SCHOOL OF CONTINUING AND DISTANCE EDUCATION

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY, ANANTAPUR

ELECTRICAL & ELECTRONICS ENGINEERING

B.TECH(CCC) III/IV THIRD YEAR

S.NO	CODE	SUBJECT	CREDITS
1	C3EE01	Power Systems	
2	C3EE02	Control Systems	
3	C3EE03	Microprocessor& Microcontrollers	
4	C3EE04	Power Electronics	
5	C3EE05	Electromechanics – II	
6	C3EE06	High Voltage Engineering	
7	C3EE07	Electromechanics Lab	
8	C3EE08	Control Systems Lab	

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C3 EE01- POWER SYSTEMS

UNIT-I Transmission line theory and performance:

Representation of lines, short, medium and long lines, rigorous solution for long line ABCD constants, Ferranti effect.

UNIT –II Power circle diagrams:

Receiving and sending end power circle diagrams, Determination of synchronous phase modifier capacity.

UNIT-III Voltage Control

Methods of voltage control, shunt capacitors and reactors, series capacitors, comparison between series and parallel capacitors, tap changing transformers, Booster transformers.

UNIT-IV Transients in power systems:

Traveling Waves – Attenuation, distortion, reflection, reflection and refraction coefficients.Lightenening phenomenon ,Protection against lightening, horn gap, surge diverters, rod gap, expulsion type lightening arresters.

UNIT-V Neutral grounding:

Effectively grounded systems, methods of neutral grounding
Solid grounding, earthing transformer

UNIT-VI

Symmetrical components:

3_Phase system,symmetrical components,representation of unbalanced voltages and currents in terms of symmetrical components,average 3-phase power in terms of symmetrical components.

Symmetrical fault calculations:

Representation of power systems,Perunit system,reactors,generator reactors,feeder reactors,bus bar reactors,calculation of 3-phase short circuit currents,concept of a short circuit of a bus.

UNIT-VII Unsymmetrical fault Analysis:

Positive, Negative and Zero sequence Networks. Unsymmetrical faults-LG, LL, LLG faults with and without fault impedance, -Problems.Zero sequence eqivivalent circuit of 3-phase transformers,phase shifting delta-Y transformers.

UNIT- VIII Power System Stability

Steady state stability, transient stability, swing equation, equal area criteria, critical clearing angle, point –by- point method, factors effecting transient stability, methods for improving steady state as well as transient stability.

TEST BOOKS:

1. Modern power system analysis by Nagrath and Kothari, Tata McGraw –Hill.

REFERENCE BOOKS

1. Electrical power systems by C.L.Wadhwa, New Age Publishers.
2. A course in electrical power by Soni Gupta Butnagar, Dhanpat Rai & sons publishers

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C3 EE02-CONTROL SYSTEMS

Objective :
In this course it is aimed to introduce to the students the principles and applications of control systems in every day life. The basic concepts of block diagram reduction, time domain analysis solutions to time invariant systems and also deals with the different aspects of stability analysis of systems in frequency domain and time domain.

UNIT – I INTRODUCTION

Concepts of Control Systems- Open Loop and closed loop control systems and their differences- Different examples of control systems- Classification of control systems, Feed-Back Characteristics, Effects of feedback.
Mathematical models – Differential equations, Impulse Response and transfer functions - Translational and Rotational mechanical systems

UNIT II TRANSFER FUNCTION REPRESENTATION

Transfer Function of DC Servo motor - AC Servo motor- Synchro transmitter and Receiver, Block diagram representation of systems considering electrical systems as examples -Block diagram algebra – Representation by Signal flow graph - Reduction using mason's gain formula.

UNIT-III TIME RESPONSE ANALYSIS

Standard test signals - Time response of first order systems – Characteristic Equation of Feedback control systems, Transient response of second order systems - Time domain specifications – Steady state response - Steady state errors and error constants – Effects of proportional derivative, proportional integral systems.

UNIT – IV STABILITY ANALYSIS IN S-DOMAIN

The concept of stability - Routh stability criterion – qualitative stability and conditional stability

Root Locus Technique:

The root locus concept - construction of root loci-effects of adding poles and zeros to G(s)H(s) on the root loci.

