ACADEMIC REGULATIONS,

COURSE STRUCTURE AND SYLLABI

FOR

M.TECH.
POWER SYSTEM CONTROL AND AUTOMATION
(Electrical & Electronics Engineering)

2012-2013

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

GAYATRIVIDYAPARISHADCOLLEGE OF ENGINEERING
(AUTONOMOUS)
ACCREDITED BY **NAAC** WITH **A** GRADE WITH A **CGPA** OF **3.47/4.00**
AFFILIATED TO JNTUK, KAKINADA
MADHURAWADA, VISAKHAPATNAM 530048

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.

F O R E W O R D

It is three years since the G.V.P College of Engineering has become Autonomous with the appreciation and support of erstwhile JNTU and the fast growing new JNTU-K. The college is progressing well with its programmes and procedures drawing more and more accolades from its sister autonomous colleges and higher authorities. The student community, also could adjust well to the new system without any acrimony.

The College is enriched with the experience of running the Post-graduate programmes under Autonomous stream. It is a moment of pride and achievement that the first Autonomous batch of M.Tech in some branches left the college to the satisfaction of all concerned including firms visited the campus for placements.

Another larger than canvas picture is foreseen for the programmes wherein the college is getting the funds through TEQIP – II for up-scaling the PG education and research under sub- component 1.2. In this connection two new PG Programmes have been introduced in Mechanical, Electrical Engineering.

New set of Boards of Studies, Academic council and Governing Body has further strengthened our hands by endorsing the practices and suggested recommendations.
The encouragement given by the affiliating JNTU-K has left no task insurmountable.

Principal

MEMBERS ON THE BOARD OF STUDIES
IN
ELECTRICAL & ELECTRONICS ENGINEERING

- Head of the Department.

- Prof. C. Radhakrishna, Director, Global Energy Consulting Engineers Pvt. Ltd., Secunderabad.
- Dr. K. Shanti Swarup, Department of Electrical Engineering, IIT Madras.
- Dr. Ch. Saibabu, Professor in Electrical Engg. and Director (Admns), JNTU-K, Kakinada.
- Dr. M. Sydulu, Professor of EEE, NIT, Warangal.
- Dr. K.A. Gopala Rao, Professor of Electrical Engg. AU College of Engg., Visakhapatnam.
- Dr. N.K. Kishore, Professor of Electrical Engg., IIT Kharagpur.
- Sri M.V.R. Krishna Rao, AGM (ETL), Visakhapatnam Steel Plant.
- Sri T. Srinivas Kishore, Assistant Professor, GMRIT, Rajam.

All faculty of the department.

ACADEMIC REGULATIONS

(Effective for the students admitted into
First year M.Techfrom the Academic Year 2012-2013)

The M.Tech.Degree of JNTU-KAKINADA shall be recommended to be conferred on candidates who are admitted to the program and fulfill all the requirements for the award of the Degree.

1.0 ELGIBILITY 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 will normally be 20 weeks with 5 days a week. A working day shall have 7 periods each of 50minutes.

3.0 COURSES OF STUDY:

M.TECH. COURSES	INTAKE
Chemical Engineering	18
Computer Science and Engineering	18
CAD/CAM	18
Infrastructural Engineering and Management	18
Structural Engineering	18
Power System Control and Automation	18
Embedded Systems & VLSI Design	18
Communications & Signal Processing	18
Software Engineering	18
Power Electronics & Drives	18
Computer Aided Analysis And Design (CAAD)	18

4.0 ATTENDANCE:

The attendance shall be considered subject wise.

a. A candidate shall be deemed to have eligibility to write 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 should re-register and repeat those subjects as and when 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.

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

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 End Semester Examination.

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

b. For the theory subjects 60 marks shall be awarded based on the performance in the End Semester Examination, 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 Mid–Term Examinations of30 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 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, 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 consists of the Head of the Department, supervisor 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. For Seminar in I, II Semesters in case of the course structure of having 5 Theory + 2 Labs. + 1 Seminar, a student has to deliver a seminar talk in each of the subjects in that semester which shall be evaluated for 10 marks each and average marks allotted shall be considered. A letter grade from A to C corresponding to the marks allotted may be awarded for the two credits so as to keep the existing structure and evaluation undisturbed.

A – Excellent	(average marks $\geq$ 8)
B – Good	(6$\leq$ average marks <8)
C – Satisfactory	(5$\leq$ average marks <6)

If a satisfactory grade is not secured, one has to repeat in the following semester.

f. In case the candidate does not secure the minimum academic requirement in any subject (as specified in 4.0 a, 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 are less than 50% and he has failed in the end examination. In such a case the candidate must re-register for the subject (s) and secure required minimum attendance. Attendance in the re-registered subject (s) has to be calculated separately to become eligible to write the end- examination in the re-registered subject(s). In the event of re-registration, the internal marks and end examination marks obtained in the previous attempt are nullified.

g. In case the candidates secure less than the required attendance in any subject(s), he shall not be permitted to appear for the End Examination in that subject(s). He shall re-register for the subject(s) when next offered.

h. 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 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 to submission.

b. A Central Research Committee (CRC) shall be constituted with a Senior Professor as chair person, Heads of all the Departments which are offering the M.Tech programs and two other senior faculty members

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 approval of DRC. However, the Departmental Project Review 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.
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. The dissertation shall be adjudicated by one examiner selected by the Principal. For this HOD shall submit in consultation

with the supervisor a panel of 5 examiners, who are experienced in that field.

j. If the report of the examiner is not favorable, the candidate shall revise and resubmit the dissertation, in a time frame as prescribed by the CRC. If the report of the examiner is unfavorable again, the dissertation shall be summarily rejected then the candidate shall change the topic of the Project and option shall be given to change the supervisor also.

k. If the report of the examiner is favorable, 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 candidate's work as:

   A. Excellent
   B. Good
   C. Satisfactory

7.0 AWARD OF DEGREE AND CLASS :

A candidate shall be eligible for the respective 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.

