the project is for 3rd and 4th semesters.

6.2 A candidate is permitted to register for the Project Work after satisfying the attendance requirement of all the subjects (theory and practical) of 1st and 2nd semesters.

6.3 A Project Review Committee (PRC) shall be constituted with Principal/his nominee as chair person, Head of the Department and one other senior faculty member of the concerned department apart from the guide. The concerned Head of the Department will be the convener for all the PRC meetings.

6.4 A candidate has to submit, in consultation with his project supervisor, the title, objective and plan of action of his project work (Based on a publication in a peer Reviewed Journal) to the Project Review Committee for its approval before the second semester end examinations. After obtaining the approval of the PRC the student can initiate the Project work after the second semester end examinations.

6.5 Every candidate shall work on projects approved by the PRC of the college.

6.6 If a candidate wishes to change his supervisor or topic of the project he can do so with approval of the PRC. However, the PRC shall examine whether the change of topic/supervisor leads to a major

change of his initial plans of project proposal. If so, his date of registration for the project work starts from the date of change of Supervisor or topic as the case may be.

6.7 A candidate shall submit status report in two stages at least with a gap of 3 months between them.

6.8 A candidate shall be allowed to submit the project report only after fulfilling the attendance requirements of all the semesters with the approval of PRC and not earlier than 40 weeks from the date of registration of the project work. For the approval of PRC the candidate shall submit the draft copy of thesis to the Head of the Department and shall make an oral presentation before the PRC.

6.9 The Candidate is desired to publish the work/accepted to be published in a journal or presented in a national/international conference/seminar of repute and relevance in order to submit the Project Report /dissertation.

6.10 Three copies of the dissertation/Project Report certified by the supervisor and the concerned Head of the Department in the prescribed form shall be submitted to the College. Once a student fails to submit the dissertation within the stipulated period of four semesters, extension of time up to one more year may be permitted by the Principal with recommendation of the College Academic Council. Beyond this period, extension may be given with the permission of the university by collecting the prescribed fee.

6.11 The dissertation shall be adjudicated by an external examiner nominated by the Vice Chancellor from among the panel of examiners submitted by the Principal in consultation with the concerned Head of the Department.

6.12 The Viva voce examination shall be conducted at the end of 3rd semester (Project work Part-A) and at the end of 4th semester or later depending on the completion of the project

6.13 The viva-voce examination shall be conducted by a board consisting of the supervisor, Head of the Department and the examiner who adjudicated the Dissertation.

The Board shall jointly report candidates work as:

A. Excellent

B. Good

C. Satisfactory

D. Unsatisfactory

Head of the Department shall coordinate and make arrangements for the conduct of viva-voce examination. If the report of the viva-voce is unsatisfactory, the candidate will retake the viva-voce examination within six months. If he fails to get a satisfactory report at the second viva-voce examination, the candidate may be asked to submit a new project proposal to PRC.

7.0Award of Class

7.1 After a student has satisfied the requirements prescribed for the completion of the course and is eligible for the award of M. Tech. Degree he shall be placed in one of the following three classes:

Class Awarded	**% of marks to be secured**
First Class with Distinction	75% and above(Without any Supplementary Appearance) and 'A' grade in project
First Class	Below 75% but not less than 60% and A or B or C grade in Project
	75% and above (With Supplementary Appearance) and A or B or C grade in Project
Second Class	Below 60% but not less than 50% and A or B or C grade in Project

(The marks in internal evaluation and end semester University examination shall be shown separately in the marks memorandum and also the project grade)

8.0General

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

8.2 In case of any doubt or ambiguity in the interpretation of the above rules, the decision of the University is final.

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

Sri Krishnadevaraya University College of Engineering and Technology : Anantapur
Department of Electrical and Electronics Engineering

M.Tech I Year I Semester Course Structure

S.No.	Abbreviation	Subject	Periods / Week		C	Marks		
			L	T/P		Internal	External	Total
1.	ACS	Advanced Control Systems	4	-	4	40	60	100
2.	APA	Advanced Power System Analysis	4	-	4	40	60	100
3.	PSD	Power System Dynamics and Control	4	-	4	40	60	100
4.	ANT	Advanced Numerical Techniques	4	-	4	40	60	100
5.	PSP	Power System Planning and Control	4	-	4	40	60	100
6.	MPL	Machines & Power Systems Lab	-	4	2	40	60	100
7.	MVL	MATLAB/LAB VIEW Lab	-	4	2	40	60	100
		TOTAL	20	8	24	280	420	700

