Table: Structure of B.E. Program

Sl. No.	Courses	Total Credits	Credits							Actual Credits
			I&II	III	IV	V	VI	VII	VIII	
1.	Basic Science Courses (BSC)	20	17	4	-	-	-	-	-	21
2.	Engineering Science Courses (ESC)	30	19	4	9	-	-	-	-	32
3.	Humanities, Social Science and Management Courses (HSMC)	10	4	-	-	3	-	-	3	10
4.	Professional Core Courses (PCC)	60	-	12	13	11	15	9	3	63
5.	Professional Elective Courses (PEC)	18	-	-	-	3	4	4	4	15
6.	Open Elective Courses (OEC)	14	-	-	-	3	3	3	3	12
7.	Seminar	2	-	-	-	-	-		2	2
8.	Project	10	-	-	-	-	-	3	7	10
9.	Internships in industry	8	-	2	-	2	-	3	-	7
10.	Mandatory Courses (MC)	NC	-	-	-	-	-	-	-	-
	Total Credits	172	40	22	22	22	22	22	22	172

Registrar:RAJEEV KUMAR
Signing Date:14.06.2024
02:26

B.E II Year (Semester-III) Electrical Engineering
Course Structure & Evaluation Scheme

Sl. No.	Category	Course Code	Course Title	Contact Hours			Sessional Marks			End Semester Marks			Credits
				L	T	P	CT	TA	Total	TE	PE	Total	
1	BSC	BSC-301	Mathematics III	3	1	0	30	10	40	60	-	100	**4**
2	PCC	BEE-301	Network Analysis and Synthesis	3	1	0	30	10	40	60	-	100	**4**
3	PCC	BEE-302	Electrical Machines - I	3	1	0	30	10	40	60	-	100	**3**
4	PCC	BEE-303	Solid state Devices and Circuits	3	0	0	30	10	40	60	-	100	**3**
5	ESC	BEC-301	Digital Electronics	3	0	0	30	10	40	60	-	100	**3**
6	MC	MC-302	Human Values and Professional Ethics	2	0	0	30	10	40	60	-	100	**0**
7	ESC	BEC-351	Digital Electronics Lab	0	0	2	20	20	40	-	60	100	**1**
8	PCC	BEE-352	Electrical Machines Lab - I	0	0	2	20	20	40	-	60	100	**1**
9	PCC	BEE-353	Solid state Devices and Circuits Lab	0	0	2	20	20	40	-	60	100	**1**
10	Project/ Internship		Mini-project/ Internship Assessment	0	0	0	-	-	100	-	-	100	**2**
			Total	**17**	**3**	**6**	**240**	**120**	**460**	**360**	**180**	**1000**	**22**

Registrar:RAJEEV KUMAR
Signing Date:14.06.2024
02:26

B.E II Year (Semester-IV) Electrical Engineering
Course Structure & Evaluation Scheme

Sl. No.	Category	Course Code	Course Title	Contact Hours			Sessional Marks			End Semester Marks			Credits
				L	T	P	CT	TA	Total	TE	PE	Total	
1	PCC	BEE401	Electrical Measurements & Instruments	3	0	0	30	10	40	60	-	100	3
2	ESC	BEC402	Linear Integrated circuits	3	0	0	30	10	40	60	-	100	4
3	PCC	BEE402	Electrical Machines- II	3	1	0	30	10	40	60	-	100	4
4	PCC	BEE403	Electromagnetic Theory	3	1	0	30	10	40	60	-	100	4
5	ESC	BCS402	Data Structures and Algorithms	3	1	0	30	10	40	60	-	100	3
6	MC	MC401	Environment and Ecology	2	0	0	30	10	40	60	-	100	0
7	PCC	BEE451	Measurements & Instrumentation Lab	0	0	2	20	20	40	-	60	100	1
8	ESC	BEC452	Linear Integrated Circuits Lab	0	0	2	20	20	40	-	60	100	1
9	PCC	BEE452	Electrical Machines Lab- II	0	0	2	20	20	40	-	60	100	1
10	ESC	BCS452	Data Structures and Algorithms Lab	0	0	2	20	20	40	-	60	100	1
			Total	**17**	**3**	**8**	**260**	**140**	**400**	**360**	**240**	**1000**	**22**

Registrar:RAJEEV KUMAR
Signing Date:14.06.2024
02:26

B.E III Year (Semester-V) Electrical Engineering
Course Structure & Evaluation Scheme

Sl. No.	Category	Course Code	Course Title	Contact Hours			Sessional Marks			End Semester Marks			Credits
				L	T	P	CT	TA	Total	TE	PE	Total	
1	PCC	BEE501	Power Systems I	3	0	0	30	10	40	60	-	100	**3**
2	PCC	BEE502	Signals and Systems	3	0	0	30	10	40	60	-	100	**2**
3	PCC	BEE503	Microprocessors and Microcontrollers	3	0	0	30	10	40	60	-	100	**3**
4	PEC	DE-EE501	Program Elective – 1	3	0	0	30	10	40	60	-	100	**3**
5	OEC	OE- 501	Open Elective – I	3	0	0	30	10	40	60	-	100	**3**
6	HSMC	BHSM501	Economics for Industry	3	0	0	30	10	40	60	-	100	**3**
7	PCC	BEE551	Power Systems Lab I	0	0	2	30	10	40	-	60	100	**1**
8	PCC	BEE552	Electronics Design Lab	0	0	2	30	10	40	-	60	100	**1**
9	PCC	BEE553	Microprocessors, Microcontrollers Lab	0	0	2	30	10	40	-	60	100	**1**
10	Project/Internship	BEE554	Internship Assessment	0	0	0	0	0	100	0	0	100	**2**
			Total	**18**	**0**	**6**	**270**	**90**	**460**	**360**	**180**	**1000**	**22**

Registrar:RAJEEV KUMAR
Signing Date:14.06.2024
02:26

B.E III Year (Semester-VI) Electrical Engineering
Course Structure & Evaluation Scheme

Sr. No.	Category	Course Code	Course Title	Contact Hours			Sessional Marks			End Semester Marks			Credits
				L	T	P	CT	TA	Total	TE	PE	Total	
1	PCC	BEE601	Power Systems II	3	1	0	30	10	40	60	-	100	**4**
2	PCC	BEE602	Automatic Control Systems	3	1	0	30	10	40	60	-	100	**4**
3	PCC	BEE603	Power Electronics	3	0	0	30	10	40	60	-	100	**4**
4	MC	MC601	Occupational Health and Safety	3	0	0	30	10	40	60	-	100	**0**
5	PEC	DE-EE602	Program Elective – 2	3	1	0	30	10	40	60	-	100	**4**
6	OEC	OE-EE601	Open Elective -2	3	1	0	30	10	40	60	-	100	**3**
7	PCC	BEE651	Power Electronics and Drives Lab	0	0	2	20	20	40	-	60	100	**1**
8	PCC	BEE652	Control Systems Lab	0	0	2	20	20	40	-	60	100	**1**
9	PCC	BEE653	Power System II Lab	0	0	2	20	20	40	-	60	100	**1**
			Total						**360**	**360**	**180**	**900**	**22**

Registrar:RAJEEV KUMAR
Signing Date:14.06.2024
02:26

B.E IV Year (Semester-VII) Electrical Engineering
Course Structure & Evaluation Scheme

Sr. No.	Category	Course Code	Course Title	Contact Hours			Sessional Marks			End Semester Marks			Credits
				L	T	P	CT	TA	Total	TE	PE	Total	
1	PCC	BEE701	Digital Signal Processing	3	0	0	30	10	40	60	-	100	**3**
2	PCC	BEE702	Advanced Electrical Drives	2	1	0	30	10	40	60	-	100	**2**
3	PCC	BEE703	Power System Operation and Control	3	0	0	30	10	40	60	-	100	**3**
4	PEC	DE-EE703	Program Elective -3	3	0	0	30	10	40	60	-	100	**4**
5	OEC	OE-EE702	Open Elective-3	3	0	0	30	10	40	60	-	100	**3**
6	PCC	BEE751	Digital Signal Processing Lab	0	0	2	20	20	40	-	60	100	**1**
7	Internship	BEE752	Internship Assessment	0	0	0	20	20	40	-	60	100	**3**
8	Project/Internship	PROJEE1	Project Stage-I	0	0	-	-	-	100	-	-	100	**3**
			Total						**380**	**300**	**120**	**800**	**22**

Registrar:RAJEEV KUMAR
Signing Date:14.06.2024
02:26

B.E IV Year (Semester-VIII) Electrical Engineering
Course Structure & Evaluation Scheme

Sr. No.	Category	Course Code	Course Title	Contact Hours			Sessional Marks			End Semester Marks			Credits
				L	T	P	CT	TA	Total	TE	PE	Total	
1	PCC	DE-EE805	Industrial Electrical Systems	3	1	0	30	10	40	60	-	100	**2**
2	PEC	DE-EE803	Program Elective - 4	3	0	0	30	10	40	60	-	100	**4**
3	OEC	OE-EE804	Open Elective -4	2	0	0	30	10	40	60	-	100	**3**
4	HSMC	BHSM804	Principles of Management	3	1	0	30	10	40	60	-	100	**3**
5	PCC	BEE851	Electrical CAD and Fabrication Lab	0	0	2	20	20	40	-	60	100	**1**
6	Seminar	BEE852	Seminar on cutting end technology	0	0	0	-	-	100	-	-	100	**2**
7	Project/ Internship	PROJEE2	Project Stage-II	0	0		-	-	50	-	50	100	**7**
			Total						**350**	**240**	**110**	**700**	**22**

*** Labview, MATLAB should be provided for Laboratory**

Registrar:RAJEEV KUMAR
Signing Date:14.06.2024
02:26

Program Electives – Department of Electrical Engineering

(Study through MOOCs allowed)

Program Elective - 1	
DEEE501	Micro Electro Mechanical Systems
DEEE502	Introduction to Power Plant Engineering
DEEE503	Electrical Engineering materials
DEEE504	Artificial Intelligence
Program Elective - 2	
DEEE601	Wind and Solar Energy
DEEE602	Digital Image and Video Processing
DEEE603	Analog and Digital Communication
DEEE604	Electrical Machine Design
DEEE605	Digital Image and Video Processing
Program Elective - 3	
DEEE701	Soft Computing
DEEE702	Digital Control Systems
DEEE703	Microcontrollers and Embedded Systems
DEEE704	Energy Audit
DEEE705	EHV AC and DC Transmission
Program Elective - 4	
DEEE801	Power Quality and FACTS
DEEE802	
DEEE803	Medical Instrumentation
DEEE804	Speech and Audio Processing
DEEE805	High Voltage Engineering

Include list of Open Electives here
Sent already

Registrar:RAJEEV KUMAR
Signing Date:14.06.2024
02:26

BEE-501	Power Systems – I	L-T-P-C: 3-0-0-3
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Understand the concepts of power systems	
CO2	Distinguish between various components of power system	
CO3	To analyse different types of faults, Estimate fault currents, over-voltages and insulation coordination	
CO4	Comprehend basic protection schemes	
CO5	Understand concepts of HVDC power transmission and renewable energy generation	

Unit – 1: **Basic Concepts (5 hours)**

Evolution of Power Systems and Present-Day Scenario - Structure of a power system: Bulk Power Grids and Micro-grids. Transmission and Distribution Systems: Line diagrams, transmission and distribution voltage levels and topologies (meshed and radial systems). Feeder, Service mains Substations, Mechanical design of Transmission, Synchronous Grids and Asynchronous (DC) interconnections - Comparison of ac and dc transmission

Unit – 2: Power System Analysis (10 hours)