% of Marks secured	Class Awarded
70% and above	First Class with Distinction
60% and above but less than 70%	First Class
50% and above but less than 60%	Second Class

The marks in internal evaluation and end examination shall be shown separately in the marks memorandum.

The grade of the dissertation shall also 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 will 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 such cases.

9.0 TRANSITORY REGULATIONS:

A candidate who has discontinued or has been detained for want of attendance or who has failed after having studied the subject iseligible for admission to the same or equivalent subject(s) as and when subject(s) is/are offered, subject to 6.0 e and 2.0

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

I SEMESTER:

COURSE CODE	THEORY/LAB	L	P	C
10EE2101	Power System Operation and Control	4	-	4
10EE2102	Advanced Power System Protection	4	-	4
10EE2103	Microprocessors and Microcontrollers	4	-	4
10EE2104	High VoltageDC Transmission	4	-	4
10EE2105	Distribution Automation	4	-	4
	Elective – I	4	-	4
10EE2106	Advanced Digital Signal Processing			
10EE2107	Digital Control Systems			
10EE2108	Power System Reliability			
10EE2109	*Power Systems Lab*	-	*3*	*2*
	Total	**24**	**3**	**26**

II SEMESTER:

COURSE CODE	THEORY/LAB	L	P	C
10EE2110	Power Systems Control and Stability	4	-	4
10EE2111	Flexible AC Transmission Systems	4	-	4
10EE2112	Extra High Voltage Transmission	4	-	4
10EE2113	Neural and Fuzzy Systems	4	-	4
10EE2114	Real Time Control of Power Systems	4	-	4
	Elective – II	4	-	4
10EE2115	Operation Research			
10EE2116	Embedded systems			
10EE2117	Power Quality			
10EE2118	*Electrical Systems Simulation Lab*	-	*3*	*2*
	Total	**24**	**3**	**26**

III SEMESTER

COURSE CODE	THEORY/LAB	L	P	C
	Commencement of Project Work			
10EE21S1	SEMINAR	**-**	**-**	**2**

IV SEMESTER

COURSE CODE	THEORY/LAB	L	P	C
10EE2119	PROJECT WORK DISSERTATION / THESIS EXCELLENT/GOOD/SATISFACTORY/ NON-SATISFACTORY	**-**	**-**	**56**

POWER SYSTEM OPERATION AND CONTROL

Course Code: 10EE2101 **L P C**
4 0 4

UNIT-I

Commitment problem:

Introductions to UCP, thermal AND Hydral constraintsin unit-commitment: Priority list scheme method, unit commitment problem solution by priority list scheme method.

UNIT-II

Unit commitment problem solutions by Dynamic programming approach. Introduction, advantages of DP method over priority list scheme, Back ward DP approach, forward DP approach algorithm and their flow charts solution UCP using Dynamic Program method.

UNIT-III

Load Frequency Control-I:

Necessity of keeping frequency constant. Definition of control area, single area control, Block diagram representation of an isolated Power System, Steady State analysis, Dynamic response-Uncontrolled case.

UNIT-IV

Proportional plus Integral control of single area and its block diagram representation, steadystate response, load frequency control and Economic dispatch control.

UNIT-V

Load Frequency Control-II:

Load frequency control of 2-area system: uncontrolled case and controlled case, tie-time bias control.

UNIT-VI

Optimal LF control-steady state representation, performance index and optimal parameter adjustment.

UNIT-VII

Generation with limited Energy supply:

Take-or-pay fuel supply contract, compositegeneration production cost function. Solution by gradient search techniques, Hard limits andslack variables, Fuel scheduling by linear programming.

UNIT-VIII

Interchange Evaluation and Power Pools Economy Interchange, Economy interchange Evaluation, Interchange Evaluation with unit commitment, Multiple Interchange contracts. After-the-fact production costing, Transmission Losses in transaction Evaluation, other types of Interchange, power pools.

Text Books:

1. A.J.Wood and B.F.Wollenberg, "Power Generation, "Operation and Control", 2nd edition, John Wiley, India, 2008.

Reference Books:

1. O.I. Elgerd, "Electrical Energy Systems Theory, 2nd edition, TMH, 1983.
2. I.J.Nagrath & D.P.Kothari, "Modern Power System Analysis", 3rdedition,Tata Mc Graw- Hill Publishing Company Ltd, 2011.

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ADVANCED POWER SYSTEM PROTECTION

Course Code: 10EE2102

L	P	C
4	0	4

UNIT-I

Primary and back up protection, current transformers for protection, potential transformer, review of electromagnetic relays, static relays.

UNIT-II

Over current relays time current characteristic, current setting, time setting, directional relay, static over current relays.

UNIT-III

Distance protection:

impedance, reactance, mho, angle impedance relays. Input quantities forvarious types of distance relays, effect of arc resistance on the performance of distance relays, selection of distance relays. MHO relay with blinders, quadrilateral relay, ellipticalrelay. Restricted mho, impedance directional, reactance relays. Swiveling characteristics.

UNIT-IV

Compensation for correct distance measurement, reduction of measuring units switched schemes. Pilot relaying schemes. Wire pilot protection, circulating current scheme, balanced voltage scheme, transley scheme , carrier current protection, phase comparison carrier current protection, carrier aided distance protection.

UNIT-V

Digital relaying algorithms, differential equation technique, discrete fourier transform technique, walsh-hadamard transform technique, rationalized harr transform technique, removal of dc offset.

UNIT-VI

Introduction to Microprocessors:

Review of microprocessors and interfacing. single chip microcomputers programmable interval timer, A/D converter.