M.Tech I Year II Semester Course Structure

S.No.	Abbreviation	Subject	Periods / Week		C	Marks		
			L	T/P		Internal	External	Total
1.	APP	Advanced Power System Protection	4	-	4	40	60	100
2.	HFD	HVDC & FACTS Devices	4	-	4	40	60	100
3.	PSD	Power System Deregulation	4	-	4	40	60	100
4.	E-I	Elective-I 1. Reactive Power Control and Managemnet 2. Power Quality issues and Improvement 3. EHVAC Transmission	4	-	4	40	60	100
5.	E-II	Elective-II 1. Advanced Digital Signal Processing 2. Embedded Systems 3. Renewable Energy Sources & Smart Grid	4	-	4	40	60	100
6.	PSL	Power System Simulation Lab	-	4	2	40	60	100
7.	MCL	Micro-controller Lab	-	4	2	40	60	100
		TOTAL	20	8	24	280	420	700

L – Lecture, T – Tutorial, P - Practical

M.Tech II Year I Semester Course Structure

SUBJECTS	CREDITS	MAX.MARKS		TOTAL	Min.Marks/grades to pass
	C	Int.	Ext.		
Seminar	6	100	-	100	50
Project Part - A	8	-	-	-	-

M.Tech II Year II Semester Course Structure

SUBJECTS	CREDITS	MAX.MARKS		TOTAL	Min.Marks/grades to pass
	C	Int.	Ext.		
Project Part - B Grades:A,B,C,D A- Excellent B- Good C- Satisfactory D- Unsatisfactory	18	-	-	-	A/B/C

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SR58101 – ADVANCED CONTROL SYSTEMS

Unit I

Introductory matrix algebra and linear vector space. State space representation of systems. Linearization of a non - linear System. Solution of state equations. Evaluation of State Transition Matrix (STM) - Simulation of state equation using MATLAB/ SIMULINK program.

Unit II

Similarity transformation and invariance of system properties due to similarity transformations. Minimal realization of SISO, SIMO, MISO transfer functions. Discretization of a continuous time state space model. Conversion of state space model to transfer function model using Fadeeva algorithm.

Unit III

Fundamental theorem of feedback control - Controllability and Controllable canonical form - Pole assignment by state feedback using Ackermann's formula – Eigen structure assignment problem.

Unit IV

Linear Quadratic Regulator (LQR) problem and solution of algebraic Riccati equation using eigenvalue and Eigen vector methods, iterative method. Controller design using output feedback.

Unit V

Observability and observable canonical form - Design of full order observer using Ackermann's formula - Bass Gura algorithm.

Duality between controllability and observability - Full order Observer based controller design. Reduced order observer design.

Unit VI

Internal stability of a system. Stability in the sense of Lyapunov, asymptotic stability of linear time invariant continuous and discrete time systems. Solution of Lyapunov type equation.

Text Books:

1. K. Ogata, Modern Control Engineering, Prentice Hall, India 1997
2. T. Kailath, T., Linear Systems, Prentice Hall, Englewood Cliffs, NJ, 1980.
3. N. K. Sinha, Control Systems, New Age International, 3rd edition, 2005**.**

References:

1. Panos J Antsaklis, and Anthony N. Michel, Linear Systems, New - age international (P) LTD. Publishers, 2009.
2. John J D'Azzo and C. H. Houpis , "Linear Control System Analysis and Design Conventional and Modern", McGraw - Hill Book Company, 1988.
3. B.N. Dutta, Numerical Methods for linear Control Systems - , Elsevier Publication, 2007.
4. C.T.Chen Linear System Theory and Design - PHI, India.
5. Richard C. Dorf and Robert H. Bishop, Modern Control Systems, 11th Edition, Pearson Edu, India, 2009.

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SR58102 – ADVANCED POWER SYSTEM ANALYSIS

UNIT-I:

Admittance Model and Network Calculations- Branch and Node Admittances, Mutually Coupled Branches in Y_{BUS} - An Equivalent Admittance Network, Modification of Y_{BUS} - Network Incidence Matrix and Y_{BUS} - Method of Successive Elimination -Node Elimination - Triangular Factorization, Sparsity and Near Optimal Ordering.