Overhead Transmission Lines and Cables: Electrical and Magnetic Fields around conductors, Corona. Parameters of lines and cables - Capacitance and Inductance calculations for simple configurations - Short, medium and long lines - Power Transfer, Voltage profile and Reactive Power - Characteristics of transmission lines - Surge Impedance Loading - Generation of Over-voltages: Lightning and Switching Surges - Protection against Over voltages, Insulation Coordination. Propagation of Surges - Voltages produced by traveling surges - Bewley Diagrams

Unit – 3: Power System Components (10 hours)

Insulators, Application of Phase-shifts - Distribution transformers, Tap-Changing transformers. Synchronous Machines: Steady-state performance characteristics. Real and Reactive Power Capability Curve of generators - Typical waveform under balanced terminal short circuit conditions – steady state, transient and sub-transient equivalent circuits. Loads: Types, Voltage and Frequency Dependence of Loads. Per-unit System and per-unit calculations

Unit – 4: Fault Analysis and Protection Systems (10 hours)

Method of Symmetrical Components (positive, negative and zero sequences) - Balanced and Unbalanced Faults - Representation of generators, lines and transformers in sequence networks - Computation of Fault Currents - Neutral Grounding

Switchgear: Types of Circuit Breakers - Attributes of Protection schemes, Back-up Protection - Protection schemes (Over-current, directional, distance protection, differential protection) and their application

Unit – 5: Introduction to DC Transmission (5 hours)

DC Transmission Systems: Line-Commutated Converters (LCC) and Voltage Source Converters (VSC). LCC and VSC based dc link, Real Power Flow control in a dc link - Comparison of ac and dc transmission

Text/References:

1. J. Grainger and W. D. Stevenson, "Power System Analysis", McGraw Hill Education, 1994.

2. O. I. Elgerd, "Electric Energy Systems Theory", McGraw Hill Education, 1995.

3. A. R. Bergen and V. Vittal, "Power System Analysis", Pearson Education Inc., 1999

4. D. P. Kothari and I. J. Nagrath, "Modern Power System Analysis", McGraw Hill Education, 2003.

5. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, "Electric Power Systems", Wiley, 2012.

BEE-502	Signals and Systems	L-T-P-C: 3-0-0-3
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Analyse different types of signals	
CO2	Represent continuous and discrete systems in time and frequency domain using different transforms	
CO3	Investigate whether the system is stable	
CO4	Sampling and reconstruction of a signal	
CO5		

Course Details:

Unit – I: Introduction to Signals and Systems (3 hours)

Signals and systems as seen in everyday life, and in various branches of engineering and science - Signal properties: periodicity, absolute integrability, determinism and stochastic character - Some special signals of importance: the unit step, the unit impulse, the sinusoid, the complex exponential, some special time-limited signals; continuous and discrete time signals, continuous and discrete amplitude signals. System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, realizability – Examples

Unit – II: Behaviour of continuous and discrete-time LTI systems (8 hours)

Impulse response and step response, convolution, input-output behavior with aperiodic convergent inputs, cascade interconnections - Characterization of causality and stability of LTI systems - System representation through differential equations and difference equations- State-space Representation of systems- State-Space Analysis, Multi-input, multi-output representation - State Transition Matrix and its Role - Periodic inputs to an LTI system, the notion of a frequency response and its relation to the impulse response.

Unit – III: Fourier Transforms (5 hours)

Fourier series representation of periodic signals, Waveform Symmetries, Calculation of Fourier Coefficients. Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. The Discrete-Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem

Unit – IV: Laplace and Z-Transforms (5 hours)

Review of the Laplace Transform for continuous time signals and systems, system functions, poles and zeros of system functions and signals, Laplace domain analysis, solution to differential equations and system behavior. The z-Transform for discrete time signals and systems, system functions, poles and zeros of systems and sequences, z-domain analysis.

Unit – V: Sampling and Reconstruction (4 hours)

The Sampling Theorem and its implications - Spectra of sampled signals - Reconstruction: ideal interpolator, zero-order hold, first-order hold. Aliasing and its effects - Relation between continuous and discrete time systems- Introduction to the applications of signal and system theory: modulation for communication, filtering, feedback control systems.

Text Books:

1. Simon Haykins and Barry Van Veen, "Signals and Systems", 2nd Edition, Wiley India.

2. Charles Phillips, "Signals, Systems and Transforms", 3rd Edition, Pearson Education.

3. A.V.Oppenphim, A.S.Willsky and S.H.Nawab; signals and systems, prentice Hall.

4. B.P.Lathi, Signal and sysytem, Oxford university press , New Delhi.

Reference Books:

1. M.J. Roberts "Signal and Systems", Tata McGraw Hill 2007.

2. ShailaApte, "Signals and Systems-principles and applications", Cambridge University press, 2016.

3. MrinalMandal and Amir Asif, Continuous and Discrete Time Signals and Systems, Cambridge University Press, 2007.

4. Peyton Peebles, "Probability, Random Variable, Random Processes", 4th Edition, Tata McGraw Hill.

5. A. NagoorKanni "Signals and Systems", 2nd edition, McGraw Hill.

6. NPTEL video lectures on Signals and Systems

BEE-503	Microprocessors and Microcontrollers	L-T-P-C: 3-0-0-3
CO1	1. Recall and apply a basic concept of digital fundamentals to microprocessor based personal computer system and Recall the memory types and understand the interfacing of memory with microprocessor. 2. Understand the internal architecture and organization of 8085 & 8086.	
CO2	1. Apply knowledge and demonstrate programming proficiency using the various addressing modes and data transfer instructions of the target microprocessor and microcontroller. 2. Analyse assembly language programs; select appropriate assemble into machine a cross assembler utility of a microprocessor and microcontroller.	
CO3	Discuss how the different peripherals are interfaced with microprocessor like 8255,8253/54,8237,8279 etc.	
CO4	1. To analyse the concepts of memory interfacing for faster execution of instructions and improves the speed of operations & hence performance of microprocessors. 2.To Understand the basic knowledge of advanced processor and analyse the internal architecture of 80286,80486 and Pentium processor.	
C05	1. Analyse the internal architecture and real time control of 8051. 2. Analyse the internal architecture of ARM Processors.	

Unit-I

Introduction to Microprocessor:

Evolution of Microprocessors, Register structure, ALU, Bus Organization, Timing and Control.

8-bit microprocessor: 8085 Microprocessor and its Architecture, Addressing Modes, The 8085 Programming Model, Instruction Classification, Instruction Format, Overview of Instruction set- Data Transfer Operation, Arithmetic Operation, Logic Operation and Branch Operation; Introduction to Assembly language program., Assembler Directives, Parameter passing and recursive procedures.

Unit-II

Programming Technique With Additional Instruction: Looping, Counting, Indexing, Additional data Transfer and 16 bit Arithmetic instruction, Counters and time delays, Stack and Subroutine

16 bit Microprocessor: Architecture of 8086- Register Organization, Execution unit, Bus Interface Unit, Signal Description, Physical Memory Organization, Mode of Operation, I/O Addressing Capabilities.

Features of Numeric processor 8087,Floating point representation, range resolution, normalization, representation of zero, unused codes, parity bit and error detection.

Unit- III

Basic of Interfacing:

Programmed I/O, Interrupt driven I/O, DMA(8257), Parallel I/O (8255-PPI), Serial I/O(8251/8250, RS-232 standard)

Registrar:RAJEEV KUMAR
Signing Date:14.06.2024
02:26

8259 Programmable Interrupt Controller, 8237-DMA Controller, 8253/8254 Programmable Timer/Counter,(8279) Keyboard and display interface, ADC and DAC interfacing

Unit- IV

Memory Interfacing:

Types of memory, RAM and ROM , Concepts of virtual memory, Cache memory. Advanced coprocessor Architecture-286,486, pentium

Unit-V

An Introduction to Microcontroller 8051 : The 8051 Architecture, Instruction set,Basic Assembly language programming concept.

Introduction to Risc Processor: ARM microcontrollers Interface design

Textooks:

1. Douglas V.Hall/8086 Microprocessors Architecture
2. R.S. Gaonker/Microprocessor Architecture: Programming and Applications with the 8085/8080A/ Penram Interational Publishing,1996.
3. Kenneth J.Ayala/The 8051 Microcontroller/Penram International Publishing.

References:

4. Liu Gibson/Microprocessor
5. Ray, A.K. & Burchandi, K.M./ “Advanced Microprocessors and Peripherals: Architecture, Programming and Interfacing”/ Tata McGraw Hill.
6. Brey, Barry B. / “INTEL microprocessors” / Prentice Hall (India) /4th Ed.

Registrar:RAJEEV KUMAR
Signing Date:14.06.2024
02:26

HSMC-501	Economics for Industry	L-T-P-C: 3-0-0-3

Economics for Industry – Common Syllabus Insert here

BEE-551	Microprocessor Laboratory	L-T-P-C: 0-0-0-2

1.To determine direct axis reactance (xd) and quadrature axis reactance (xq) of a salient pole alternator.

2. To determine negative and zero sequence reactances of an alternator.

3. To determine sub transient direct axis reactance (xd) and sub transient quadrature axis reactance (xq) of an alternator

4. To determine fault current for L-G, L-L, L-L-G and L-L-L faults at the terminals of an alternator at very low excitation

5. To study the IDMT over current relay and determine the time current characteristics 6. To study percentage differential relay

7. To study Impedance, MHO and Reactance type distance relays

8. To determine location of fault in a cable using cable fault locator

9. To study Ferranti effect and voltage distribution in H.V. long transmission line using transmission line model.

10. To study operation of oil testing set.

Simulation Based Experiments (using MATLAB or any other software)

11. To determine transmission line performance.

12. To obtain steady state, transient and sub-transient short circuit currents in an alternator

13. To obtain formation of Y-bus and perform load flow analysis

14. To perform symmetrical fault analysis in a power system

15. To perform unsymmetrical fault analysis in a power system

Text Books:-

1. Hasdi Sadat, "Power System Analysis" Tata Mc.Graw Hill.

2. T. K. Nagsarskar & M.S. Sukhija,' Power System Analysis' Oxford Universitry Press.

Note: - At least 10 experiments should be performed out of which 3 should be simulation based. (A) Hardware Based:

1. To determine direct axis reactance (xd) and quadrature axis reactance (xq) of a salient pole alternator.

2. To determine negative and zero sequence reactances of an alternator.

3. To determine sub transient direct axis reactance (xd) and sub transient quadrature axis reactance (xq) of an alternator

4. To determine fault current for L-G, L-L, L-L-G and L-L-L faults at the terminals of an alternator at very low excitation

5. To study the IDMT over current relay and determine the time current characteristics 6. To study percentage differential relay

7. To study Impedance, MHO and Reactance type distance relays

8. To determine location of fault in a cable using cable fault locator

9. To study Ferranti effect and voltage distribution in H.V. long transmission line using transmission line model.

10. To study operation of oil testing set.

Simulation Based Experiments (using MATLAB or any other software)

11. To determine transmission line performance.

12. To obtain steady state, transient and sub-transient short circuit currents in an alternator

13. To obtain formation of Y-bus and perform load flow analysis

14. To perform symmetrical fault analysis in a power system

15. To perform unsymmetrical fault analysis in a power system

Text Books:-

1. Hasdi Sadat, "Power System Analysis" Tata Mc.Graw Hill.

2. T. K. Nagsarskar & M.S. Sukhija,' Power System Analysis' Oxford Universitry Press.

BEE-552	**Microprocessor Laboratory**	**L-T-P-C: 0-0-0-2**

Study Experiments

1. To study 8085 based microprocessor system

2. To study 8086 and 8086A based microprocessor system

3. To study Pentium Processor

B. Programming based Experiments (any four)

4. To develop and run a program for finding out the largest/smallest number from a given set of numbers.

5. To develop and run a program for arranging in ascending/descending order of a set of numbers

6. To perform multiplication/division of given numbers

7. To perform conversion of temperature from 0 F to 0 C and vice-versa

8. To perform computation of square root of a given number

9. To perform floating point mathematical operations (addition, subtraction, multiplication and division)

C. Interfacing based Experiments (any four)

10. To obtain interfacing of RAM chip to 8085/8086 based system

11. To obtain interfacing of keyboard controller

12. To obtain interfacing of DMA controller

13. To obtain interfacing of PPI

14. To obtain interfacing of UART/USART

15. To perform microprocessor based stepper motor operation through 8085 kit

16. To perform microprocessor based traffic light control

17. To perform microprocessor based temperature control of hot water.

BEE-553	Electronics Design Lab	L-T-P-C: 0-0-2-1

Note: Minimum ten experiments are to be performed from the following list: VSM Proteus / e-sim may be used