UNIT – V FREQUENCY RESPONSE ANALYSIS

Introduction, Frequency domain specifications-Bode diagrams-Determination of Frequency domain specifications and transfer function from the Bode Diagram-Phase margin and Gain margin-Stability Analysis from Bode Plots.

UNIT – VI STABILITY ANALYSIS IN FREQUENCY DOMAIN

Polar Plots, Nyquist Plots and applications of Nyquist criterion to find the stability –Effects of adding poles and zeros to G(s)H(s) on the shape of the Nyquist diagrams.

UNIT – VII CLASSICAL CONTROL DESIGN TECHNIQUES

Compensation techniques – Lag, Lead, Lead-Lag Controllers design in frequency Domain, PID Controllers.

UNIT – VIII State Space Analysis of Continuous Systems

Concepts of state, state variables and state model, derivation of state models from block diagrams, Diagonalization- Solving the Time invariant state Equations- State Transition Matrix and it's Properties

TEXT BOOKS:

1. Control Systems Engineering – by I. J. Nagrath and M. Gopal, New Age International (P) Limited, Publishers, 2nd edition.

2. Modern Control Engineering – by Katsuhiko Ogata – Prentice Hall of India Pvt. Ltd., 3rd edition, 1998.

REFERENCE BOOKS:

1. Control Systems by N.K.Sinha, New Age International (P) Limited Publishers, 3rd Edition, 1998.
2. Automatic Control Systems 8th edition– by B. C. Kuo 2003– John wiley and son's.,

3. Control Systems Engg. by NISE 3rd Edition – John wiley

4. Control Systems by S.Kesavan , Hitech Publications.

5. " Modelling & Control Of Dynamic Systems" by Narciso F. Macia George J. Thaler, Thomson Publishers.

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C3 EE03-MICROPROCESSORS AND MICROCONTROLLERS

Objective :
The objective of the Microprocessor and Microcontrollers is to do the students familiarize the architecture of 8086 processor, assembling language programming and interfacing with various modules. The student can also understand of 8051 Microcontroller concepts, architecture, programming and application of Microcontrollers. Student able to do any type of industrial and real time applications by knowing the concepts of Microprocessor and Microcontrollers.

UNIT-I 8086 ARCHITECTURE:
Functional Diagram, Register Organization, Addressing modes, Instructions, Functional schematic, Minimum and Maximum mode operations of 8086, 8086 Control signal interfacing, Timing Diagrams.

UNIT-II ASSEMBLY LANGUAGE PROGRAMMMING OF 8086

Assembly Directives, Macro's, Simple Programs using Assembler, Implimentation of FOR Loop, WHILE, REPEAT and IF-THEN-ELSE Features, String Manupulation, Procedures.

UNIT-III I/O INTERFACE
Parallel data transfer scream, Programmed I/O, Interrupt Driven I/O, 8255 PPI, Various modes of operations and interface of I/O devices to 8086, A/D, D/A Converter Interfacing, Stepper Motor Interfacing.

UNIT-IV INTERFACING WITH ADVANCED DEVICES.

8086 System bus structure, Memory and I/O Interfacing with 8086, Interfacing through various IC Peripheral Chips, 8257 (DMA Controller), 8259 (Interrupt Priority Control), Memory Interface using RAMS, EPROMS and EEPROMS.

UNIT-V COMMUNICATION INTERFACE
Serial Communication Standards, USART Interfacing RS-232, IEEE-488, 20mA Current Loop, Prototyping and Trouble shooting, Software Debugging tolls, MDS.

UNIT-VI INTRODUCTION TO MICRO CONTROLLERS
Overview of 8051 Micro Controller, Architecture, I/O ports and Memory Organization, Addressing modes and Instruction set of 8051, Simple Programs using Stack Pointer, Assembly language programming.