UNIT-II:

Impedance Model and Network Calculations, the BUS Admittance and Impedance Matrices - Thevenin's Theorem and Z_{BUS} - Algorithms for building Z_{BUS} Modification of existing Z_{BUS} - Calculation of Z_{BUS} elements from Y_{BUS} - Power Invariant Transformations, Mutually Coupled Branches in Z_{BUS}.

UNIT-III:

Gauss Seidel method, N-R Method, Decoupled method- Fast decoupled method, comparison between power flow solutions. DC load flow.

UNIT-IV:

Z_{BUS} Method in Contingency Analysis - Adding and Removing Multiple Lines-Piecewise Solution of Interconnected Systems-Analysis of Single Contingencies - Analysis of Multiple Contingencies - Contingency Analysis of DC Model - System Reduction for Contingency and Fault Studies.

UNIT-V:

Fault Analysis: Symmetrical faults-Fault calculations using Z_{BUS}- Fault calculations using Z_{BUS} equivalent circuits

UNIT-VI

Selection of circuit breakers- Unsymmetrical faults-Problems on various types of faults.

TEXT BOOK:

1. John J.Grainger and W.D. Stevenson- "Power System Analysis" - T.M.H.Edition.

REFERENCE:

1. Olle. L.Elgard- "Electrical Energy Systems Theory"-T.M.H.Edition.

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SR58103 – POWER SYSTEM DYNAMICS AND CONTROL

Unit I

Basic concepts: Power system stability states of operation and system security system dynamics problems system model analysis of steady State stability and transient stability, simplified representation of Excitation control.

Unit II

Modeling of synchronous machine: synchronous machine park's Transformation Transformation of flux linkages, Transformation of stator voltage equations and rotor equations.

Unit III

Analysis of steady state performance, per unit quantities - Equivalent circuits of synchronous machine - determination of parameters of equivalent circuits.

Excitation system: Excitation system modeling, excitation systems block Diagram system representation by state equations.

Unit IV

Dynamics of a synchronous generator connected to infinite bus: system model Synchronous machine model, stator equations rotor equations, Synchronous machine model with field circuit and with field circuit and one equivalent damper winding on q axis (model 1.1), calculation of Initial conditions.

Unit V

Analysis of single machine system: small signal analysis with block diagram Representation characteristic equation and application of routh Hurwitz criterion

Synchronizing and damping torque analysis, small signal model State equations.

Unit VI

Application of power system stabilizers: basic concepts in applying PSS, Control signals, structure and tuning of PSS, washout circuit, dynamic compensator analysis of single machine infinite bus system with and without PSS.

Text book

1. Power system dynamics K.R. PADIYAR, B.S. Publications Hyderabad

Reference

1. Power system control and stability P.M. Anderson and A.A. Fouad John wiley sons

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SR58105 – POWER SYSTEM PLANNING AND CONTROL

UNIT-I: Economic operation

Load forecasting - Unit commitment – Economic dispatch problem of thermal units – Gradient method - Newton's method – Base point and participation factor method.

UNIT-II: Unit Commitment

Optimal Unit Commitment, Constraints in unit commitment, spinning reserve, Thermal Unit Constraints, Other constraints, Hydro constraints, Must Run, Fuel constraints.Solution methods of Unit Commitment - Priority-List methods, Dynamic Programming solution. Backward DP Approach, Forward DP Approach, Restricted Search Ranges, Strategies- Reliability considerations

UNIT-III: Hydrothermal co-ordination

Short-term hydrothermal scheduling problem - Gradient approach – Hydro units in series - pumped storage hydro plants-hydro - scheduling using dynamic programming and linear programming.

UNIT-IV: Generation with limited energy supply

Introduction, Take-or-Pay Fuel Supply Contract, Composite Generation production Cost Function, Solution by Gradient Search Techniques, Hard limits and Slack Variables.

UNIT-V: Production Cost Models

Introduction- uses and types- production costing using load duration curves- outages considered.Probabilistic Production Cost Programs-Probabilistic Production Cost Computations- Simulating Economic Scheduling with the Unserved Load Method- The Expected Cost Method-Practical Problems.

UNIT-VI: Interchange of Power & Energy

Economic interchange between interconnected utilities – Inter utility energy evaluation – Power pools – Transmission effects and Issues: Limitations – Wheeling.