BEE-551	Power Systems Lab – I	L-T-P-C: 3-0-0-3

Note: - At least 10 experiments should be performed out of which 3 should be simulation based. (A) Hardware Based:

1. To determine direct axis reactance (xd) and quadrature axis reactance (xq) of a salient pole alternator.

2. To determine negative and zero sequence reactances of an alternator.

3. To determine sub transient direct axis reactance (xd) and sub transient quadrature axis reactance (xq) of an alternator

4. To determine fault current for L-G, L-L, L-L-G and L-L-L faults at the terminals of an alternator at very low excitation

5. To study the IDMT over current relay and determine the time current characteristics 6. To study percentage differential relay

7. To study Impedance, MHO and Reactance type distance relays

8. To determine location of fault in a cable using cable fault locator

9. To study Ferranti effect and voltage distribution in H.V. long transmission line using transmission line model.

10. To study operation of oil testing set.

Simulation Based Experiments (using MATLAB or any other software)

11. To determine transmission line performance.

12. To obtain steady state, transient and sub-transient short circuit currents in an alternator

13. To obtain formation of Y-bus and perform load flow analysis

14. To perform symmetrical fault analysis in a power system

15. To perform unsymmetrical fault analysis in a power system

Text Books:-

1. Hasdi Sadat, "Power System Analysis" Tata Mc.Graw Hill.

2. T. K. Nagsarskar & M.S. Sukhija,' Power System Analysis' Oxford Universitry Press.

BEE-601	Power Systems – II	L-T-P-C: 3-0-0-3
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Apply numerical methods to analyse a power system in steady state	
CO2	Comprehend stability constraints in a synchronous grid	
CO3	Understand methods to control the voltage, frequency and power flow	
CO4	Comprehend the monitoring and control of a power system	
CO5	Appreciate the basics of power system economics	

UNIT-I: Power Flow Analysis

Analysis of Power Flows: Formation of Bus Admittance Matrix. Real and reactive power balance equations at a node. Load and Generator Specifications Application of numerical methods for solution of nonlinear algebraic equations – Gauss Seidel and Newton-Raphson methods for the solution of the power flow equations - Computational Issues in Large-scale Power Systems

UNIT-II: Stability Constraints in synchronous grids (8 hours)

Swing Equations of a synchronous machine connected to an infinite bus - Loss of synchronism due to Three--phase fault - Analysis using numerical integration of swing equations (Forward Euler, Runge-Kutta 4th order methods) - Equal Area Criterion. Impact of stability constraints on Power System Operation- Effect of generation rescheduling and series compensation of transmission lines on stability

UNIT-III: Load Frequency Control

Control of Frequency and Voltage: Turbines and Speed-Governors, Frequency dependence of loads, Droop Control and Power Sharing - Automatic Generation Control.

.

UNIT-IV: Monitoring Power System And Excitation Control

Overview of Energy Control Centre Functions: SCADA systems and its components, protocol - Phasor Measurement Units - and Wide-Area Measurement Systems. Normal, Alert, Emergency, Extremis states of a Power System.

Excitation System Control in synchronous generators, Automatic Voltage Regulators. Shunt Compensators, Static VAR compensators and STATCOMs - Tap Changing Transformers. Three phase Induction regulators, Voltage Stability, Voltage Collapse.

UNIT-V: Basic Pricing Principles

Generator Cost Curves, Vertically Integrated Utility and restructured Power System - Role of Different entities in restructured market - Market clearing price, Single sided and double sided linear bid market - Transmission and Distributions charges

Text/References:

1. J. Grainger and W. D. Stevenson, “Power System Analysis”, McGraw Hill Education, 1994.

2. O. I. Elgerd, “Electric Energy Systems Theory”, McGraw Hill Education, 1995.

3. A. R. Bergen and V. Vittal, “Power System Analysis”, Pearson Education Inc., 1999.

4. D. P. Kothari and I. J. Nagrath, “Modern Power System Analysis”, McGraw Hill Education, 2003.

5. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, “Electric Power Systems”, Wiley, 2012.

BEE-602	Automatic Control System	L-T-P-C: 3-0-0-3
CO1	Understand concepts of Time Domain and Frequency Domain Analysis	
CO2	Model linear-time-invariant systems using transfer function	
CO3	Model linear-time-invariant systems using state-space representations	
CO4	Apply the concept of stability in linear-time invariant systems	
C05	Design simple feedback controllers	

UNIT I

Control System And Their Representation: Terminology and basic structure of control system, Open loop and Closed loop systems, analogous systems. Physical Systems and their models, Electromechanical systems, electrical analogy of physical systems. Transfer function, Block diagram representation of physical systems, Block diagram algebra, Signal Flow graph and Mason's formula.

UNIT II

Time Response: Types of test inputs, Response of first and second order system, Time domain specifications, Static and Dynamic Error coefficients.

UNIT III

Frequency Domain Analysis: Concepts of Gain margin and phase margin, Bode plots Frequency-domain specifications, Polar plots, Inverse Polar Plots, M-N circle.

UNIT IV

Stability Theory: Routh Hurwitz Stability Criterion, Root locus plot, Properties of Root loci and applications, Stability range from the loci. Determination of roots of the closed loop system, Effect of pole zero addition, Nyquist stability criterion.

UNIT V

Controllers: Introduction to PID and Lag-lead type Controllers
State Variable Analysis: Concepts of state, state variable and state model. State variable models for LTI systems. Canonical representations, Transfer function to state-space and vice-versa. Solution to state equations. Concepts of controllability & observability.
Compensation Design: compensation design using frequency domain techniques

Text book:

1. KUO B.CI Automatic control system/Pill.
2. Ogata Kj Modern Control Engineering / PHI.
3. Nagrath I.J. & Gopal, M/Control Systems Engineering/New Age International.
4. S.N. Sivanandam/Control Systems Engineering /Vikas Publishing House Pvt. Ltd.

References:

1. Singh & Janardhanan - Modern control engineering, Cengage learning
2. Control Systems,Srivastava,TMH 2009
3. Systems and Control - Stanislawhizak, Oxford
4. Control System Engineering,S. K. Bhattacharya,Pearson
5. Control Systems: Theory And Applications,Ghosh,Pearson

BEE-603	Power Electronics	L-T-P-C: 3-0-0-3
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Ability to analyse different types of power semiconductor devices and their switching.	
CO2	Demostrate the triggering circuit and snubber circuit, operation of choppers and basic topologies of DC-DC Switching regulators	
CO3	Ability to analyse operation, characteristics and performance parameter of controlled rectifiers	
CO4	Illustrate the operation of AC voltage controller and cyclo- converter and its application.	
C05	Analyse the operation of single phase and three phase inverters with and without PWM techniques and to understand harmonic reduction methods.	

UNIT-I

Power Semiconductor Devices: Diode, Thyristors, BJT, Power MOSFET and Power IGBT and their characteristics. Firing Circuit for Thyristor - Two transistor analogy of SCR , Series and parallel connections of SCR's - Thyristor Commutation Technique - Gate drive Circuits for MOSFET and IGBT. GTO, MCT and TRIAC

UNIT-II

Single phase half wave controlled, rectifier with resistive and inductive loads, effect of freewheeling diode. Single phase fully controlled and half controlled bridge converters -

Three phase half wave converters, Three phase fully controlled and half controlled bridge converters, Effect of source impedance, Single phase and three phase dual converters -

Resonant converters

UNIT-III

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 Oscillation choppers (Principle of operation only) -waveforms AC Chopper Problems.

UNIT-IV

Principle of On-Off and phase controls, Single phase ac voltage controller with resistive and inductive loads - Three phase ac voltage controllers (various configurations and comparison), Single phase transformer tap changer

Cyclo -Converters, Basic principle of operation, single phase to single phase, three phase to single phase and three phase to three phase cyclo-converters, output voltage equation

UNIT-V

Single-phase voltage source inverter: Power circuit of single-phase voltage source inverter, switch states and instantaneous output voltage, square wave operation of the inverter, concept of average voltage over a switching cycle, bipolar sinusoidal modulation and unipolar sinusoidal modulation, modulation index and output voltage

Three-phase voltage source inverter: Power circuit of a three-phase voltage source inverter, switch states, instantaneous output voltages, average output voltages over a sub-cycle, three-phase sinusoidal modulation - Harmonics reduction techniques, Single phase and three phase current source inverters

Text Books

1. P.S.Bhimbra, “Power Electronics“,Khanna publications.

2. M.D.Singh & K.B.Kanchandhani, Power Electronics, Tata McGrawHill Publishing company, 1998.

Reference Books

1. Vedam Subramanyam, Power Electronicsby New Age International (P) Limited, Publishers

2. P.C.Sen, Power Electronics, Tata McGraw-Hill Publishing.

BEE-661	Power Systems Lab -II	L-T-P-C: 0-0-2-1

Note: Minimum ten experiments are to be performed from the following list

1. Calculate the parameters of single phase transmission line
2. Calculate the parameters of three phase single circuit transmission line
3. Calculate the parameters of three phase double circuit transmission line
4. Determine the ABCD constant for transmission line.
5. Simulate the Ferranti effect in transmission line
6. Calculate the corona loss of transmission line
7. Calculation of sag & tension of transmission line
8. Calculation of string efficiency of insulator of transmission line
9. Calculation for grading of underground cables
10. Simulate the skin effect in the transmission line
11. Calculation of ground clearance of transmission line
12. Calculate the parameters for underground cable

BEE-662	Control System Laboratory	L-T-P-C: 0-0-2-1

Note: The minimum of 10 experiments are to be performed from the following, out of which at least three should be software based.

1. To study P, PI and PID temperature controller for an oven and compare their performance.

2. To study and calibrate temperature using resistance temperature detector (RTD)

4. To design Lag, Lead and Lag-Lead compensators using Bode plot.

5. To study DC position control system

6. To study synchro-transmitter and receiver and obtain output vs input characteristics

7. To determine speed-torque characteristics of an ac servomotor.

8. To study performance of servo voltage stabilizer at various loads using load bank.

9. To study behavior of separately excited dc motor in open loop and closed loop conditions at various loads.

Software based experiments (Use MATLAB, LABVIEW software etc.)

10. To simulate PID controller for transportation lag.

11. To determine time domain response of a second order system for step input and obtain performance parameters.

12. To convert transfer function of a system into state space form and vice-versa.

13. To plot root locus diagram of an open loop transfer function and determine range of gain ‘k’ fir stability.

14. To plot a Bode diagram of an open loop transfer function.

15. To draw a Nyquist plot of an open loop transfers functions and examine the stability of the closed loop system.

Reference Books:

1. K.Ogata,"Modern Control Engineering" Prentice Hall of India.

2. Norman S.Nise, "Control System Engineering", John Wiley & Sons.

3. M.Gopal, "Control Systems: Principles & Design" Tata Mc Graw Hill

BEE-663	**Power Electronics and Drives Laboratory**	L-T-P-C: 0-0-2-1

Note: The minimum of 10 experiments is to be performed out of which at least three should be software based.

1. To study V-I characteristics of SCR and measure latching and holding currents.

2. To study UJT trigger circuit for half wave and full wave control.

3. To study single-phase half wave controlled rectified with (i) resistive load (ii) inductive load with and without free wheeling diode.