UNIT-VII

Microprocessor based protective relays:

over current, directional, impedance, reactance relays. Generalized mathematical expressions for distance relays, mho and offset mho relays, quadrilateral relay.

UNIT-VIII

Microprocessor implementation of digital distance relaying algorithms.

Text Books

1. Badri Ram & D.N.Vishwakarma, "Power System Protection & Switchgear", 2nd edition, Tata McGraw – Hill, 2011.
2. Madhava Rao T.S, "Power System Protection, Static Relays with Microprocessor and Applications", 2nd edition, TMH, 2008.

Reference Books

1. RavindraNath. B and Chandar PHI. "Power System Protection and Switchgear"New Age International 2007.

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MICROPROCESSORS AND MICROCONTROLLERS

Course Code: 10EE2103

L	P	C
4	0	4

UNIT-I

8086/8088 Processors:

Introduction to 8086 Microprocessors, Architecture, Addressing modes, Instruction set, Register Organization, Assembler directives.

UNIT-II

Hardware description:

Pindiagram signal description min & max modes, bus timing, ready & wait states, 8086 based micro computing system.

UNIT-III

Special features AND Related Programming:

Stack structure of 8086, Memory segmentation, Interrupts, ISR, NMI, MI and interrupt Programming, Macros.

UNIT-IV

Advanced Microprocessors:

Intel 80386 programming model, memory paging, Introduction to 80486, Introduction to Pentium Microprocessors and special Pentium pro features**.**

UNIT-V

Basic peripherals AND Their Interfacing:

Memory Interfacing (DRAM) PPI- Modes of operation of 8255, Interfacing to ADC and DAC.

UNIT-VI

Special Purpose Programmable Peripheral Devices and Their interfacing :

Programmable interval timer , (8253) , PIC 8259A, display controller Programmable communication Interface 8251, USART and Exercises.

UNIT-VII

Microcontrollers:

Introduction to Intel 8 bit &16 bit Microcontrollers, 8051- Architecture, Memory organization, Addressing Modes and exercises

UNIT-VIII

Hardware description of 8051:

Instruction formats, Instruction sets, interrupt Structure & interrupt priorities, Port structures & Operation linear counter Functions, different Modes of Operation and Programming examples.

Text Books :-

1. Barry b Brey, "The Intel Microprocessors" Architecture Programming & Interfacing, 7th edition, PHI, 2006
2. A.K. Ray and B.M. Kishore, "Advanceed Microprocessors", 3rd edition, Thomson publishers, 2006
3. Kentrith J Ayala, " The 8051 Microcontrollers" Architecture Programming & Application, 2nd edition, Thomson publishers, 2009.

Reference Books:-

1. DOUGLAS V.Hall, "Microprocessors & Interfacing Programming & Hardware", 2nd edition, TMH Publishers, 2010.
2. C.R.Sarma, "Microprocessors & Microcontrollers", 1st edition, Premier Publications, 2008.

HIGH VOLTAGED.C. TRANSMISSION

Course Code: 10EE2104

L	P	C
4	0	4

UNIT-I

H.V.D.C. Transmission:

General considerations, Power Handling Capabilities of HVDC Lines, Basic Conversion principles, static converter configuration.

UNIT-II

Static Power Converters:

3-pulse, 6-pulse and 12-pulse converters, converter station and Terminal equipment, commutation process, Rectifier and inverter operation, equivalent circuit for converter – special features of converter transformers.

UNIT-III

Harmonics in HVDC Systems, Harmonic elimination, AC and DC filters.

UNIT-IV

Control of HVDC Converters and systems:

constant current, constant extinction angle and constant Ignition angle control. Individual phase control and equidistant firing angle control, DC power flow control.

UNIT-V

Interaction between HV AC and DC systems – Voltage interaction, Harmonicinstability problems and DC power modulation.

UNIT-VI

Multi-terminal DC links and systems;

series, parallel and series-parallel systems, their operation and control.

UNIT--VII

Transient Overvoltages in HVDC systems:

Over voltages due to disturbances on DC side, over voltages due to DC and AC side line faults

UNIT-VIII

Converter Faults and Protection in HVDC Systems:

Converter faults, over Current protection - valve group, and DC line protection. Overvoltage protection of converters, surge arresters.

Text Books:

1.E.W. Kimbark; "Direct current Transmission", Wiley Inter Science – NewYork, 1971

2. K.R.Padiyar; "HVDC Power Transmission Systems", 2nd edition, New Age International Publishers, 2010.

Reference Books :

1.J.Arillaga; H.V.D.C.Transmission", PeterPeregrinusltd., London UK 1983.

2. E.Uhlman; "Power Transmission by Direct Current", Springer Verlag, Berlin Helberg – 1985.

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DISTRIBUTION AUTOMATION

Course Code: 10EE2105

L	P	C
4	0	4

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:

DA Capabilities, Automation System Computer Facilities, Management Processes, Information Management, System Reliability Management, System Efficiency Management, Voltage Management, Load Management.

UNIT-III

Communication Systems for DA:

DA Communication Requirements, Communication Reliability, Cost Effectiveness, Data Rate Requirements, Two Way Capability, Ability to communicate during outages and faults, Ease of operation and Maintenance, Conforming to the Architecture of Data Flow

UNIT-IV

Communication Systems used in DA:

Distribution Line Carrier (Power line carrier), Ripple Control, Zero Crossing Technique, Telephone, Cable TV, Radio, AM Broadcast,FM SCA, VHF Radio, UHF Radio,microwave,satellite. Fibre Optics, Hybrid Communication Systems, Communication systems used in Field Tests.

UNIT-V

Technical Benefits:

DA Benefit Categories, Capital Deferred Savings, Operation and Maintenance Savings, Interruption Related Savings, Customer-related Savings, Operational Savings, Improved Operation, Function Benefits, Potential Benefits for Functions, Function-shared Benefits, Guidelines for Formulation of Estimating Equations.