Text Books:

1. Allen J.Wood and Wollenberg B.F., 'Power Generation Operation and control', John Wiley & Sons, 2nd Edition.

Reference Books:

1. Nagrath, I.J. and Kothari D.P., 'Modern Power System Analysis', TMH, New Delhi, 1980.
2. D.P.Kothari & J.S.Dhillon, Power System Optimization , PHI,2004

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SR58104 – Advanced Numerical Techniques

Unit-I

Function Interpolation: Lagrange representation, Newton representation (divided differences, finite differences), osculating polynomials, piecewise polynomial functions.

Unit-II

Numerical Integration: formulas of interpolatory kind, stability and convergence; Newton-Cotes formulas, Gaussian quadrature.

Unit-III

Numerical Differentiation: formulas of interpolatory kind, instability; application examples.

Unit-IV

Ordinary Differential Equations, Initial Value problems: equations and systems of equations of order 1. Single-step explicit methods, single-step implicit methods, multistep linear methods, predictor-corrector methods.

Unit-V

Boundary Problems: shoot method for the linear problem and for non-linear problems, finite-difference methods.

Unit-VI

Partial Differential Equations.

TextsBooks:

1. Richard L. Burden and J. Douglas Fairs, Numerical Analysis, Brooks/Cole 2001.
2. G. D. Smith, Numerical solutions to Partial Dif erential Equations, Brunel University, Clarendon Press, Oxford, 1985.
3. R. Mitchell and S. D. F. Griffiths, The Finite Difference Methods in Partial Differential Equations, Wiley, 1980.
4. Joe D. Hoffman, Numerical methods for Engineers and Scientists, McGrow Hill, 1993.
5. D. Kincaid and W. Cheney, Numerical Analysis: Mathematics of Scientific Computing, 3rd Ed., AMS, 2002.
6. K. E. Atkinson, An Introduction to Numerical Analysis, Wiley, 1989.

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ADVANCED POWER SYSTEM PROTECTION

UNIT-I: **Static Relays**

Advantages of static relays - Basic construction of static relays – Level detectors – Replica impedance-mixing circuits-general equation for two input phase and amplitude comparators –Duality between amplitude and phase comparator.

UNIT-II: Amplitude Comparators

Circulating current type and opposed voltage type rectifier bridge comparators – Direct and Instantaneous comparators.

Phase Comparators: Coincidence circuit type block spike phase comparator, techniques to measure the period of coincidence – Integrating type – Rectifier and vector product type phase comparators.

UNIT-III: Static over Current Relays

Introduction - Instantaneous over current relay – Time over current relays - Basic principles-Definite time and Inverse definite time over current relays.

Static Differential Relays

Analysis of static differential relays – static relay schemes – Dual bias transformer differential protection – Harmonic restraint relay.

Static Distance Relays: Static impedance – reactance - MHO and angle impedance relay sampling comparator – realization of reactance and MHO relay using a sampling comparator.

UNIT-IV: Multi –Input Comparators

Conic section characteristics – Three input amplitude comparator – Hybrid comparator – Switched distance schemes – Polyphase distance schemes-Phase fault scheme – Three phase scheme – combined and ground fault scheme.

UNIT-V: Microprocessor Based Protective Relays-I

Over current relays – Impedance relays – Directional relay – Reactance relay (Block diagram and flow chart approach only).

UNIT-VI: Microprocessor Based Protective Relays-II

Generalized mathematical expression for distance relays - Measurement of resistance and reactance – MHO and offset MHO relays – Realization of MHO characteristics – Realization of Offset MHO characteristics (Block diagram and flow chart approach only) Basic principle of Digital computer relaying.

Text Books:

1. T.S.Madhava Rao, Power system Protection static relay, Tata McGraw Hill, 2nd Edition, 1989.

Reference Books:

1. Badri Ram and D.N.Vishwakarma, Power system Protection and Switchgear, Tata McGraw Hill, First Edition -1995.

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FUNDAMENTALS OF HVDC & FACTS DEVICES

UNIT-I INTRODUCTION

comparison of AC and DC Transmission systems, Application of D.C. Transmission, Types or DC links, Typical layout of a HVDC converter station. HVDC converters, pulse number, Analysis of & phase Bridge circuit with and without overlap, converter Bridge characteristics, equivalent circuits or Rectifier and inverter configurations Twelve pulse converters.

UNIT -II CONVERTER AND HVDC SYSTEM CONTROL

Principles of DC links control, converter control characteristics, system control Hierarchy, Firing angle control, current and extinction Angle control starting and stopping of DC link.

UNIT -III HARMONICS, FILTERS AND REACTIVE POWER CONTROL

Introduction, generation of Harmonics, AC and DC Filters, Reactive power requirements at steady state.