4. To study single phase (i) fully controlled (ii) half controlled bridge rectifiers with resistive and inductive loads.

5. To study three-phase fully/half controlled bridge rectifier with resistive and inductive loads.

6. To study single-phase ac voltage regulator with resistive and inductive loads. 7. To study single phase cyclo-converter

8. To study triggering of (i) IGBT (ii) MOSFET (iii) power transistor

9. To study operation of IGBT/MOSFET chopper circuit

10. To study MOSFET/IGBT based single-phase series-resonant inverter.

11. To study MOSFET/IGBT based single-phase bridge inverter. Software based experiments(PSPICE/MATLAB)

12. To obtain simulation of SCR and GTO thyristor.

13. To obtain simulation of Power Transistor and IGBT.

14. To obtain simulation of single phase fully controlled bridge rectifier and draw load voltage and load current waveform for inductive load.

15. To obtain simulation of single phase full wave ac voltage controller and draw load voltage and load current waveforms for inductive load.

16. To obtain simulation of step down dc chopper with L-C output filter for inductive load and determine steady-state values of output voltage ripples in output voltage and load current.

Text/Reference Books:

1. M.H.Rashid, “Power Electronics: Circuits, Devices and Applications”, 3 rd Edition, prentice Hall of India.

2. D.W. Hart, “Introduction to power Electronics” Prentice hall Inc.

3. Randal Shaffer, “Fundamentals of Power Electronics with MATLAB” Firewall Media,

BEE-701	**Power System Operation and Control**	**L-T-P-C: 3-0-0-3**
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Comprehend structure of Power System	
CO2	Understand the economic operation of power system	
CO3	Describe Load Frequency Control methods	
CO4	Explain Automatic Voltage Control methods	
CO5	Understand State Estimation	

UNIT-I: Introduction

Structure of power systems, Power system control center and real time computer control, SCADA system Level decomposition in power system Power system security Various operational stages of power system Power system voltage stability

UNIT-II: Economic Operation

Concept and problems of unit commitment Input-output characteristics of thermal and hydro-plants System constraints Optimal operation of thermal units without and with transmission losses, Penalty factor, incremental transmission loss, transmission loss formula (without derivation) Hydrothermal scheduling long and short terms Concept of optimal power flow

UNIT-III: Load Frequency Control

Concept of load frequency control, Load frequency control of single area system: Turbine speed governing system and modeling, block diagram representation of single area system, steady state analysis, dynamic response, control area concept, P-I control, load frequency control and economic dispatch control. Load frequency control of two area system: Tie line power modeling, block diagram representation of two area system, static and dynamic response

UNIT-IV: Automatic Voltage Control

Schematic diagram and block diagram representation, different types of Excitation systems & their controllers - Voltage and Reactive Power control: Concept of voltage control, methods of voltage control- control by tap changing transformer. Shunt Compensation, series compensation, phase angle compensation

UNIT-V: State Estimation

Detection and identification, Linear and non-linear models - Flexible AC Transmission Systems: Concept and objectives FACTs controllers: Structures & Characteristics of following FACTs Controllers. TCR,FC-TCR, TSC, SVC, STATCOM, TSSC, TCSC, SSSC, TC-PAR, UPFC

Text Books:

1. D.P. Kothari & I.J. Nagrath, "Modern Power System Analysis" Tata Mc Graw Hill, 3rd Edition.

2. P.S.R. Murty, "Operation and control in Power Systems" B.S. Publications.

3. N. G. Hingorani & L. Gyugyi, " Understanding FACTs" Concepts and Technology of Flexible AC Transmission Systems"

4. A. J. Wood & B.F. Wollenburg, " Power Generation, Operation and Control " John Wiley & Sons.

Reference Books:

1. O.I. Elgerd, "Electric Energy System Theory" Tata McGraw Hill.

2. P. Kundur, " Power System Stability and Control Mc Graw Hill.

3. T. K. Nagsarkar & M.S. Sukhiza,' Power System Analysis' Oxford University Press.

BEE-703	**Advanced Electrical Drives**	**L-T-P-C: 3-0-0-3**
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	To comprehend the fundamentals of Electric Drives	
CO2	To understand the dynamics of Electric Drive	
CO3	To comprehend the dynamics of starting and braking of DC, Three phase Induction and Synchronous motors	
CO4	Understand the power electronic converters used for dc motor speed control	
CO5	Understand the power electronic converters used for induction motor speed control	

UNIT-I: Fundamentals of Electric Drive

Electric Drives and its parts, advantages of electric drives Classification of electric drives Speed-torque conventions and multi-quadrant operations Constant torque and constant power operation Types of load torque: components, nature and classification

UNIT-II: Dynamics of Electric Drive

Dynamics of motor-load combination Steady state stability of Electric Drive Transient stability of electric Drive Selection of Motor Power rating: Thermal model of motor for heating and cooling, classes of motor duty, determination of motor power rating for continuous duty, short time duty and intermittent duty. Load equalization

UNIT-III: Electric Braking

Purpose and types of electric braking, braking of DC, Three phase Induction and Synchronous motors - Dynamics during Starting and Braking: Calculation of acceleration time and energy loss during starting of DC shunt and three phase induction motors, methods of reducing energy loss during starting. Energy relations during braking, dynamics during braking

UNIT-IV: Power Electronic Control of DC Drives

Single phase and three phase controlled converter fed separately excited DC motor drives (continuous conduction only), dual converter fed separately excited DC motor drive, rectifier control of DC series motor. Supply harmonics, power factor and ripples in motor current Chopper control of separately excited DC motor and DC series motor.

UNIT-V: Power Electronic Control of AC Drives

Three Phase induction Motor Drive: Static Voltage control scheme, static frequency control scheme (VSI, CSI, and cyclo – converter based) static rotor resistance and slip power recovery control schemes. Three Phase Synchronous motor: Self controlled scheme Special Drives: Switched Reluctance motor, Brushless dc motor. Selection of motor for particular applications

Text Books:

1. G.K. Dubey, "Fundamentals of Electric Drives", Narosa publishing House.

2. S.K. Pillai, "A First Course on Electric Drives", New Age International.

3. B.N. Sarkar, "Fundamental of Industrial Drives", Prentice Hall of India Ltd.

Reference Books:

1 M. Chilkin, "Electric Drives",Mir Publishers, Moscow.

2 Mohammed A. El-Sharkawi, "Fundamentals of Electric Drives", Thomson Asia, Pvt. Ltd. Singapore.

3 N.K. De and Prashant K. Sen, "Electric Drives", Prentice Hall of India Ltd.

4 V. Subrahmanyam, "Electric Drives: Concepts and Applications", TataMcGraw Hill.

BEE-701	Digital Signal Processing	L-T-P-C: 3-0-0-3
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Represent signals mathematically in continuous and discrete-time, and in the frequency domain.	
CO2	Understand the Discrete-Fourier Transform (DFT) and the FFT algorithms	
CO3	Realize Digital filter structures	
CO4	Design digital filters for various applications	
C05	Apply multi-rate digital signal processing for the analysis of real-life signals including image	

UNIT-I SIGNALS AND SIGNAL PROCESSING:

Characterization & classification of signals, typical Signal Processing operations, example of typical Signals, typical Signals Processing applications, discrete time random signals- Discrete Time Signals, Operations on Sequences, the sampling process, Discrete-Time systems, Time-Domain characterization of LTI Discrete-Time systems, Correlation of signals.

UNIT-II TRANSFORM-DOMAIN REPRESENTATION OF SIGNALS:

Discrete-Time Fourier Transform, Discrete Fourier Transform, DFT properties, computation of the DFT of real sequences, Linear Convolution using the DFT. FFT Algorithms.

DIGITAL PROCESSING OF CONTINUOUS-TIME SIGNALS:

Sampling of Continuous Signals, Analog Filter Design, Anti-aliasing Filter Design, Sample-and-hold circuits, A/ D & D/ A converter, Reconstruction Filter Design

UNIT-III DIGITAL FILTER STRUCTURE:

Block Diagram representation, Signal Flow Graph Representation, Equivalent Structures, FIR Digital Filter Structures, IIR Filter Structures, Parallel all pass realization of IIR transfer function, Digital Sine-Cosine generator.

UNIT-III: DIGITAL FILTER DESIGN:

Impulse invariance method of IIR filter design, Bilinear Transform method of IIR Filter Design, Design of Digital IIR notch filters, FIR filter Design based on truncated fonner sens, FIR filter design based on Frequency Sampling approach - Applications of DSP

UNIT-V MULTIRATE DIGITAL SIGNAL PROCESSING:

Introduction to multi-rate digital signal processing, sampling rate conversion, filter structures, multistage decimator and interpolators, digital filter banks.

DIGITAL IMAGE PROCESSING: Digital Image Representation, Fundamental Steps in Image Processing, Elements of Digital image processing systems.

TEXT Text / Reference Books:

1. S. K. Mitra, “Digital Signal Processing: A computer based approach”, McGraw Hill, 2011.

2. A.V. Oppenheim and R. W. Schafer, “Discrete Time Signal Processing”, Prentice Hall, 1989.

3. J. G. Proakis and D.G. Manolakis, “Digital Signal Processing: Principles, Algorithms And Applications”, Prentice Hall, 1997.

4. L. R. Rabiner and B. Gold, “Theory and Application of Digital Signal Processing”, Prentice Hall, 1992.

5. J. R. Johnson, “Introduction to Digital Signal Processing”, Prentice Hall, 1992.

6. Digital Signal Processing : Salivahanan & Gnanapriya; TMH Pub.

BEE-751	Digital Signal Processing Lab	L-T-P-C: 0-0-2-1

Perform at least any 10 experiments (At least 5 from each section)

LIST OF EXPERIMENTS: http://vlabs.iitkgp.ernet.in/dsp/#

Perform the following experiments using MATLAB:

1. To represent basic signals (Unit step, unit impulse, ramp, exponential, sine and cosine).

2. To develop program for discrete convolution.

3. To develop program for discrete correlation.

4. To understand stability test.

5. To understand sampling theorem.

6. To design analog filter (low-pass, high pass, band-pass, band-stop).

7. To design digital IIR filters (low-pass, high pass, band-pass, band-stop).

8. To design FIR filters using windows technique.

9. To design a program to compare direct realization values of IIR digital filter

10. To develop a program for computing parallel realization values of IIR digital filter.

11. To develop a program for computing cascade realization values of IIR digital filter

12. To develop a program for computing inverse Z-transform of a rational transfer function

Simulation Experiments using Virtual lab: http://vlabs.iitkgp.ernet.in/rtes/#

- DF-Part1: Digital FIR filter design and simulation
- DF-Part2: Fixed point Implementation of Digital FIR Filter
- DF-Part3: MCU-DAC interfacing and generation of ramp wave
- DF-Part4: Interfacing of ADC and data transfer by software polling, study of aliasing

- DF-Part5: ADC triggering through timer(On Chip Timer)
- DF-Part6: Interrupt driven data transfer from ADC
- DF-Part7 Implementation of Digital FIR Filter on 8051 Microcontroller
- SM-Part1: LCD - MCU interfacing and displaying a string
- SM-Part2 Keyboard-MCU interfacing take a input from keypad and display on LCD
- SM-Part3: Stepper Motor Control Using ATMEGA-16 Microcontroller
- HN-Part1: Interface a LED matrix and display a number on the matrix.
- HN-Part2: Interfacing 4x4 switch matrix with the microcontroller
- HN-Part3: Implementation of Hopfield network in C to recognize a simple ASCII character.
- HN-Part4: Implementation of Hopfield Network on ATMEGA-16 microcontroller
- SC: Serial Communication between micro controller and PC
- TC: Temperature control using ATmega16

BEE-801	**Industrial Electrical Systems**	**L-T-P-C: 3-0-0-3**
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Understand the electrical wiring systems for residential, commercial and industrial consumers, representing the systems with standard symbols and drawings, SLD	
CO2	Understand various components of industrial electrical systems	
CO3	Analyse and select the proper size of various electrical system components.	
CO4		
C05		

UNIT I: Electrical System Components (8 Hours) LT system wiring components, selection of cables, wires, switches, distribution box, metering system, Tariff structure, protection components- Fuse, MCB, MCCB, ELCB, inverse current characteristics, symbols, single line diagram (SLD) of a wiring system, Contactor, Isolator, Relays, MPCB, Electric shock and Electrical safety practices

UNIT II: Residential and Commercial Electrical Systems (8 Hours) Types of residential and commercial wiring systems, general rules and guidelines for installation, load calculation and sizing of wire, rating of main switch, distribution board and protection devices, earthing system calculations, requirements of commercial installation, deciding lighting scheme and number of lamps, earthing of commercial installation, selection and sizing of components.