UNIT-VII 8051 INTERRUPTS COMMUNICATION
Interrupts, Timer/Counter and Serial Communication, Programming Timer Interrupts, Programming External H/W interrupts, Programming the serial communication interrupts, Interrupt Priority in the 8051, Programming 8051 Timers, Counters and Programming.

UNIT- VIII INTERFACING AND INDUSTRIAL APPLICATIONS

Applications of Micro Controllers, Interfacing 8051 to LED's, Push button, Relay's and Latch Connections, Keyboard Interfacing, Interfacing Seven Segment Display, ADC and DAC Interfacing.

TEXT BOOKS:

1. Kenneth J Ayala, " The 8051 Micro Controller Architecture, Programming and Applications", Thomson Publishers, 2nd Edition.
2. Kenneth J Ayala, " The 8086 Micro Processors Architecture, Programming and Applications", Thomson Publishers, 2005.

REFERENCE BOOKS:

1. Ajay V. Deshmukh, "Microcontrollers – theory applications", Tata McGraw-Hill Companies – 2005.
2. D.V.Hall, "Micro Processor and Interfacing ", Tata McGraw-Hill.
3. Ray and BulChandi, " Advanced Micro Processors", Tata McGraw-Hill.

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C3 EE04-POWER ELECTRONICS

UNIT – I : POWER SEMI CONDUCTOR DEVICES

Thyristors – Silicon Controlled Rectifiers (SCR's) – BJT – Power MOSFET – Power IGBT and their characteristics and other thyristors – Basic theory of operation of SCR – Static characteristics – Turn on and turn off methods- Dynamic characteristics of SCR - Turn on and Turn off times -Salient points – Two transistor analogy- UJT firing circuit —– Series and parallel connections of SCR's – Snubber circuit details – Specifications and Ratings of SCR's, BJT, IGBT - Numerical problems.

UNIT – II :SINGLE PHASE LINE COMMUTATED CONVERTERS

Phase control technique – Single phase Line commutated converters – Mid point and Bridge connections – Half controlled and Fully controlled converters with Resistive, RL loads and RLE load– Derivation of average load voltage and current – Line commutated inverters -Active and Reactive power inputs to the converters without and with Free wheeling Diode – Effects of Source inductance – Derivation of load voltage and current – Numerical Problems

UNIT – III: THREE PHASE LINE COMMUTATED CONVERTERS

Three phase converters – Three pulse and six pulse converters – Mid point and bridge connections average load voltage With R and RL loads – Effect of Source inductance–Dual converters – Waveforms – Numerical problems.

UNIT – IV: AC VOLTAGE CONTROLLERS

AC voltage controllers – Single phase two SCR's in anti parallel – With R and RL loads – modes of operation of Triac – Triac with R and RL loads – Derivation of RMS load voltage, current and power factor wave forms – Firing circuits -Numerical problems

UNIT –V : CYCLO CONVERTERS

Cyclo converters – Single phase mid point cyclo converters with Resistive and inductive load (Principle of operation only) – Bridge configuration of single phase cyclo converter (Principle of operation only) – Waveforms

UNIT – VI : COMMUTATION CIRCUITS

Forced commutation – Classification – Voltage and Current commutation – Basic circuits for forced commutation

UNIT – VII:CHOPPERS

Choppers – Time ratio control and Current limit control strategies – Step down choppers Derivation of load voltage and currents with R, RL and RLE loads- Step up Chopper – load voltage expression

Morgan's chopper – Jones chopper and Oscillation copper (Principle of operation only) Waveforms — AC Chopper – Problems.

UNIT – VIII: INVERTERS

Inverters – Single phase inverter – Basic series inverter – Basic parallel Capacitor inverter bridge inverter – Waveforms – Sim Mc Murray and Mc Murray – Bedford inverters - Voltage control techniques for inverters Pulse width modulation techniques – Numerical problems.