UNIT -IV POWER FLOW ANALYSIS IN AC/DC SYSTEMS

Introduction, Modeling of DC/AC converters, controller equations, solutions of AD/DC load flow-simultaneous approach and sequential approach.

UNIT – V FACTS CONCEPTS

Flow of power in AC parallel paths and Meshed systems, Basic types of FACTS controllers.

UNIT - VI STATIC SHUNT AND SERIES COMPENSATORS

Objectives of shunt compensation, Methods of controllable VAR generation, Static VAR compensators.

Objectives of series compensation, variable impedance type-thyristor switched series capacitors (TCSC), switching converter type series compensators power angle characteristics – Basic operating control Schemes.

Introduction, unified power flow controller (UPFC), Basic operating principle, Independent real and reactive power flow controller, control structure.

TEXT BOOKS:

1. HVDC power Transmission systems by K.R. Padiyar, Wiley Eastern Limited
2. Understanding of FACTS by N.G. Hingorani & L. Gyugyi, IEEE Press.
3. Flexible AC Transmission Systems (FACTS) Young Huasong & Alian T. hons, The Institution of Electrical Engineers, IEE Power and Energy Series 30.
4. An Introduction to: Reactive Power Control and Voltage Stability in Power Transmission Systems by Abhijit Chakrabarti, D. P. Kothari, A. K. Mukhopadhyay and Abhinandan De, Eastern Economy Edition, 2010.

REFERENCE BOOKS:

1. EHV - AC, HYDC Transmission & Distribution Engineering, S.Rao,Khanna publishers, 3rd edition 2003.
2.Power Electronic Control in Electrical Systems- E Acha. VG Agelidis & O Anaya-Lara. THE Miller – Elsevier, 2009.

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POWER SYSTEM DEREGULATION

UNIT I: Key Issues in Electric Utilities

Introduction – Restructuring models – Independent System Operator (ISO) – Power Exchange - Market operations – Market Power – Standard cost – Transmission Pricing – Congestion Pricing – Management of Inter zonal/Intra zonal Congestion.

UNIT II: Open Access Same-time Information System (OASIS)

Structure of OASIS - Posting of Information – Transfer capability on OASIS.

UNIT III: Available Transfer Capability (ATC)

Transfer Capability Issues – ATC – TTC – TRM – CBM Calculations – Calculation of ATC based on power flow.

UNIT IV: Electricity Pricing

Introduction – Electricity Price Volatility Electricity Price Indexes – Challenges to Electricity Pricing – Construction of Forward Price Curves – Short-time Price Forecasting.

UNIT V: Power System Operation in Competitive Environment

Introduction – Operational Planning Activities of ISO- The ISO in Pool Markets – The ISO in Bilateral Markets – Operational Planning Activities of a GENCO.

Market Power**:** Introduction - Different types of market Power – Mitigation of Market Power - Examples.

UNIT VI: Transmission Congestion Management

Introduction - Transmission Cost Allocation Methods : Postage Stamp Rate Method - Contract Path Method - MW-Mile Method – Unused Transmission Capacity Method - MVA-Mile method – Comparison of cost allocation methods.

Text Books:

1. Kankar Bhattacharya, Math H.J. Boller and Jaap E.Daalder, Operation of Restructured Power System, Kulwer Academic Publishers, 2001.
2. Mohammad Shahidehpour and Muwaffaq alomoush, Restructured Electrical Power Systems, Marcel Dekker, Inc., 2001.

Reference Books:

1. Loi Lei Lai, Power System Restructuring and Deregulation, John Wiley & Sons Ltd., England.

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REACTIVE POWER CONTROL AND MANAGEMENT
ELECTIVE -I

UNIT I: Load Compensation

Objectives and specifications – Reactive power characteristics – Inductive and capacitive approximate biasing – Load compensator as a voltage regulator – Phase balancing and power factor correction of unsymmetrical loads - Examples.

UNIT II: Steady – State Reactive Power Compensation in Transmission System

Uncompensated line – Types of compensation – Passive shunt and series and dynamic shunt compensation – Examples.

Transient State Reactive Power Compensation in Transmission Systems:

Characteristic time periods – Passive shunt compensation – Static compensations - Series capacitor compensation – Compensation using synchronous condensers – Examples.