UNIT III: Illumination Systems (6 Hours) Understanding various terms regarding light, lumen, intensity, candle power, lamp efficiency, specific consumption, glare, space to height ratio, waste light factor, depreciation factor, various illumination schemes, Incandescent lamps and modern luminaries like CFL, LED and their operation, energy saving in illumination systems, design of a lighting scheme for a residential and commercial premises, flood lighting.

UNIT IV: Industrial Electrical Systems I (8 Hours) HT connection, industrial substation, Transformer selection, Industrial loads, motors, starting of motors, SLD, Cable and Switchgear selection, Lightning Protection, Earthing design, Power factor correction – kVAR calculations, type of compensation, Introduction to PCC, MCC panels. Specifications of LT Breakers, MCB and other LT panel components.

UNIT V: Industrial Electrical Systems II (6 Hours) DG Systems, UPS System, Electrical Systems for the elevators, Battery banks, Sizing the DG, UPS and Battery Banks, Selection of UPS and Battery Banks.

Industrial Electrical System Automation (6 Hours) Study of basic PLC, Role of in automation, advantages of process automation, PLC based control system design, Panel Metering and Introduction to SCADA system for distribution automation.

Text/Reference Books

2. S.L. Uppal and G.C. Garg, "Electrical Wiring, Estimating & Costing", Khanna publishers, 2008.

3. K. B. Raina, "Electrical Design, Estimating & Costing", New age International, 2007.

4. S. Singh and R. D. Singh, "Electrical estimating and costing", Dhanpat Rai and Co., 1997.

5. Web site for IS Standards.

6. H. Joshi, "Residential Commercial and Industrial Systems", McGraw Hill Education, 2008.

BHSM-804	Principles of Management	L-T-P-C: 3-0-0-3
CO1	Remembering the concept of Management, human relation and skills of management	
CO2	Understand the meaning of planning , strategic management	
CO3	Understand the steps of Decision Making and Technique	
CO4	Remembering of the nature of organisation, motivational technique, leaderships etc.	
C05	Performs and evaluate of budgetary and no budgetary control technique	

UNIT I

Definition of management, science or art, manager vs entrepreneur; Types of managers- managerial roles and skills; Evolution of management- scientific, human relations, system and contingency approaches; Types of Business Organizations, sole proprietorship, partnership, company, public and private enterprises; Organization culture and environment; Current trends and issues in management.

UNIT II

Nature and purpose of Planning, types of Planning, objectives, setting objectives, policies, Strategic Management, Planning Tools and Techniques, Decision making steps & processes.

UNIT III

Registrar:RAJEEV KUMAR
Signing Date:14.06.2024
02:26

Nature and purpose of Organizing, formal and informal organization, organization structure, types, line and staff authority, departmentalization, delegation of authority, centralization and decentralization, job design, human resource management, HR planning, Recruitment selection

UNIT IV

Training & Development, Performance Management, Career planning and Management. Directing, individual and group behavior, motivation, motivation theories, motivational techniques, job satisfaction, job enrichment, leadership, types & theories of leadership, effective communication.

UNIT V

Controlling, system and process of controlling, budgetary and non-budgetary control techniques, use of computers and IT in management control, productivity problems and management, control and performance, direct and preventive control, reporting.

Text Books:

1. Robins S.P. and Couiter M., Management, Prentice Hall India, 10th ed., 2009.

2. Stoner JAF, Freeman RE and Gilbert DR, Management, 6th ed., Pearson Education, 2004.

3. Tripathy PC & Reddy PN, Principles of Management, Tata McGraw Hill, 1999.

Electrical CAD and Fabrication Lab

Conduct at least any 10 experiments

1. Simulation of Transient response of RLC Circuit To an input (i) step (ii) pulse and(iii) Sinusoidal signals

2. Transformer design & Fabrication.

3. Small Power Supply design & Fabrication.

4. Filter design & Fabrication.

5. Controller design & Fabrication.

6. Inductor design and Fabrication.

7. Measurement of electrical parameters of AC & DC machine.

8. Design & Fabrication of High Power factor controlled rectifier.

9. Design & Fabrication of Microcontroller based digital energy meters / sensors.

10. Design & Fabrication of Power amplifier.

11. Design Fabrication of AC phase converter and its firing circuit.

12. IGBT based single phase inverter design and Fabrication.

13. Design & Fabrication of chopper.

14. Simulation of single Phase Inverter with PWM control

DEPARTMET ELECTIVES

DEEE-501	Micro Electro Mechanical Systems	L-T-P-C: 3-0-0-3
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Understand different materials used and the rudiments of Micro fabrication techniques.	
CO2	Understand and analyse the operation of various sensors and actuators	
CO3	Choose application of MEMS to real life problems	

UNIT I : INTRODUCTION [10 hours]
Intrinsic Characteristics of MEMS – Energy Domains and Transducers- Sensors and Actuators – Introduction to Micro fabrication – Silicon based MEMS processes – New Materials – Review of Electrical and Mechanical concepts in MEMS – Semiconductor devices – Stress and strain analysis – Flexural beam bending- Torsional deflection.

UNIT II : SENSORS AND ACTUATORS-I [9 hours]
Electrostatic sensors – Parallel plate capacitors – Applications – Inter-digitated Finger capacitor – Comb drive devices – Micro Grippers – Micro Motors – Thermal Sensing and Actuation – Thermal expansion – Thermal couples – Thermal resistors – Thermal Bimorph – Applications – Magnetic Actuators – Micromagnetic components – Case studies of MEMS in magnetic actuators- Actuation using Shape Memory Alloys

UNIT III : SENSORS AND ACTUATORS-II [9 hours]

Piezoresistive sensors – Piezoresistive sensor materials – Stress analysis of mechanical elements –

Applications to Inertia, Pressure, Tactile and Flow sensors – Piezoelectric sensors and actuators – piezoelectric effects – piezoelectric materials – Applications to Inertia , Acoustic, Tactile and Flow sensors.

TEXT BOOKS:

1. Chang Liu, "Foundations of MEMS", Pearson Education Inc., 2006.
2. Stephen D Senturia, "Microsystem Design", Springer Publication, 2000.
3. Tai Ran Hsu, "MEMS & Micro systems Design and Manufacture" Tata McGraw Hill, New Delhi, 2002.

REFERENCES:

1. Nadim Maluf," An Introduction to Micro Electro Mechanical System Design", Artech House, 2000.
2. Mohamed Gad-el-Hak, editor, " The MEMS Handbook", CRC press Baco Raton, 2000

BEE-502	**Introduction to Power Plant Engineering**	**L-T-P-C: 3-0-0-3**
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Describe the layout and the operation of all parts of a Hydro-electric power plant	
CO2	Explain the layout and the operation of all parts of a Thermal power plant	
CO3	Comprehend the layout and the operation of all parts of a Nuclear power plant	
CO4	Understand Wind power generation and Solar Power generation and all the equipment involved in it	
C05	Understand plant selection, choice of size and number of Generators in combined operation of power plants	

UNIT I Hydro-electric power plants – selection of site, elements of power plant, classification, water turbines, governor action, hydro-electric generator, plant layout, pumped storage plants.

UNIT II Thermal Steam power plants – selection of site, elements and operational circuits of the power plant, turbo-alternators, plant layout, steam turbines, controls and auxiliaries.

UNIT III Nuclear power plants – selection of site, nuclear reaction – fission process and chain reaction, constituents of power plant and layout, nuclear reactor – working, classification, control, shielding and waste disposal.

UNIT IV Renewable power plants – Solar power generation – Photo-voltaic and solar thermal generation – solar concentrators, Wind power generation – types of wind mills, wind generators, tidal, biomass, geothermal and magneto-hydro dynamic power generation, micro-hydel power plants, fuel cells and diesel and gas power plants.

UNIT V Combined operation of power plants – plant selection, choice of size and number of generator units, interconnected systems, real and reactive power exchange among interconnected systems. Power plant economics: load curve, different terms and definitions, cost of electrical energy, tariffs methods of electrical energy, performance & operating characteristics of power plants, Economic Load Sharing.

Text Books:

1. Chakrabarti A., Soni M.L., Gupta P.V., and Bhatnagar U.S., 'A text book on Power Systems Engg.', DhanpatRai and Sons, New Delhi, 2nd revised edition, 2010.

2. JB Gupta, 'A course in Power Systems', S.K. Kataria and sons, reprint 2010-2011.

Reference Books:

1. Wadhwa, C.L., 'Generation Distribution and Utilization of Electrical Energy', New Age International publishers, 3rd edition, 2010.

2. Deshpande M.V, `Elements of Electrical Power systems Design', Pitman, New Delhi, PHI Learning Private Limited, 1st edition, 2009.

DEEE-503	**Electrical & Electronics Engineering Materials**	**L-T-P-C: 3-0-0-3**
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Understand bonds, energy bands and classification of materials	
CO2	Comprehend conductivity in Metals	
CO3	Explain the mechanism of conduction in semiconductor materials	
CO4	Recount magnetic properties of materials	

UNIT – I Crystal Structure of Materials:

A. Bonds in solids, crystal structure, co-ordination number, atomic packing factor, Miller Indices, Bragg's law and x-ray diffraction, structural Imperfections, crystal growth

B. Energy bands in solids, classification of materials using energy band.

UNIT – II Conductivity of Metals:

Electron theory of metals, factors affecting electrical resistance of materials, thermal conductivity of metals, heat developed in current carrying conductors, thermoelectric effect, superconductivity and super conducting materials, Properties and applications of electrical conducting and insulating materials, mechanical properties of metals

UNIT – III Mechanism of Conduction in semiconductor materials:

Types of semiconductors, current carriers in semiconductors, Half effect, Drift and Diffusion currents, continuity equation, P-N junction diode, junction transistor, FET & IGFET, properties of semiconducting materials.

UNIT – IV Magnetic Properties of Material

Origin of permanent magnetic dipoles in matters, Classification Diamagnetism, Paramagnetism, Ferromagnetism, Antiferromagnetism and Ferrimagnetism, magnetostriction, properties of magnetic materials, soft and hard magnetic materials, permanent magnetic materials.

Text Books :

1 A.J. Dekker, "Electrical Engineering Materials" Prentice Hall of India

2 R.K. Rajput," Electrical Engg. Materials," Laxmi Publications.

3 C.S. Indulkar & S.Triruvagdan "An Introduction to Electrical Engg. Materials, S. Chand & Co.

References:

1 Solymar, "Electrical Properties of Materials" Oxford University Press.

2 Ian P. Hones," Material Science for Electrical and Electronic Engineering," Oxford University Press

3 G.P. Chhalotra & B.K. Bhat, "Electrical Engineering Materials" Khanna Publishers.

4 T. K. Basak, "Electrical Engineering Materials" New age International.

DEEE-504	**Artificial Intelligence**	**L-T-P-C: 3-0-0-3**
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Explain basic AI algorithms	
CO2	Represent Knowledge using rules and rule based deduction	
CO3	Understand the concept of approximate reasoning and be able to apply it through statistical, fuzzy reasoning etc	
CO4	Comprehend machine learning by ANN, Genetic algorithm	
C05	Exhibit knowledge of AI applications to Robotics and other intelligent systems	

UNIT-I FOUNDATIONAL ISSUES IN ARTIFICIAL INTELLIGENCE:

Foundation and history of AI, AI problems and techniques, AI programming languages, Introduction to LISP and PROLOG, problem spaces and searches, blind search strategies, Breadth first- Depth first - heuristic search techniques, Hill climbing, best first - A* algorithm, AO* algorithm- game tree, Min max algorithms, game playing- alpha beta pruning.