UNIT-VI

Parameters Required, Economic Impact Areas, Resources for determining benefits Impact on Distribution Integration System of Benefits into Economic Evaluation.

UNIT-VII

Economic Evaluation Methods:

Development and Evaluation of Alternate Plans, Select Study Area, Select Study Period, Project Load Growth, Develop Alternatives, Calculate Operation and Maintenance Costs, Evaluate Alternatives.

UNIT-VIII

Economic Comparison of Alternate Plans, Classification of Expenses and Capital Expenditures, Comparison of Revenue Requirements of Alternative Plans, Book Life and Continuing Plant Analysis, Year-by-Year Revenue Requirement Analysis, Short Term Analysis,end of Study Adjustment, Break Even Analysis, Sensitivity Analysis, Computational Aids.

Text Book:

1. D. Bassett, K. Clinard, J. Grainger, S. Purucker, and D. Ward, "Tutorial Course: Distribution Automation", *IEEE Tutorial Publication 88EH0280-8-PWR*, 1988.

Reference Book :

1. IEEE Working Group on "Distribution Automation"

ADVANCED DIGITAL SIGNAL PROCESSING

Course Code:10EE2106

L	P	C
4	0	4

UNIT-I: IIR Digital Filter Structure

Block diagram representation-Equivalent Structure-IIR digital filter Structures Allpass Filters-tunable IIR Digital Filters-IIR tapped cascaded Lattice Structures-Computational complexity of digital filter structures.

UNIT – II: FIR Digital Filter Structure

Block diagram representation-Equivalent Structure-FIR digital filter Structures FIR cascaded Lattice structures-Parallel-Digital Sine-cosine generator-Computational complexity of digitalfilter structures.

UNIT-III: IIR Digital filter design

Preliminary considerations-Bilinear transformation method of IIR filter design-design of Low pass high pass, Band pass, and Band stop- IIR digital filters-Spectral transformations of IIR filters

UNIT-IV: FIR Digital filter design

FIR filter design-based on Windowed Fourier series-design of FIR digital filters with least–mean-Square-error-constrained Least-square design of FIR digital filters

UNIT-V: DSP algorithm implementation

Computation of the discrete Fourier transform-Number representation-Arithmetic operations-handling of overflow-Tunable digital filters-function approximation.

UNIT-VI Analysis of finite Word length effects

The Quantization process and errors-Quantization of fixed -point and floating –point Numbers-Analysis of coefficient Quantization effects –

Analysis of Arithmetic Round-off errors-Dynamic range scaling-signal-to- noise ratio in Low -order IIR filters-Low-Sensitivity Digital filters

UNIT-VII Errors Analysis of Digital Filters

Reduction of Product round-off errors using error feedback-Limit cycles in IIR digital filters- Round-off errors in FFT Algorithms.

UNIT VIII: Power Spectrum Estimation

Estimation of spectra from Finite Duration Observations signals – Non-parametric methodsfor power spectrum Estimation – parametric method for power spectrum Estimation-Estimationof spectral form-Finite duration observation of signals-Non-parametric methods for power spectrum estimation-Walsh methods-Blackman & torchy method.

Text Books:

1. Sanjit K. Mitra, "Digital signal processing", 3rd edition, TMH publisher, 2007.
2. Alan V. Oppenheim, Ronald W. Shafer "Discrete Time Signal Processing" 2nd edition, Pearson, 1996.
3. John G. Proakis, "Digital Signal Processing principles, algorithms and Applications", 3rd edition, PHI publisher, 2002.

Reference Books:

1. S. Salivahanan, A.Vallavaraj, C. Gnanapriya, "Digital Signal Processing" 2nd edition, TMH publisher, 2009.
2. LourensR. Rebinar & Bernold, "Theory and Applications of Digital Signal Proceesing", 1st edition, PHI publisher, 2010.
3. Andrew Auntonian, "Digital Filter Analysis, Design and Applications", 2nd edition, TMH publisher, 2005.

DIGITAL CONTROL SYSTEMS

Course Code:10EE2107

L	P	C
4	0	4

UNIT- I : Sampling and Reconstruction

Introduction, sample and hold operations, Sampling theorem, Reconstruction of original sampled signal to continuous-time signal. Z – TRANSFORMS: Introduction, Linear difference equations, pulse response, Z – transforms, Theorems of Z – Transforms, the inverse Z – transforms, Modified Z- Transforms.

UNIT-II: Z-Plane Analysis Of Discrete-Time Control System

Z-Transform method for solving difference equations; Pulse transforms function, block diagram analysis of sampled – data systems, mapping between s-plane and z-plane: Primary strips and Complementary Strips.

UNIT-III:State Space Analysis

State Space Representation of discrete time systems, Pulse Transfer Function Matrix solving discrete time state space equations, State transition matrix and it's Properties, Methods for Computation of State Transition Matrix, Discretization of continuous time state – space equations

UNIT-IV:Controllabilityand Observability

Concepts of Controllability and Observability, Tests for Controllability and Observability. Duality between Controllability and Observability, Controllability and Observability conditions for Pulse Transfer Function.

UNIT-V:Stability Analysis

Stability Analysis of closed loop systems in the Z-Plane. Jury stablility test – Stability Analysis by use of the Bilinear Transformation and Routh Stability criterion. Stability analysis using Liapunov theorems.

UNIT-VI: Design of Discrete Time Control System By Conventional Methods

Design of digital control based on the frequency response method – Bilinear Transformation and Design procedure in the w-plane, Lead, Lag and Lead-Lag compensators and digital PID controllers. Design digital control through deadbeat response method.