UNIT-III: Reactive Power Coordination

Objective – Mathematical modeling – Operation planning – Transmission benefits – Basic concepts of quality of power supply – Disturbances - Steady – state variations – Effects of under Voltages – Frequency – Harmonics, radio frequency and electromagnetic interferences.

UNIT-IV : Demand Side Management

Load patterns – Basic methods load shaping – Power tariffs - KVAR based tariffs penalties for voltage flickers and Harmonic voltage levels.

Distribution Side Reactive Power Management

System losses – Loss reduction methods – Examples – Reactive power planning – Objectives – Economics Planning capacitor placement – Retrofitting of capacitor banks.

UNIT-V: User Side Reactive Power Management

KVAR requirements for domestic appliances – Purpose of using capacitors – Selection of capacitors – Deciding factors – Types of available capacitor, characteristics and Limitations.

UNIT-VI: Reactive Power Management in Electric Traction Systems and Arc Furnaces

Typical layout of traction systems – Reactive power control requirements – Distribution transformers - Electric arc furnaces – Basic operations- Furnaces transformer – Filter requirements – Remedial measures – Power factor of an arc furnace.

Text Books:

1. J.E.Miller, Reactive Power Control in Electric Power Systems, John Wiley and Sons, 1982.
2. D.M.Tagare, Reactive power Management, Tata McGraw Hill, 2004 (Units V to VIII).

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POWER QUALITY ISSUES AND IMPROVEMENTS
ELECTIVE-I

UNIT-I INTRODUCTION:
Power quality, Voltage quality, Concern, power quality Evaluation procedure, Transients,
Long-duration- short duration-voltage variations, voltage imbalance, wave form distortion, voltage fluctuation, power frequency variations, power quality terms, CBEMA and ITI curves.

UNIT-II VOLTAGE SAGS AND INTERRUPTIONS:
Sources of sagas and interruptions, Estimating voltage sag performance, fundamental principles of protection, solutions at the end-user level, Motor-starting sags, and utility system fault-clearing issues.

UNIT-III TRANSIENT OVER VOLTAGES:
Sources of over voltages, principles of over voltage protection, devices for over voltage protection, utility capacitor-switching transients, utility system lightning protection, switching transient problems with loads.

UNIT-IV FUNDAMENTALS OF HARMONICS:
Harmonic Distortion, voltage versus current distortion, harmonics versus transients, power system quantities under non sinusoidal conditions, Harmonic indices, Harmonic sources from commercial loads, Harmonic sources from Industrial loads, system response characteristics, effects of harmonic distortion.

UNIT-V EVALUATION OF HARMONICS:
Harmonic distortion evaluations, Principles of Controlling Harmonics, Harmonic studies, Devices for Controlling Harmonic Distortion.

UNIT-VI LONG-DURATION VOLTAGE VARIATIONS:
Principles of regulating the voltage, Devices for voltage regulation, utility voltage regulator Application, capacitors for voltage regulation flicker- power quality measuring equipment

TEXT BOOKS:
1. Electrical Power Systems Quality, Roger C. Dugan, Mark F. McGranaghan, Surya Santoso, H.Wayne Beaty, 2nd Edition, TMH Education Pvt. Ptd.
2. Power quality by C. Sankaran, CRC Press

REFERENCE BOOKS:
1. Electrical systems quality Assessment by J. Arrillaga, N.R. Watson, S. Chen, John Wiley & Sons
2. Understanding Power quality problems by Math H. J. Bollen IEEE Press
3. Power system harmonic analysis by J. Arrillaga, John Wiley & Sons
4. Power quality in electrical systems by Alexander Kusko, Marc T. Thompson .

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EHV AC TRANSMISSION
ELECTIVE -I

UNIT – I: Preliminaries

Necessity of EHV AC transmission – Advantages and problems – Power handling capacity and line losses- Mechanical considerations – Resistance of conductors – Properties of bundled conductors – Bundle spacing and bundle radius - Examples.

UNIT – II: Line and Ground Reactive Parameters

Line inductance and capacitances – Sequence inductances and capacitances – Modes of propagation – Ground return – Examples.

Voltage Gradients of Conductors:

Electrostatics – Field of sphere gap – Field of line changes and properties – Charge – potential relations for multi-conductors – Surface voltage gradient on conductors – Distribution of voltage gradient on sub-conductors of bundle – Examples.

UNIT – III: Corona Effects – I

Power loss and audible noise (AN) – corona loss formulae – Charge voltage diagram – Generation, characteristics - Limits and measurements of AN – Relation between 1-phase and 3 -phase AN level – Examples.