UNIT-II KNOWLEDGE REPRESENTATION:
Issues, predicate logic, logic programming, semantic nets, frames and inheritance, constraint propagation, representing knowledge using rules, rules based deduction systems.

UNIT III APPROXIMATE REASONING:

Reasoning under uncertainty, review of probability, Baye's probabilistic inferences and Dempster Shafer theory, Heuristic methods, symbolic reasoning under uncertainty, Statistical reasoning, Fuzzy reasoning, Temporal reasoning, Non-monotonic reasoning.

UNIT-IV PLANNING & LEARNING:

Planning in situational calculus, Representation for planning, Partial order planning algorithm, Learning from examples, Discovery as learning, Learning by analogy, Explanation based learning, Introductory remarks on learning by Neural Networks and Genetic Algorithms.

UNIT-V APPLICATIONS:

Rule based systems architecture, Expert systems, Knowledge acquisition concepts, AI application to robotics, and current trends in intelligent systems.

TEXT BOOK:

1. Artificial Intelligence: A Modern Approach,. Russell & Norvig. Prentice Hall, 1995.

REFERENCE BOOKS:

1. Elain Rich and Kevin Knight, “Artificial Intelligence”, TMH, 1991.

2. Staurt Russel and Peter Norvig, “Artificial Intelligence - A modern approach”, PHI, 1998.

3. Patrick Henry Winston, “Artificial intelligence”, 3rd Ed., Addition Wesley, 1992. 4. Dan W. Patterson, “Artificial Intelligence”, PHI, 1990

DEEE-601	**Wind and Solar Energy Systems**	**L-T-P-C: 3-0-0-3**
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Understand the energy scenario and the consequent growth of the power generation from renewable energy sources	
CO2	Explain the basic physics of wind and solar power generation	
CO3	Comprehend the power electronic interfaces for wind and solar generation	
CO4	Analyse the issues related to the grid-integration of solar and wind energy systems	

Unit I: Physics of Wind Power: (5 Hours)

History of wind power, Indian and Global statistics, Wind physics, Betz limit, Tip speed ratio, stall and pitch control, Wind speed statistics-probability distributions, Wind speed and power-cumulative distribution functions.

Unit II: Wind generator topologies: (12 Hours)

Review of modern wind turbine technologies, Fixed and Variable speed wind turbines, Induction Generators, Doubly-Fed Induction Generators and their characteristics, Permanent-Magnet Synchronous Generators, Power electronics converters. Generator-Converter configurations, Converter Control.

Unit III: The Solar Resource: (3+8 Hours)

Introduction, solar radiation spectra, solar geometry, Earth Sun angles, observer Sun angles, solar day length, Estimation of solar energy availability.

Solar photovoltaic: Technologies-Amorphous, mono-crystalline, polycrystalline; V-I characteristics of a PV cell, PV module, array, Power Electronic Converters for Solar Systems, Maximum Power Point Tracking (MPPT) algorithms. Converter Control.

Unit IV: Network Integration Issues: (8 Hours)

Overview of grid code technical requirements. Fault ride-through for wind farms - real and reactive power regulation, voltage and frequency operating limits, solar PV and wind farm behavior during grid disturbances. Power quality issues. Power system interconnection experiences in the world. Hybrid and isolated operations of solar PV and wind systems.

Unit V: Solar thermal power generation: (3 Hours)

Technologies, Parabolic trough, central receivers, parabolic dish, Fresnel, solar pond, elementary analysis.

Text / References:

1. T. Ackermann, “Wind Power in Power Systems”, John Wiley and Sons Ltd., 2005.

2. G. M. Masters, “Renewable and Efficient Electric Power Systems”, John Wiley and Sons, 2004.

3. S. P. Sukhatme, “Solar Energy: Principles of Thermal Collection and Storage”, McGraw Hill, 1984.

4. H. Siegfried and R. Waddington, “Grid integration of wind energy conversion systems” John Wiley and Sons Ltd., 2006.

5. G. N. Tiwari and M. K. Ghosal, “Renewable Energy Applications”, Narosa Publications, 2004.

6. J. A. Duffie and W. A. Beckman, “Solar Engineering of Thermal Processes”, John Wiley & Sons, 1991.

3. Julian w. Gardner, Vijay K. Varadan, Osama O. Awadelkarim, “Micro Sensors MEMS and Smart Devices”, John Wiley & Son LTD,2002
4. James J.Allen, “Micro Electro Mechanical System Design”, CRC Press Publisher, 2010
5. Thomas M.Adams and Richard A.Layton, “Introduction MEMS, Fabrication and Application,” Springer 2012

DEEE-602	EHV AC & DC Transmission	L-T-P-C: 3-0-0-3
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Understand the need of EHV transmission and their applications	
CO2	Explain losses and switching surges in EHV AC transmission and methods to reduce them	
CO3	Comprehend methods of Extra High Voltage Testing	
CO4	Describe types EHV DC transmission links	
C05	Comprehend faults that can occur in EHV DC transmission and the protection	

UNIT I: Introduction

Need of EHV transmission, standard transmission voltage, comparison of EHV AC & DC transmission systems and their applications & limitations, surface voltage gradients in conductor, distribution of voltage gradients on sub-conductors, mechanical considerations of transmission lines, modern trends in EHV AC and DC transmission

UNIT-II: EHV AC Transmission:

Corona loss formulas, corona current, audible noise – generation and characteristics corona pulses their generation and properties, radio interference (RI) effects, over voltage due to switching, ferro-resonance, reduction of switching surges on EHV system, principle of half wave transmission.

UNIT-III: Extra High Voltage Testing:

Characteristics and generation of impulse voltage, generation of high AC and DC voltages, measurement of high voltage by sphere gaps and potential dividers. Consideration for Design of EHV Lines: Design factors under steady state limits, EHV line insulation design based upon transient over voltages. Effects of pollution on performance of EHV lines.

UNIT-IV: EHV DC Transmission – I:

Types of dc links, converter station, choice of converter configuration and pulse number, effect of source inductance on operation of converters. Principle of DC link control, converter controls characteristics, firing angle control, current and excitation angle control, power control, starting and stopping of DC link.

UNIT-V:EHV DC Transmission – II:

Converter faults, protection against over currents and over voltages, smoothing reactors, generation of harmonics, AC and DC filters, Multi Terminal DC systems (MTDC): Types, control, protection and applications.

Text Books:

1.R. D. Begamudre, “Extra High Voltage AC Transmission Engineering” Wiley Eastern.

2.K. R. Padiyar, “HVDC Power Transmission Systems: Technology and System Reactions” New Age International.

3.J. Arrillaga,“ High Voltage Direct current Transmission” IFFE Power Engineering Series 6, Peter Peregrinus Ltd, London.

4.M. S. Naidu & V. Kamaraju, “High Voltage Engineering” Tata Mc Graw Hill. Reference Books:

5.M. H. Rashid , “ Power Electronics : Circuits, Devices and Applications” Prentice Hall of India. 6.S. Rao, “EHV AC and HVDC Transmission Engineering and Practice” Khanna Publisher.

7.“EPRI, Transmission Line Reference Book, 345 KV and above” Electric Power Research Institute. Palo Alto, California, 1982.

DEEE-603	Analog and Digital Communication	**L-T-P-C: 3-0-0-3**
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Exhibit knowledge of Elements of communication system	
CO2	Understand Phase modulation Techniques	
CO3	Understand Pulse modulation systemss	
CO4	Analyse digital modulation Techniques	
C05	Analyse information coding techniques	

UNIT I:

Elements of communication system and its limitations - Amplitude Modulation: Amplitude modulation and detection, Generation and detection of DSB-SC, SSB and vestigial side band modulation, carrier acquisition AM transmitters and receivers, super hetrodyne receiver, IF amplifiers, AGC circuits Frequency Division multiplexing

UNIT II:

Angle Modulation: Basic definitions Narrow band and wideband frequency modulation, transmission bandwidth of FM signals Generation and detection of frequency modulation Noise: External noise, internal noise Noise calculations, signal to noise ratio Noise in AM and FM systems

UNIT III:

Pulse Modulation: Introduction, sampling process Analog Pulse Modulation Systems-Pulse Amplitude Modulation, Pulse width modulation and Pulse Position Modulation. Waveform coding Techniques: Discretization in time and amplitude, Quantization process, quantization noise, Pulse code Modulation, Differential Pulse code Modulation, Delta Modulation and Adaptive Delta Modulation.

UNIT IV:

Digital Modulation Techniques: Types of digital modulation, waveforms for amplitude, frequency and phase shift keying, methods of generation of coherent and non-coherent, ASK,FSK and PSK, comparison of above digital techniques.

UNIT V:

Time Division Multiplexing: Fundamentals, Electronic Commutator, Bit/byte interleaving, TI carrier system, synchronization and signaling of TI, TDM and PCM hierarchy, synchronization techniques Introduction to Information Theory: Measure of information, Entropy & Information rate, channel capacity, Hartley Shannan law, Huffman coding, Shannan Fano coding.

Text Books:

1. Simon Haykin,“ Communication Systems” John Wiley & Sons 4th Edition

2. G.Kennedy and B. Davis,” Electronic Communication Systems” 4th Edition, Tata McGraw Hill

3. Simon Haykin, “Digital Communications” John Wiley & Sons

4. T.L. Singal, “Analog & Digital Communication”, Tata Mc Graw Hill

Reference Books:

1. B.P. Lathi, “Modern Analog & Digital Communication Systems” Oxford University Press.

2. Taub & Schilling, "Communication System: Analog and Digital" Tata Mc Graw Hill

3. R.P. Singh & S.D. Sapre, "Communication Systems Analog and Digital" Tata McGraw Hill.

ODEE-604	**Electrical Machine Design**	**L-T-P-C: 3-0-0-3**
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Understand the construction and performance characteristics of electrical machines	
CO2	Grasp the various factors which influence the design of Transformers: electrical, magnetic and thermal loading of electrical machines	
CO3	Comprehend the principles of electrical machine design and carry out a basic design of an Induction Motor	
CO4	Carry out a basic design of an Synchronous Machine	

C05	Use software tools to do design calculations

UNIT I: Introduction Major considerations in electrical machine design, electrical engineering materials, space factor, choice of specific - electrical and magnetic loadings, thermal considerations, heat flow, temperature rise, rating of machines.

UNIT II: Transformers Sizing of a transformer, main dimensions, kVA output for single- and three-phase transformers, window space factor, overall dimensions, operating characteristics, regulation, no load current, temperature rise in transformers, design of cooling tank, methods for cooling of transformers.

UNIT III: Induction Motors Sizing of an induction motor, main dimensions, length of air gap, rules for selecting rotor slots of squirrel cage machines, design of rotor bars & slots, design of end rings, design of wound rotor, magnetic leakage calculations, leakage reactance of poly-phase machines, magnetizing current, short circuit current, circle diagram, operating characteristics.

UNIT IV: Synchronous Machines Sizing of a synchronous machine, main dimensions, design of salient pole machines, short circuit ratio, shape of pole face, armature design, armature parameters, estimation of air gap length, design of rotor, design of damper winding, determination of full load field mmf, design of field winding, design of turbo alternators, rotor design.