UNIT-VII: State Feedback Controllers and Observers

Design of state feedback controller through pole placement – Necessary and sufficient conditions, Ackerman's formula. State Observers – Full order and Reduced order observers.

UNIT- – VIII Linear Quadratic Regulators

Min/Max principle, Linear Quadratic Regulators, Kalman filters, State estimation through Kalman filters, introduction to adaptive controls.

Text books:

1. K. Ogata, "Discrete Time Control systems", 2nd edition, Pearson, Education, 2010.
2. M. Gopal, "Digital Control and State Variable Methods", 1st edition, TMH, 2010.

Reference books:

1. Kuo, "Digital Control Systems",. 2nd edition, Oxford University Press, 2003.
2.M. Gopal , "Digital Control Engineering", 1st edition, TMH publisher, 2008.

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POWER SYSTEM RELIABILITY

	L	P	C
Course Code: 10EE2108	**4**	**0**	**4**

UNIT- I: Generating System Reliability Analysis – I

Generation system model – capacity outage probability tables – Recursive relation for capacitive model building – sequential addition method – UNIT- removal – Evaluation of loss of load and energy indices – Examples

UNIT-II: Generating System Reliability Analysis – II

Frequency and Duration methods – Evaluation of equivalent transitional rates of identical and non-identical UNIT-s – Evaluation of cumulative probability and cumulative frequency of non-identical generating UNIT-s – 2-level daily load representation - merging generation and load models – Examples

UNIT-III: Operating Reserve Evaluation

Basic concepts - risk indices – PJM methods – security function approach – rapid start and hot reserve UNIT-s – Modelling using STPM approach.

UNIT-IV: Bulk Power System Reliability Evaluation

Basic configuration – conditional probability approach – system and load point reliability indices – weather effects on transmission lines – Weighted average rate and Markov model – Common mode failures.

UNIT-V: Inter Connected System Reliability Analysis

Probability array method–Two inter connected systems with independent loads – effects of limited and unlimited tie capacity– imperfect tie – Two connected Systems with correlated loads – Expression for cumulative probability and cumulative frequency.

UNIT-VI: Distribution System Reliability Analysis – I (Radial configuration)

Basic Techniques – Radial networks – Evaluation of Basic reliability indices, performance indices - load point and system reliability indices – customer oriented, loss and energy oriented indices – Examples

UNIT-VII: Distribution System Reliability Analysis – II (Parallel configuration)

Basic techniques – inclusion of bus bar failures, scheduled maintenance – temporary and transient failures – weather effects – common mode failures – Evaluation of various indices – Examples

UNIT-VIII: Substations and Switching Stations:

Effects of short-circuits - breaker operation – Open and Short-circuit failures – Active and Passive failures – switching after faults – circuit breaker model – preventive maintenance – exponential maintenance times.

Text Books:

1. Roy Billinton and Ronald N. Allan, "Reliability Evaluation of Power Systems", 2nd edition, Springer, New York and London, 1996.
2. J. Endrenyi, John Wiley and Sons, "Reliability Modeling in Electric Power Systems", 1st edition, 1978.

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POWER SYSTEMS LAB

Course Code: 10EE2109

L	P	C
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1.Fault Analysis of 3-phase Alternator

2.Determination of Xd and Xq of 3-phase Salient Pole Synchronous Motor

3. IDMT (Inverse Definite Minimum Time) Relay Characteristics

4. Determination of breakdown strength of oil by variable distance electrodes.

5. Determination of Transmission Line Parameters.

6. Fault Analysis (LL, LG, LLL) of Transmission Lines.

7. Determination of Earth Resistance under various conditions.

8. Milli Volt Drop Test (Calibration of Tongtester).

9. Breakdown Characteristic of Sphere Air Gap.

10. Breakdown Characteristic of Plane Rod Gap.

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POWER SYSTEM CONTROL AND STABILITY

Course Code: 10EE2110

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UNIT-I: The Elementary Mathematical Model

A Classical model of one machine connected to an infinite bus – Classical model of multimachine system –Problems – Effect of the excitation system on Transient stability.

UNIT-II: System Response to Small Disturbances

The unregulated synchronous Machine – Effect of small changes of speed – modes of oscillation of an unregulated Multimachine system – regulated synchronous machine – voltage regulator with one time lag – Governor with one time lag – Problems.

UNIT-III: Dynamic Stability

Concept of Dynamic stability – effect of excitation on Dynamic stability – examination of dynamic stability by Routh's criterion

UNIT-IV: Power System Stabilizers

Introduction to supplementary stabilizing signals- Block diagram of the linear system- Approximate model of the complete exciter – generator system – Lead compensation.

UNIT-V: Excitation systems

Excitation system response – Non-continuously regulated systems – continuously regulated systems – Excitation system compensation – state space description of the excitation system- simplified linear model – effect of excitation on generator power limits.

UNIT-VI: Types of Excitation systems

Type –2 system: rotating rectifier system, Type-3 system: Static with terminal potential and current supplies - Typex–4 system: non – continuous acting - Block diagram representation – state space modeling equations of these types.

UNIT-VII: Stability Analysis using direct method of Lyapunov

Review of Lyapunov's stability theorems of non-liner systems using energy concept – Method based on first concept – Method based on first integrals – Quadratic forms – Variable gradient method – Zubov's method – Popov's method, Lyapunov function for single machine connected to infinite bus.

UNIT-VIII: Introduction to Voltage Stability

What is voltage stability –Factors affecting voltage instability and collapse – Comparison of Angle and voltage stability – Analysis of voltage instability and collapse – Integrated analysis of voltage and Angle stability – Control of voltage instability

Text Book:

1. P.M. Anderson, A.A. Fouad, "Power System Control and Stability", 2nd Edition ,IOWA State University Press, Galgotia Publications, 2002.