TEXT BOOKS :

1. Power Electronics – by M. D. Singh & K. B. Kanchandhani, Tata Mc Graw – Hill Publishing company,1998.
2. Power Electronics - by V.R.Murthy , 1st edition -2005, OXFORD University Press

REFERENCE BOOKS :

1. Power Electronics : Circuits, Devices and Applications – by M. H. Rashid, Prenties Hall of India 2nd edition, 1998.
2. Power Electronics – by Vedam Subramanyam, New Age International (P) Limited, Publishers
3. Power Electronics – by C. W. Lander, Mc Graw – Hill companies, 2nd edition,1993.
4. Power Electronics : Principles and Applications – by J. Vithayathil, Mc Graw – Hill companies, 2nd edition,1995.
5. Power Electronics-by P.C.Sen,Tata Mc Graw-Hill Publishing.
6. Thyristorised Power Controllers – by G. K. Dubey, S. R. Doradra, A. Joshi and R. M. K. Sinha, New Age International (P) Limited Publishers, 1996.
7. "Modern Power Electronics : Evolution, Technology and applications" – by B. K. Bose, Jaico Publishing House,1999.

ple forced commutation circuits for bridge inverters –

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C3 EE05-ELECTROMECHANICS – II

UNIT – I

Synchronous Generator: Constructional features of round rotor and salient pole machines – Armature windings – Integral slot and fractional slot windings; Distributed and concentrated windings – distribution, pitch and winding factors –

UNIT-II

E.M.F.equation – Harmonics in generated e.m.f. – suppression of harmonics – armature reaction leakage reactance – synchronous reactance and impedance – experimental determination – phasor diagram – load characteristics.

UNIT – III

Regulation by synchronous impedance method, M.M.F. method, Z.P.F. method and A.S.A. methods

UNIT – IV

salient pole alternators – two reaction analysis – experimental determination of Xd and Xq. (Slip test) Phasor diagrams – Regulation of salient pole alternators.

UNIT – V

Synchronizing alternators with infinite bus bars – synchronizing power torque – parallel operation and load sharing.

Effect of change of excitation and mechanical power input.

Analysis of short – circuit current wave form – determination of sub-transient, transient and steady state reactances.

UNIT – VI

Synchronous Motor: Theory of operation – phasor diagram – Variation of current and power factor with excitation – synchronous condenser

UNIT-VII

Mathematical analysis for power developed .Excitation and power circles – hunting and its suppression – Methods of starting – synchronous induction motor.

UNIT – VIII

Single phase Motors: Single phase induction motor – Constructional features-Double revolving field theory – Elementary idea of cross-field theory – split-phase motors – shaded pole motor – principle & performance of A.C. Series motor.

TEXT BOOKS

1. Electric Machines – by I.J.Nagrath & D.P.Kothari, Tata Mc Graw-Hill Publishers, 1997.

2. Electrical Machines – by P.S. Bimbra, Khanna Publishers.

3. Electromachines-III (Synchronous and single-phase machines), S.Kamakashiah, Hitech Publishers.

REFERENCE BOOKS:

1. The Performance and Design of A.C.Machines – by M.G.Say, ELBS and Ptiman & Sons.

2. Electric Machinery – by A.E. Fitzgerald, C.Kingsley and S.Umans, Mc Graw-Hill Companies, 5^{th} edition, 1990.

3. Electrical Machines – by Mukerjee and Chjakravarthy, Khanna Publishers.

4. Theory of Alternatinf Current Machinery by Langsdorf, Tata Mc Graw-Hill, 2^{nd} edition.

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C3 EE06- HIGH VOLTAGE ENGINEERING

UNIT – I Fundamentals of electric breakdown in Gases

Mean free path of atoms/molecules and its importance – collision frequency – Review of Bhor's postulates – Ionization energy of gas – Gas as an insulating medium – Types of Ionization by collision – Types of collisions. Condition for ionization by electron/ion collision – Collision cross section – Electric fields of low E/P (electric field/pressure in a gas medium)

UNIT – II Breakdown mechanism in Gases, Liquids and Solids: (Elementary treatment only)

Ionisation process in gaseous media – Townsend mechanism and criterion of breakdown in gases – Paschen's law and its application – Streamer theory of breakdown – Corona discharges – Different theories of breakdown in solid dielectrics – Pure and commercial liquids.