Corona Effects – II

Radio interference (RI) - Corona pulses generation, properties, limits – Frequency spectrum – Modes of propagation – Excitation function – Measurement of RI, RIV and excitation functions – Examples.

UNIT – IV: Electro Static Field

Electrostatic field: calculation of electrostatic field of EHV/AC lines – Effect on humans, animals and plants – Electrostatic induction in unenergised circuit of double - circuit line – Electromagnetic interference - Examples.

UNIT- V: Traveling Wave Theory

Traveling wave expression and solution - Source of excitation - Terminal conditions - Open circuited and short circuited end - Reflection and refraction coefficients - Lumped parameters of distributed lines - Generalized constants - No load voltage conditions and charging current.

UNIT –VI: Voltage Control

Power circle diagram and its use – Voltage control using synchronous condensers – Cascade connection of shunt and series compensation – Sub synchronous resonance in series capacitor – Compensated lines – Static VAR compensating system.

Text Books:

1. R. D. Begamudre, EHVAC Transmission Engineering, New Age International (p) Ltd.
2. S. Rao, HVAC and DC Transmission.

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ADVANCED DIGITAL SIGNAL PROCESSING
ELECTIVE-II

UNIT-I:

Short introduction, Analog to digital and Digital to Analog conversion, sampled and Hold circuit, Continuous time Fourier Transforms.Discrete-time signals and systems, Discrete-time Fourier transform- its properties and applications, Fast Fourier Transform (in time-domain and Frequency domain) , IDFT and its properties.

UNIT-II: z- Transform:

Definition and properties, Rational z-transforms, Region of convergence of a rational z- Transform, The inverse z- Transform, Z-Transform properties, Computation of the convolution sum of finite-length sequences, The transfer function

UNIT-III Digital Filter Structures:

Block Diagram representation, Equivalent structures, Basic FIR Digital Filter structures, Basic IIR Digital Filter structures, Realization of Basic structures using MATLAB, All pass filters, Computational complexity of Digital filter structures.

UNIT IV: **IIR Digital Filter Design:**

Preliminary considerations, Bilinear transformation method of IIR Filter design, Design of low pass IIR Digital filters, Design of High pass, Band pass and band stop IIR digital filters, Spectral Transformations of IIR filter, IIR digital filter design using MATLAB, Computer aided design of IIR digital filters.

UNIT V:FIR Digital Filter Design:

Preliminary considerations, FIR filter design based on windowed Fourier series, Computer aided design of Equiripple Linear phase FIR filters, Design of Minimum phase FIR filters, FIR digital filter design using MATLAB, Design of computationally efficient FIR digital filters.

UNIT VI: Analysis of Finite word length effects:

The quantization process and errors, quantization of Fixed point numbers, Quantization of floating point numbers, Analysis of coefficient quantization effects, Analysis of arithmetic round off errors, Low sensitivity digital filters, Reduction of product round off errors using error feedback, Round off errors in FFT algorithms.

Text Books:

1. S.K. Mitra**, Digital Signal Processing**-, Tata McGraw-Hill, Third Edition, 2006.
2. B.P. Lathi, **Principle of Signal Processing and Linear Systems**-, Oxford International Student Version, 2009.
3. M. Mondal and A Asif, **Continuous and Discrete Time Signals and Systems**, Cambridge, 2007.

References:

1. Li Tan, **Digital Signal Processing- Fundamentals and Applications**-, Indian reprint, Elsevier, 2008.
2. Alan V. Oppenheim, Ronald W. Schafer, and John R.Buck, **Discrete- Time Signal Processing**-, Pearson Edu, 2008.

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EMBEDDED SYSTEMS
ELECTIVE-II

UNIT- I OVERVIEW OF EMBEDDED SYSTEM

Embedded System, types of Embedded System, Requirements of Embedded System, Issues in Embedded software development, Applications. Structural units in a processor, Processor selection, Memory devices, Memory selection, Memory Allocation & Map; Interfacing.

UNIT-II DEVICES & BUSES FOR DEVICE NETWORKS

I/O devices, Timer & Counter devices, Serial Communication, Communication between devices using different buses.

UNIT-III DEVICE DRIVERS AND INTERRUPT SERVICING MECHANISM

Device drives, Parallel and serial port device drives in a system, Interrupt servicing mechanism, context and periods for context switching, Deadline and Interrupt Latency.