Reference Books:

1. M.A. Pai, "Power System Stability – Analysis by the direct method of Lyapunov", North Holland Publishing Company, Newyork, 1981.
2. K.R. Padiyar, "Power System Dynamics (Stability & Control)", 2nd edition, B.S.Publications, 2002.

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FLEXIBLE AC TRANSMISSION SYSTEMS

Course Code: 10EE2111

L	P	C
4	0	4

UNIT-I

FACTS Concepts:

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 FACT Scontrollers.

UNIT-II

Voltage Source Converters:

Single phase, three phase full wave bridge converters, transformer connections for 12 pulse, 24 and 48 pulse operation.

UNIT-III

Three level voltage source converter, pulse width modulation converter, basic concept of current source Converters, and comparison of current source converters with voltage source converters.

UNIT-IV

Static Shunt Compensation:

Objectives of shunt compensation, mid pointvoltage regulation voltage Instability prevention, improvement of transient stability, Power oscillation damping,

UNIT-V

Methods of controllable var generation, variable impedance type static var generators switching converter type var generators hybrid var generators.

UNIT- VI

SVC and STATCOM:

The regulation and slope transfer function and dynamic performance, transient stability enhancement and power oscillation damping operating point control and summary of compensator control.

UNIT-VII

Static Series Compensators:

concept of series capacitive compensation, improvement of transient stabillity, power oscillation damping.

UNIT-VIII

Functional requirements. GTO thyristor controlled series Capacitor (GSC), thyristor switched series capacitor (TSSC), and thrystor controlled series capacitor (TCSC) control schemes for GSC TSSC and TCSC.

Text Book :

1. N.G. Hingorani and L. Guygi,"Understanding FACTS Devices", IEEE Press Publications 2000.

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EXTRA HIGH VOLTAGE TRANSMISSION

Course Code: 10EE2112

L	P	C
4	0	4

UNIT-I

E.H.V. A.C. Transmission Line Trends and Preliminary Aspects: Standard transmission voltages – Power handling capacities and line losses – Mechanical aspects.

UNIT-II

Calculation of Line Resistance and Inductances:
Resistance of conductors, Temperature rise of conductor and current carrying capacity. Properties of bundled conductors and geometric mean radius of bundle, Inductance of two conductor lines and multi – conductor lines, Maxwell's coefficient matrix.

UNIT-III

Line Capacitance Calculation:
Capacitance of two conductor line, and capacitance of multi conductor lines, potential coefficients for bundled conductor lines, sequence inductances and capacitances and diagonalization.

UNIT-IV

Calculation of electro static field traveling waves due to corona – Audible Noise due to corona, its generation, characteristics and limits, measurement of audible Noise.

UNIT-V

Surface Voltage Gradient on conductors:
Surface gradient on 2 conductor bundle and Cosine Law, Maximum surface voltage gradient of bundle with more than 3 sub-conductors, Mangoldt formula.

UNIT-VI

Corona:

Corona in EHV lines – Corona loss formulae – Attenuation of traveling waves due to corona – Audible Noise due to corona, its generation, characteristics and limits, Measurement of Audible Noise.

UNIT-VII

Power Frequency Voltage Control:

Problems at power frequency, Generalized Constants, No load voltage conditions and charging currents, Voltage Control using synchronous condenser, Cascade connection of components : Shunt and Series compensation, Sub Synchronous Resonance in series – capacitor compensated lines.

UNIT-VIII

Static Reactive Compensation Systems:

Introduction, SVC Schemes, Harmonics injected into network by TCR, Design of Filters for suppressing harmonics injected into the system.

Text Book:

1. Rakosh Das Begamudre, "Extra High Voltage AC Transmission Engineering –Wiley Eastern ltd., New Delhi – 1987.

Reference Book:

1. Turan Gonen, " Electric Power Transmission System Engineering", John Wiley, 1998
2. EHV Transmission line reference book – Edison Electric Institute (GEC) 1986
3. Turan Gonen, " Electric Power Transmission System Engineering: Analysis and Design" CRC Press, 2009

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NEURAL AND FUZZY SYSTEMS

Course Code: 10EE2113

L	P	C
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UNIT–I:Introduction to Neural Networks

Introduction, Humans and Computers, Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Hodgkin-Huxley Neuron Model, Integrate-and-Fire Neuron Model, Spiking Neuron Model, Characteristics of ANN, McCulloch-Pitts Model, Historical Developments, Potential Applications of ANN.

UNIT-II: Essentials of Artificial Neural Networks:

Artificial Neuron Model, Operations of Artificial Neuron, Types of Neuron Activation Functions, ANN Architectures, Classification Taxonomy of ANN – Connectivity, Neural Dynamics (Activation and Synaptic), Learning Strategy (Supervised, Unsupervised, Reinforcement), Learning Rules, Types of Application

UNIT–III: Feed Forward Neural Networks

Introduction, Perceptron Models: Discrete, Continuous and Multi-Category, Training Algorithms: Discrete and Continuous Perceptron Networks, Perceptron Convergence theorem, Limitations of the Perceptron Model, Applications. Multilayer Feed forward Neural Networks Credit Assignment Problem, Generalized Delta Rule, Derivation of Backpropagation (BP) Training, Summary of Backpropagation Algorithm, Kolmogorov Theorem, Learning Difficulties and Improvements.

UNIT-IV: Associative Memories

Paradigms of Associative Memory, Pattern Mathematics, Hebbian Learning, General Concepts of Associative Memory (Associative Matrix, Association Rules, Hamming Distance, The Linear Associator, Matrix Memories, Content Addressable Memory), Bidirectional

Associative Memory (BAM) Architecture, BAM Training Algorithms: Storage and Recall Algorithm, BAM Energy Function, Proof of BAM Stability Theorem, Architecture of Hopfield Network: Discrete and Continuous versions, Storage and Recall Algorithm, Stability Analysis, Capacity of the Hopfield Network.