UNIT V: Computer aided Design (CAD): Limitations (assumptions) of traditional designs, need for CAD analysis, synthesis and hybrid methods, design optimization methods, variables, constraints and objective function, problem formulation. Introduction to FEM based machine design. Introduction to complex structures of modern machines-PMSMs, BLDCs, SRM and claw-pole machines.

Text / References:

1. A. K. Sawhney, “A Course in Electrical Machine Design”, Dhanpat Rai and Sons, 1970.
2. M.G. Say, “Theory & Performance & Design of A.C. Machines”, ELBS London.
3. S. K. Sen, “Principles of Electrical Machine Design with computer programmes”, Oxford and IBH Publishing, 2006.
4. K. L. Narang, “A Text Book of Electrical Engineering Drawings”, SatyaPrakashan, 1969.
5. A. Shanmugasundaram, G. Gangadharan and R. Palani, “Electrical Machine Design Data Book”, New Age International, 1979.
6. K. M. V. Murthy, “Computer Aided Design of Electrical Machines”, B.S. Publications, 2008.
7. Electrical machines and equipment design exercise examples using Ansoft’s Maxwell 2D machine design package.

DEEE-701	**Soft Computing**	**L-T-P-C: 3-0-0-3**
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Artificial Intelligence, Various types of production systems, characteristics of production systems	
CO2	Neural Networks, architecture, functions and various algorithms involved	
CO3	Fuzzy Logic, Various fuzzy systems and their functions	
CO4	Genetic algorithms, its applications and advances	
C05	The unified and exact mathematical basis as well as the general principles of various soft computing techniques. Text	

UNIT I

Introduction To Soft Computing And Neural Networks : Evolution of Computing - Soft Computing Constituents – From Conventional AI to Computational Intelligence - Adaptive Networks – Feed forward Networks – Supervised Learning

UNIT II

Neural Networks – Radia Basis Function Networks - Reinforcement Learning – Unsupervised Learning Neural Networks – Adaptive Resonance architecture

Fuzzy Sets and Fuzzy Logic: Fuzzy Sets – Operations on Fuzzy Sets – Fuzzy Relations - Fuzzy Rules and Fuzzy Reasoning

UNIT III

Fuzzy Inference Systems – Fuzzy Expert Systems – Fuzzy Decision Making Neuro-Fuzzy Modeling : Adaptive Neuro-Fuzzy Inference Systems – Coactive Neuro-Fuzzy Modeling – Classification and Regression Trees

UNIT IV

Data Clustering Algorithms – Rule based Structure Identification, Neuro-Fuzzy Control

Machine Learning : Machine Learning Techniques – Machine Learning Using Neural Nets – Genetic Algorithms (GA)

UNIT V

Applications of GA in Machine Learning - Machine Learning Approach to Knowledge Acquisition. Support Vector Machines for Learning – Linear Learning Machines – Support Vector Classification – Support Vector Regression - Applications

Text Book:

1. Digital Neural Network -S.Y Kung , Prentice-Hall of India

2. James A. Freeman and David M. Skapura, "Neural Networks Algorithms, Applications, and Programming Techniques", Pearson Edn.,

3. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, "Neuro-Fuzzy and Soft Computing", Prentice-Hall of India,

References:

1. Amit Konar, "Artificial Intelligence and Soft Computing", First Edition,CRC Press, 2000.

2. David E. Goldberg, Genetic Algorithms in Search, Optimization and Machine Learning", Addison Wesley

3. George J. Klir and Bo Yuan, "Fuzzy Sets and Fuzzy Logic-Theory and Applications", Prentice Hall

4. Mitchell Melanie, "An Introduction to Genetic Algorithm", Prentice Hall, 1998. 5. Simon Haykin, "Neural Networks: A Comprehensive Foundation", Prentice Hall,

DEEE-702	**Microcontrollers and Embedded Systems**	**L-T-P-C: 3-0-0-3**
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Describe the architectural features and instructions of ARM microcontroller	
CO2	Apply the knowledge gained for Programming ARM for different applications	
CO3	Interface external devices and I/O with ARM microcontroller.	
CO4	Interpret the basic hardware components and their selection method based	

	on the characteristics and attributes of an embedded system
CO5	Demonstrate the need of real time operating system for embedded system applications

UNIT I

Microprocessors versus Microcontrollers, ARM Embedded Systems: The RISC design philosophy, The ARM Design Philosophy, Embedded System Hardware, Embedded System Software.

ARM Processor Fundamentals: Registers, Current Program Status Register, Pipeline,

Exceptions, Interrupts, and the Vector Table , Core Extensions

UNIT II

Introduction to the ARM Instruction Set: Data Processing Instructions, Programme

Instructions, Software Interrupt Instructions, Program Status Register Instructions, Coprocessor Instructions, Loading Constants

ARM programming using Assembly language: Writing Assembly code, Profiling and cycle counting, instruction scheduling, Register Allocation, Conditional Execution, Looping Constructs

UNIT III

Embedded System Components: Embedded Vs General computing system, History of embedded systems, Classification of Embedded systems, Major applications areas of embedded systems, purpose of embedded systems

Core of an Embedded System including all types of processor/controller, Memory, Sensors,

Actuators, LED, 7 segment LED display, stepper motor, Keyboard, Push button switch, Communication Interface (onboard and external types), Embedded firmware, Other system components.

UNIT IV

Embedded System Design Concepts: Characteristics and Quality Attributes of Embedded Systems, Operational quality attributes ,non-operational quality attributes, Embedded

Systems-Application and Domain specific, Hardware Software Co-Design and Program Modelling, embedded firmware design and development

UNIT V

RTOS and IDE for Embedded System Design: Operating System basics, Types of operating systems, Task, process and threads (Only POSIX Threads with an example program), Thread preemption, Multiprocessing and Multitasking, Task Communication (without any program), Task synchronization issues – Racing and Deadlock

Binary and counting semaphores (Mutex example without any program), How to choose an RTOS, Integration and testing of Embedded hardware and firmware, Embedded system Development Environment – Block diagram (excluding Keil), Disassembler/decompiler, simulator, emulator and debugging techniques, target hardware debugging, boundary scan.

Textbooks:

1. Andrew N Sloss, Dominic Symes and Chris Wright, ARM system developers guide, Elsevier, Morgan Kaufman publishers, 2008.

2. Shibu K V, "Introduction to Embedded Systems", Tata McGraw Hill Education, Private Limited, 2nd Edition.

Reference Books:

1. Raghunandan..G.H, Microcontroller (ARM) and Embedded System, Cengage learning Publication,2019

2. The Insider's Guide to the ARM7 Based Microcontrollers, Hitex Ltd.,1st edition, 2005.

3. Steve Furber, ARM System-on-Chip Architecture, Second Edition, Pearson, 2015.

4. Raj Kamal, Embedded System, Tata McGraw-Hill Publishers, 2nd Edition, 2008.

DEEE-703	**Digital Control Systems**	**L-T-P-C: 3-0-0-3**
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Obtain discrete representation of LTI systems.	
CO2	Analyse discrete LTI systems by Z transforms	
CO3	Analyse stability of open loop and closed loop discrete-time systems	
CO4	Design and analyse digital controllers	
C05	Design state feedback and output feedback controllers	

UNIT I: Discrete Representation of Continuous Systems (6 hours)

Basics of Digital Control Systems. Discrete representation of continuous systems. Sample and hold circuit. Mathematical Modelling of sample and hold circuit. Effects of Sampling and Quantization. Choice of sampling frequency. ZOH equivalent.

UNIT II:

Discrete System Analysis (6 hours)

Z-Transform and Inverse Z Transform for analyzing discrete time systems. Pulse Transfer function. Pulse transfer function of closed loop systems. Mapping from s-plane to z plane. Solution of Discrete time systems. Time response of discrete time system.

Stability of Discrete Time System (4 hours)

Stability analysis by Jury test. Stability analysis using bilinear transformation. Design of digital control system with dead beat response. Practical issues with dead beat response design.

UNIT III: State Space Approach for discrete time systems (10 hours)

State space models of discrete systems, State space analysis. Lyapunov Stability. Controllability, reach-ability, Reconstructibility and observability analysis. Effect of pole zero cancellation on the controllability & observability.

UNIT IV: Design of Digital Control System (8 hours)

Design of Discrete PID Controller, Design of discrete state feedback controller. Design of set point tracker. Design of Discrete Observer for LTI System. Design of Discrete compensator.

UNIT V: Discrete output feedback control (8 hours)

Design of discrete output feedback control. Fast output sampling (FOS) and periodic output feedback controller design for discrete time systems.

Text Books:

1. K. Ogata, "Digital Control Engineering", Prentice Hall, Englewood Cliffs, 1995.

2. M. Gopal, "Digital Control Engineering", Wiley Eastern, 1988.

3. G. F. Franklin, J. D. Powell and M. L. Workman, "Digital Control of Dynamic Systems", Addison-Wesley, 1998.

4. B.C. Kuo, "Digital Control System", Holt, Rinehart and Winston, 1980.

DEEE-704	**Energy Audit**	**L-T-P-C: 3-0-0-3**
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Understand the Power distribution system planning, operation and maintenance	
CO2	Describe the types of Energy auditing and energy audit instruments.	
CO3	Explain the short and long term measures to reduce loss and improve energy efficiency	
CO4	Understand Demand Side Management	

UNIT I: INTRODUCTION TO THE POWER DISTRIBUTION SYSTEM:

Description of the power distribution system- voltage levels, Components of the distribution system- Substation, Transformer, feeders, distribution system planning, operation & maintenance objectives, activities involved in O&M, grid management, load scheduling & dispatch, load balancing, 6633/ 11 KV substation equipment, 11/ 0.4 KV substation equipment, Distribution transformers- reasons for DT failures.

UNIT II: ENERGY ACCOUNTING & ENERGY AUDIT:

Need for energy accounting, objectives & functions of energy accounting, Energy flow diagram in power distribution system, energy accounting procedure- Energy measurement, and problems in energy accounting & overcoming these problems in energy accounting, Definition, need and types of energy audit, energy audit instruments, procedure for conducting an energy audit.

UNIT III: AT&C LOSS REDUCTION & EFFICIENCY IMPROVEMENT:

Concepts and principles of distribution losses- transmission & distribution losses, AT&C losses in power distribution network, factors contributing to high technical & commercial losses. Technical loss reduction- Short term measures for technical loss reduction, long term plans for technical loss reduction, Commercial loss reduction- reasons for commercial losses, measures for commercial loss reduction.

UNIT IV: DEMAND SIDE MANAGEMENT:

An introduction, Why DSM?, Benefits of DSM, DSM in power systems: load management, DSM techniques and emerging trends, EC Act 2001, DSM on consumer side – the industrial sector, the agricultural sector, the domestic & commercial sectors, ESCO-a route for DSM.

TEXT BOOKS:

1. Handbook of Energy Engineering, The Fairmont Press, INC.-Albert Thumann& Paul Mehta.

2. Energy Management Supply & Conservation, Butterworth Heinemann, 2002-dr. Clive Beggs.

REFERENCE BOOKS:

1. Hand book on energy audit & environment management by ISBN 81-1993.0920 TERI

DEEE-801	**Power Quality and FACTS**	**L-T-P-C: 3-0-0-3**
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Explain the characteristics of ac transmission and the effect of shunt and series reactive compensation	
CO2	Comprehend the basic concepts of power quality and the controllers	
CO3	Understand the working principles of FACTS devices and their operating characteristics	
CO4	Application of FACTS to Power Flow Control and to distribution systems	

C05	Describe the working principles of devices used to improve power quality and be familiar with UPQC

UNIT I:

Transmission Lines and Series/Shunt Reactive Power Compensation (4 hours)

Basics of AC Transmission. Analysis of uncompensated AC transmission lines. Passive Reactive Power Compensation. Shunt and series compensation at the mid-point of an AC line. Comparison of Series and Shunt Compensation.