UNIT -IV PROGRAM MODELING CONCEPTS

Program elements, Modeling Processes for Software Analysis, Programming Models, Modeling of Multiprocessor Systems. Software engineering practices-Software algorithm Concepts, design, implementation, testing, validating, debugging, Software Management and maintenance.

UNIT-V HARDWARE AND SOFTWARE CO-DESIGN

Embedded system design and co design issues in software development, design cycle in development phase for Embedded System, Use of ICE & Software tools for development of ES, Issues in embedded system design.

UNIT -VI RTOS

OS Services, I/O Sub Systems, Real Time and Embedded Systems OS, Interrupt routines in RTOS Environment, RTOS Task Scheduling Models.

TEXT BOOKS:

1. Embedded Systems : Architecture, Programming and Design – Rajkamal, TMH, 2003.
2. Programming for Embedded System: DreamTech Software Team-John Wiley -2002

REFERENCES:

1.Embedded Systems & Robots by Subrata Ghoshal, CENGAGE

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RENEWABLE ENERGY SOURCES AND SMART GRID
ELECTIVE-II

UNIT I:

Introduction, problems associated with fossil fuel based energy options, need for alternate sources of energy, present energy scenario, renewable energy sources.

Basic characteristics of sunlight – Solar energy resource – Photovoltaic cell - characteristics – Equivalent circuit – Photo voltaic for battery charging.

UNIT II:

Wind source – Wind statistics - Energy in the wind – Aerodynamics - Rotor types – Forces developed by blades - Aerodynamic models – Braking systems – Tower - Control and monitoring system – Power performance.

UNIT III:

Micro-hydel electric systems – Power potential – Scheme layout – Generation efficiency and turbine part flow - Isolated and parallel operation of generators – Geothermal - tidal and OTEC systems.

UNIT – IV

Introduction, Ageing Assets and Lack of Circuit Capacity, Thermal Constraints, Operational Constraints, Security of Supply, National Initiatives, Early Smart Grid Initiatives, Active Distribution Networks, Virtual Power Plant, Other Initiatives and Demonstrations, Overview of the Technologies Required for The Smart Grid.

Data Communications: Introduction, Dedicated and Shared communication Channels, Switching Techniques, Circuit Switching, Message switching, Packet Switching. Communication Channels, Wired communication, Optical Fibre, Radio Communication, Cellular Mobile Communication, Layered Architecture and Protocols, The ISO/OSI Model, TCP/IP.

Communication Technologies: IEEE 802 Series, Mobile Communications, Multi Protocol Label Switching, Power line communication, Standards for Information Exchange, Standards for smart metering, Modbus, DNP3, IEC61850

UNIT- VI

Introduction, Smart metering – evolution of electricity metering, key components of smart metering, smart meters: an overview of the hardware used - signal acquisition, signal conditioning, analogue to digital conversion, computation, input/output, communication.

Communication infrastructure and protocols for smart metering – Home are network, Neighborhood area Network, Data Concentrator, meter data management system. Protocols for communication. Demand side Integration – Services provided by DSI, Implementation of DSI, Hardware support, Flexibility Delivered by Prosumers from the Demand side, System support from DSI.

Text Books:

1. S.P. Sukhatme, Solar Energy – Thermal Collection and Storage, Tata-Mc Graw Hill New Delhi, 1984.
2. G.D.Rai, Non-conventional Energy Sources, Khanna Publishers, New Delhi, 1999.
3. El Wakil, Power Plant Technology, Tata Mc Graw Hill, New York, 1999.
4. Smart Grid, Janaka Ekanayake, Liyanage, Wu, Akihiko Yokoyama, Jenkins, Wiley Publications, 2012.
5. Smart Grid: Fundamentals of Design and Analysis, James Momoh, Wiley, IEEE Press., 2012.

Reference Books:

1. Arora and S.Domkundwar, A Course in Power Plant Engineering, Dhanpat Rai and Sons, New Delhi 1998.
2. Ed Nejat Vezirog, Alternate Energy Sources, Mc Graw Hill, New York.
3. John F.Walker & Jenkins. N , Wind Energy Technology, John Wiley and sons, Chichester , U.K , 1997.
4. Van Overstraeton and Mertens R.P, Physics, Technology and Use of Photovoltaics, Adam Hilger, Bristol,1996.

Freries LL , Wind Energy Conversion Systems, Prentice Hall, U.K., 1990.