UNIT- V: Self-Organizing Maps (SOM) and Adaptive Resonance Theory (ART)

Introduction, Competitive Learning, Vector Quantization, Self-Organized Learning Networks, Kohonen Networks, Training Algorithms, Linear Vector Quantization, Stability-Plasticity Dilemma, Feed forward competition, Feedback Competition, Instar, Outstar, ART1, ART2, Applications.

UNIT–VI: Classical & Fuzzy Sets

Introduction to classical sets - properties, Operations and relations; Fuzzy sets, Membership, Uncertainty, Operations, properties, fuzzy relations, cardinalities, membership functions.

UNIT-VII: Fuzzy Logic System Components

Fuzzification, Membership value assignment, development of rule base and decision making system, Defuzzification to crisp sets, Defuzzification methods.

UNIT- VIII: Applications Neural network applications:

Process identification, Function Approximation, control and Process Monitoring, fault diagnosis and load forecasting.

Fuzzy logic applications: Fuzzy logic control and Fuzzy classification.

Text Books:

1. Rajasekharan and Rai, "Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications", 1st Edition, PHI Publication, 2008.
2. Jacek M. Zurada, "Introduction to Artificial Neural Systems", 1st Edition, Jaico Publishing House, 2007.

Reference Books:

1. N. Yadaiah and S. BapiRaju, "Neural and Fuzzy Systems": Foundation, Architectures and Applications, Pearson Education, 2010.
2. James A Freeman and Davis Skapura, "Neural Networks", 1st edition, Pearson Education, 2011.
3. Simon Hykins, "Neural Networks",1st edition, Pearson Education, 2005.
4. C.Eliasmith and CH.Anderson, "Neural Engineering: Computation, representation and Dynamics in Neurobiological Systems", 1st edition PHI, 2004.
5. Bart Kosko, "Neural Networks and Fuzzy Logic System", 1st edition, PHI Publications, 2007.

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REAL TIME CONTROL OF POWER SYSTEMS

Course Code: 10EE2114

L	P	C
4	0	4

UNIT-I

Power system control-operation**,** operator activities, control center, elements of computer control system

UNIT-II

Supervisory and control functions – data acquisition, monitoring and event processing,control functions

UNIT-III

Time tagged data, disturbance data collection and analysis, reports and calculations

UNIT-IV

Man-machine communication – operators console, VDU display, operator dialogs, mimic diagrams, printing facilities

UNIT- V

Real time software – Classification of programs, Structure of real time programs, construction techniques and tools

UNIT-VI

Programming language requirements for process control

UNIT-VII

Computer control of power systems – Evolution, time scale of system control, online control,Software for state estimation

UNIT-VIII

Generation and load control, security analysis, Software coordination

Text Books:

1. Torsten Cegrell, “Power system Control-Technology”,Prentice Hall., 1986.
2. S. Bennett and D.A. Linkens,“Real Time Computer Control”, IEE Series., London Pcregrinus, 1984

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OPERATIONS RESEARCH

Course Code: 10EE2115

L	P	C
4	0	4

UNIT-I

Linear Programming Problem:

Formulation – Graphical method - Simplex method – Artificial variable techniques – Big-M tune –phase methods

UNIT-II

Duality theorem – Dual simplex method – Sensitivity analysis - effect of changes in cost coefficients, Constraint constants, Addition/Deletion of variables & constraints

UNIT-III

Transportation problem:

formulation – Initial basic feasible solution methods – Northwest, Least cost & Vogel's methods, MODI optimization - Unbalanced & degeneracy treatment

UNIT-IV

Assignment problem:

Formulation – Hungarian method – Variants of assignment problems, Sequencing problems – Flow shop sequencing – n jobs×2 machines sequencing - n jobs×3 machines sequencing – Job-shop sequencing – 2 jobs×m machines sequencing – Graphical methods.

UNIT-V

Game Theory:

Introduction - Terminology – Saddle point games - with out Saddle point games - 2×2 games, analytical method - 2×n and m×2 games – graphical method – dominance principle

UNIT-VI

Dynamic programming:

Bellman's principle of optimality – short route – capital investment – inventory allocation

UNIT-VII

Non linear optimization:

Single variable optimization problem – Unimodal function - Elimination methods – Fibinocci & Golden reaction methods - Interpolation methods - Quadratic & cubic interpotation method. Multi variable optimization problem – Direct research methods – Univariant method – Pattern search methods – Powell's , Hook-Jeaves & Rosen-brock's search method.

UNIT-VIII

Geometric programming:

Polynomial – Arithmetic – Seametric inequality – Unconstrained G.P – Constraint G.P with ≤ type constraint.

Simulation: Definition – Types-steps-Simulation of simple electrical systems – Advantages and Disadvantages

Text Books:

1. S.S. Rao, "Optimization theory & Applications", 3rd edition, Wiley, 2008.

2. S.D. Sharma, "Operations Research", 15th edition, Kedarnath and Ramnath, 2008.

3. Kausur& Kumar, "Operations Research", Springer Publishers,2010.

Reference Books:

1. M.C. Joshi & K.M. More Ugalya, "Optimization Techniques: Theory & Practice", 1st Edition, Narosa Publications, 2007.

2. Beweridze, “Optimization: Theory & Practice”, McGraw Hill, 2009.
3. Law & Kelton,“Simulation Modelling” & Analysis”, 3rd edition, TMH, 2009.
4. A.D. Belegundu , J.R. Chandrupata, “Optimization Concepts and Applications in Engineering”, 1st edition, Pearson Education, 2005.