UNIT – III Generation of High DC, AC and Impulse Voltages

Cockcroft Walton double circuits – Multipliers – Vande Graaff generator – Generation of High AC Voltages – Cascade connection of transformers – Resonant transformers – Tesla coil.

UNIT – IV Generation of impulse voltages

Generation of impulse voltage – Definition of impulse wave – B.I.S. Specifications – Single stage and multi stage impulse generator circuits. Tripping methods of impulse generator circuits – impulse current generator.

UNIT – V Measurement of High D.C. and A.C. and Impulse Voltage

Peak voltage – Sphere gaps for measurement of DC, AC and Impulse voltages. Measurement of high DC Voltage by generating volt meter – Potential Dividers.

Measurement of High AC Voltages – Series impedance and Capacitor meters – Capacitance potential dividers – CVT.

UNIT – VI Measurement of Impulse Voltages and Currents.

Measurement of impulse voltages and currents – Potential dividers – Measurement of High DC, AC and Impulse current – Hall generators – Magnetic potentio meters – Magnetic devices – Low current resistive shunts (Peak)

UNIT – VII High Voltage testing techniques:
Measurement of dielectric constant and loss angle – High voltage Schering Bridge – Partial discharge measurements in high voltage apparatus.

UNIT-VIII Power Frequency & Impulse Testing of high voltage Apparatus

Power frequency and impulse testing of high voltage apparatus – BIS specifications – HV testing of insulators, Bushing, Cables and Transformers.

TEXT BOOK

1. High Voltage Engineering – by Naidu & Kamaraju Tata Mc Graw Hill Publishing Company, 2^{nd} edition.

2. High Voltage Engineering Fundamentals – by E.Kuffel & WS.Zaengel, Oxford Pergamon Press.

REFERENCE BOOKS:

1. High voltage Technology – by L.L.ALSTON, OXFORD University Press.

2. High Voltage Engineering – by C.L.Wadhwa, New age International (P) Limited, Publishers, 1995.

3. High voltage insulation Engineering – by Ravidra Arora, Wolfgang Mosch, New Age International (P) Limited, Publishers, 1995.

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C3 EE07-ELECTROMECHNICS LAB

The following experiments are required to be conducted as compulsory experiments:

1. O.C. & S.C. Tests on Single phase Transformer
2. Sumpner's test on a pair of single phase transformers
3. Scott connection of transformers
4. No-load & Blocked rotor tests on three phase Induction motor
5. Regulation of a three –phase alternator by synchronous impedance & m.m.f. methods
6. V and Inverted V curves of a three—phase synchronous motor.
7. Equivalent Circuit of a single phase induction motor
8. Determination of Xd and Xq of a salient pole synchronous machine

In addition to the above eight experiments, atleast any two of the following experiments are required to be conducted from the following list:

9. Parallel operation of Single phase Transformers
10. Separation of core losses of a single phase transformer
11. Brake test on three phase Induction Motor
12. Regulation of three-phase alternator by Z.P.F. and A.S.A methods
13. Efficiency of a three-phase alternator
14. Heat run test on a bank of 3 Nos. of single phase Delta connected transformers
15. Measurement of sequence impedance of a three-phase alternator.
16. Performance characteristics of a Schrage motor

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C3 EE08-CONTROL SYSTEMS LAB

The following are the experiments required to e conducted as compulsory experiments:

1. Time response of Second order system
2. Characteristics of Synchros
3. Programmable logic controller – Study and Verification of truth tables of logic gates, simple boolean expressions and application of speed control of motor.
4. Effect of feedback on DC servo motor
5. Transfer function of DC motor
6. Effect of P, PD, PI, PID Controller on a second order systems
7. State space model for classical transfer function using MATLAB – Verification
8. Simulation of Transfer functions using operational amplifier

In addition to the above eight experiments, atleast any two of the experiments from the list are required to be conducted:

9. Lag and lead compensation – Magnitude and phase plot
10. Transfer function of DC generator
11. Temperature controller using PID
12. Characteristics of magnetic amplifiers
13. Characteristics of AC servo motor
14. Root locus plot, Bode Plot from MATLAB