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EMBEDDED SYSTEMS

Course Code: 10EE2116

L	P	C
4	0	4

UNIT-I

Embedded Computing:

Introduction, Complex Systems and Microprocessor, The Embedded System Design Process, Formalisms for System Design, Design Examples. (Chapter I from Text Book 1, Wolf)

UNIT-II

The 8051 Architecture:

Introduction, 8051 Micro controller Hardware, Input/Output Ports and Circuits, External Memory, Counter and Timers, Serial data Input/Output, Interrupts. (**Chapter 3 from Text Book 2, Ayala**)

UNIT-III

Basic Assembly Language Programming Concepts:

The Assembly Language Programming Process, Programming Tools and Techniques, Programming the 8051.Data Transfer and Logical Instructions. (**Chapters 4,5 and 6 from Text Book 2, Ayala**)

UNIT-IV

Arithmetic Operations, Decimal Arithmetic. Jump and Call Instructions, Further Details on Interrupts. (**Chapter 7 and 8 from Text Book 2, Ayala**)

UNIT-V

Applications:

Interfacing with Keyboards, Displays, D/A and A/D Conversions, Multiple Interrupts, Serial Data Communication. (**Chapter 10 and 11 from Text Book 2, Ayala**)

UNIT- VI

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
(**Chapter 6 and 7 from Text Book 3, Simon**)

UNIT-VII

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. (Chapter 8,9,10 and 11 from Text Book 3, Simon)

UNIT-VIII

Introduction to advanced architectures:
ARM and SHARC, Processor and memory organization and Instruction level parallelism; Networked embedded systems: Bus protocols, I^2C bus and CAN bus; Internet-Enabled Systems, Design Example-Elevator Controller.(Chapter 8 from Text Book 1, Wolf).

Text Books:

1. Wayne Wolf, "Computers as Components", Morgan Kaufman, 2010.
2. Kenneth J. Ayala, "The 8051 Microcontroller, Third Edition, Cenage Learning, 2010.
3. David E. Simon, "An Embedded Software Primer", Pearson Education, 2011.

Reference Books:

1. Jean. J. Labrosse,"Embedded System building blocks", 2nd edition, CMP publishers,1999.
2. Raj Kamal,"Embedded Systems: Architecture, Programming and Design", 2nd edition, TMH, 2008.
3. Ajay V Deshmukh, "Micro Controllers: Theory and Applications", TMH, 2004.
4. Frank Vahid, Tony Givargis, "Embedded System Design", John Wiley, 2011.
5. Raj kamal, "Microcontrollers: Architecture, Programming, Interfacing and System Design", 2nd edition, Pearson Education, 2011.

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POWER QUALITY

Course Code: 10EE2117 **L P C**
4 0 4

UNIT-I: Introduction:
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, Remedies to improve power quality, power quality monitoring

UNIT-II: Long Interruptions:
Interruptions – Definition – Difference between failure, outage, Interruptions – causes of Long Interruptions – Origin of Interruptions – Limits for the Interruption frequency – Limits for the interruption duration – costs of Interruption – Overview of Reliability evaluation to power quality, comparison of observations and reliability evaluation.

UNIT-III : Short Interruptions:
Short interruptions – definition, origin of short interruptions, basic principle, fuse 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-IV: Voltage sag – characterization – Single phase:
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.

UNIT-V:Voltage sag – characterization – Three phase:
Three phase faults, phase angle jumps, magnitude and phase angle jumps for three phase unbalanced sags, load influence on voltage sags.

UNIT- VI: PQ considerations in Industrial Power Systems:
Voltage sag – equipment behaviur of Power electronic loads, induction motors, synchronous motors, 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.

UNIT- VII: Mitigation of Interruptions and Voltage Sags:
Overview of mitigation methods – from fault to trip, reducing the number of faults, reducing the fault clearing time, changing the power system, installing mitigation equipment, improving equipment immunity, different events and mitigation methods. System equipment interface – voltage source converter, series voltage controller, shunt controller, combined shunt and series controller.

UNIT- VIII: Power Quality and EMC Standards:
Introduction to standardization, IEC Electromagnetic compatibility standards, European voltage characteristics standards, PQ surveys.

Text Book:
1. Math H J. Bollen. "Understanding Power Quality Problems", First Indian edition, IEEE Press, 2001.

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ELECTRICAL SYSTEMS SIMULATION LAB

Course Code: 10EE2118 **L P C**
- 0 2

1. Write program and simulate dynamical system of following models:
   a) I/O Model
   b) State variable model
   Also identify time domain specifications of each.
2. Obtain frequency response of a given system by using various methods:
   (a)General method of finding the frequency domain specifications.
   (b) Polar plot
   (c) Bode plot
   Also obtain the Gain margin and Phase margin.
3. Determine stability of a given dynamical system using following methods.
   a) Root locus
   b) Bode plot
   c) Nyquist plot
   d) Liapunov stability criteria
4. Transform a given dynamical system from I/O model to state variable model and vice versa.
5. Obtain model matrix of a given system, obtain its diagonalized form if exists or obtain Jordon Canonical form of system.
6. Write a program and implement linear quadratic regulator
7. Design a compensator for a given system for required specifications.
8. Conduct a power flow study on a given power system.
9. Design a PID controller.
10. Conduct a power flow study on a given power system network using Guass-Seidel iterative method.

11. Develop a program to solve Swing Equation.
12. Develop a Simulink model for a single area load frequency problem and simulate the same.
13. Develop a Simulink model for a two-area load frequency problem and simulate the same.
14. Design a PID controller for two-area power system and simulate the same.
15. PSPICE Simulation of Single phase full converter using RL&E loads.
16. PSPICE Simulation of Three phase full converter using RL&E loads.
17. PSPICE Simulation of Single phase AC Voltage controller using RL load.
18. PSPICE Simulation of Three phase inverter with PWM controller.
19. PSPICE Simulation of Resonant Pulse commutation Circuit.
20. PSPICE Simulation of Impulse Commutation Circuit.

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