Thyristor-based Flexible AC Transmission Controllers (FACTS) (6 hours)

Description and Characteristics of Thyristor-based FACTS devices: Static VAR Compensator (SVC), Thyristor Controlled Series Capacitor (TCSC), Thyristor Controlled Braking Resistor and Single Pole Single Throw (SPST) Switch. Configurations/Modes of Operation, Harmonics and control of SVC and TCSC. Fault Current Limiter.

UNIT II:

Voltage Source Converter based (FACTS) controllers (8 hours)

Voltage Source Converters (VSC): Six Pulse VSC, Multi-pulse and Multi-level Converters, Pulse-Width Modulation for VSCs. Selective Harmonic Elimination, Sinusoidal PWM and Space Vector Modulation. STATCOM: Principle of Operation, Reactive Power Control: Type I and Type II controllers, Static Synchronous Series Compensator (SSSC) and Unified Power Flow Controller (UPFC): Principle of Operation and Control. Working principle of Interphase Power Flow Controller. Other Devices: GTO Controlled Series Compensator. Fault Current Limiter.

UNIT III:

Application of FACTS (4 hours)

Application of FACTS devices for power-flow control and stability improvement. Simulation example of power swing damping in a single-machine infinite bus system using a TCSC. Simulation example of voltage regulation of transmission mid-point voltage using a STATCOM.

Power Quality Problems in Distribution Systems (4 hours)

Power Quality problems in distribution systems: Transient and Steady state variations in voltage and frequency. Unbalance, Sags, Swells, Interruptions, Wave-form Distortions: harmonics, noise, notching, dc-offsets, fluctuations. Flicker and its measurement. Tolerance of Equipment: CBEMA curve.

UNIT IV:

DSTATCOM (8 hours)

Reactive Power Compensation, Harmonics and Unbalance mitigation in Distribution Systems using DSTATCOM and Shunt Active Filters. Synchronous Reference Frame Extraction of Reference Currents. Current Control Techniques in for DSTATCOM.

UNIT V:

Dynamic Voltage Restorer and Unified Power Quality Conditioner (6 hours)

Voltage Sag/Swell mitigation: Dynamic Voltage Restorer – Working Principle and Control Strategies. Series Active Filtering. Unified Power Quality Conditioner (UPQC): Working Principle. Capabilities and Control Strategies.

Text/References

1. N. G. Hingorani and L. Gyugyi, "Understanding FACTS: Concepts and Technology of FACTS Systems", Wiley-IEEE Press, 1999.

2. K. R. Padiyar, "FACTS Controllers in Power Transmission and Distribution", New Age International (P) Ltd. 2007.

3. T. J. E. Miller, "Reactive Power Control in Electric Systems", John Wiley and Sons, New York, 1983.

4. R. C. Dugan, "Electrical Power Systems Quality", McGraw Hill Education, 2012.

5. G. T. Heydt, "Electric Power Quality", Stars in a Circle Publications, 1991

DEEE-802	**Digital Image & Video Processing**	**L-T-P-C: 3-0-0-3**
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Mathematically represent the various types of images and analyse them	
CO2	Process these images for the enhancement of certain properties or for optimized use of the resources	
CO3	Appreciate the use of wavelet transformation in Image processing	
CO4	Develop algorithms for image compression and coding	
C05	Understand video coding and video segmenting	

UNIT I

Digital Image Fundamentals-Elements of visual perception, image sensing and acquisition, image sampling and quantization, basic relationships between pixels – neighborhood, adjacency, connectivity, distance measures.

Image Enhancements and Filtering - Gray level transformations, histogram equalization and specifications, pixel-domain smoothing filters – linear and order-statistics, pixel-domain sharpening filters – first and second derivative, two-dimensional DFT and its inverse, frequency domain filters – low-pass and high-pass.

UNIT II

Color Image Processing - Color models–RGB, YUV, HSI; Color transformations– formulation, color complements, color slicing, tone and color corrections; Color image smoothing and sharpening; Color Segmentation.

Image Segmentation- Detection of discontinuities, edge linking and boundary detection, thresholding – global and adaptive, region-based segmentation.

UNIT III

Wavelets and Multi-resolution image processing- Uncertainty principles of Fourier Transform, Time frequency localization, continuous wavelet transforms, wavelet bases and multi-resolution analysis, wavelets and Sub-band filter banks, wavelet packets.

UNIT IV

Image Compression-Redundancy–inter-pixel and psycho-visual; Lossless compression – predictive, entropy; Lossy compression-predictive and transform coding; Discrete Cosine Transform; Still image compression standards–JPEG and JPEG-2000

UNIT V

Fundamentals of Video Coding-Inter-frame redundancy, motion estimation techniques – full-search, fast search strategies, forward and backward motion prediction, frame classification – I, P and B; Video sequence hierarchy–Group of pictures, frames, slices, macro-blocks and blocks; Elements of a video encoder and decoder; Video coding standards – MPEG and H.26X.

Video Segmentation-Temporal segmentation–shot boundary detection, hard-cutsand soft-cuts; spatial segmentation–motion-based; Video object detection and tracking.

Text/Reference Books:

1. R.C. Gonzalez and R.E. Woods, Digital Image Processing, Second Edition, Pearson Education 3rd edition 2008

2. Anil Kumar Jain, Fundamentals of Digital Image Processing, Prentice Hall of India.2nd edition 2004 3. Murat Tekalp , Digital Video Processing" Prentice Hall, 2nd edition 2015

DEEE-803	**Medical Instrumentation**	**L-T-P-C: 3-0-0-3**
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Define basic medical terms and physical values that can be handled by medical instrumentation	
CO2	Describe methods and implementation of electrical and non- electrical medical parameters diagnostics	
CO3	Analyse the electrical parameters after acquisition	
CO4	Understand medical imaging modalities and analysis	
C05	Comprehend the functioning of **life assisting, therapeutic and robotic devices**	

UNIT I: FUNDAMENTALS OF BIOMEDICAL ENGINEERING
Cell and its structure – Resting and Action Potential – Nervous system and its fundamentals - Basic components of a biomedical system- Cardiovascular systems- Respiratory systems -Kidney and blood flow - Biomechanics of bone - Biomechanics of soft tissues - Basic mechanics of spinal column and limbs -Physiological signals and transducers - Transducers – selection criteria – Piezo electric, ultrasonic transducers - Temperature measurements – Fibre-optic temperature sensors.

UNIT II: NON ELECTRICAL PARAMETERS MEASUREMENT AND DIAGNOSTIC PROCEDURES
Measurement of blood pressure - Cardiac output - Heart rate - Heart sound - Pulmonary function measurements – spirometer – Photo Plethysmography, Body Plethysmography – Blood Gas analysers, pH of blood –measurement of blood pCO_2, pO_2, finger-tip oxymeter - ESR, GSR measurements.

UNIT III: ELECTRICAL PARAMETERS ACQUISITION AND ANALYSIS
Electrodes – Limb electrodes –floating electrodes – pregelled disposable electrodes - Micro, needle and surface electrodes – Amplifiers, Preamplifiers, differential amplifiers, chopper amplifiers – Isolation amplifier - ECG – EEG – EMG – ERG – Lead systems and recording methods – Typical waveforms - Electrical safety in medical environment, shock hazards – leakage current-Instruments for checking safety parameters of biomedical equipments.

UNIT IV: IMAGING MODALITIES AND ANALYSIS
Radio graphic and fluoroscopic techniques – Computer tomography – MRI – Ultrasonography – Endoscopy – Thermography –Different types of biotelemetry systems - Retinal Imaging - Imaging application in Biometric systems - Analysis of digital images.

UNIT V: LIFE ASSISTING, THERAPEUTIC AND ROBOTIC DEVICES
Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators – Diathermy – Heart – Lung machine – Audio meters – Dialysers – Lithotripsy - ICCU patient monitoring system - Nano Robots - Robotic surgery – Advanced 3D surgical techniques- Orthopedic prostheses fixation.

Text Book:

1. J. G. Webster, Medical Instrumentation, Application and Design, John Wiley and Sons

2. L. Cromwell, F. J. Weibell and L. A. Pfeiffer, Biomedical Instrumentation Measurements, Pearson education, Delhi, 1990.

References:

1. R. S. Khandpur, Handbook of Biomedical Instrumentation, Tata Mc Graw Hill

2. J. J. Carr and J. M. Brown, Introduction to Biomedical Equipment Technology, Pearson

DEEE-804	Speech and Audio-processing	L-T-P-C: 3-0-0-3
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Understand Speech production and speech coding	
CO2	Analyse the quality and properties of speech signal	
CO3	Mathematically model the speech signal	
CO4	Modify and enhance the speech and audio signals	

UNIT I

Registrar:RAJEEV KUMAR
Signing Date:14.06.2024
02:26

Introduction- Speech production and modeling - Human Auditory System; General structure of speech coders; Classification of speech coding techniques – parametric, waveform and hybrid ; Requirements of speech codecs –quality, coding delays, robustness.

Speech Signal Processing- Pitch-period estimation, all-pole and all-zero filters, convolution; Power spectral density, periodogram, autoregressive model, autocorrelation estimation.

UNIT II

Linear Prediction of Speech- Basic concepts of linear prediction; Linear Prediction Analysis of non-stationary signals –prediction gain, examples; Levinson-Durbin algorithm; Long term and short-term linear prediction models; Moving average prediction.

UNIT III

Speech Quantization- Scalar quantization–uniform quantizer, optimum quantizer, logarithmic quantizer, adaptive quantizer, differential quantizers; Vector quantization – distortion measures, code book design, code book types

Scalar Quantization of LPC- Spectral distortion measures, Quantization based onreflection coefficient and log area ratio, bit allocation; Line spectral frequency – LPC to LSF conversions, quantization based on LSF

UNIT IV

Linear Prediction Coding- LPC model of speech production; Structures of LPC encoders and decoders; Voicing detection; Limitations of the LPC model

Code Excited Linear Prediction - CELP speech production model; Analysis-by-synthesis; Generic CELP encoders and decoders; Excitation codebook search – state-save method, zero-input zero-state method; CELP based on adaptive codebook, Adaptive Codebook search; Low Delay CELP and algebraic CELP.

Speech Coding Standards - An overview of ITU-T G.726, G.728 and G.729standards

Text/Reference Books:

1. “Digital Speech” by A.M.Kondoz, Second Edition (Wiley Students‟ Edition), 2004.

2. “Speech Coding Algorithms: Foundation and Evolution of Standardized Coders”, W.C. Chu, WileyInter science, 2003.

DEEE-805	**High Voltage Engineering**	**L-T-P-C: 3-0-0-3**
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Understand the basic physics related to various breakdown processes in solid, liquid and gaseous insulating materials	
CO2	Exhibit knowledge of generation and measurement of D. C., A.C., and Impulse voltages	
CO3	Comprehend tests on H. V. equipment and on insulating materials, as per the standards.	
CO4	Analyse how over-voltages arise in a power system	
C05	Understand protection against these overvoltages	

Unit 1:

Breakdown in Gases (8 Hours) Ionization processes and de-ionization processes, Types of Discharge, Gases as insulating materials, Breakdown in Uniform gap, non-uniform gaps, Townsend's theory, Streamer mechanism, Corona discharge

Unit 2:

Breakdown in liquid and solid Insulating materials (7 Hours) Breakdown in pure and commercial liquids, Solid dielectrics and composite dielectrics, intrinsic breakdown, electromechanical breakdown and thermal breakdown, Partial discharge, applications of insulating materials.

Unit 3:

Generation of High Voltages (7 Hours) Generation of high voltages, generation of high D. C. and A.C. voltages, generation of impulse voltages, generation of impulse currents, tripping and control of impulse generators.

Unit 4:

Measurements of High Voltages and Currents (7 Hours) Peak voltage, impulse voltage and high direct current measurement method, cathode ray oscillographs for impulse voltage and current measurement, measurement of dielectric constant and loss factor, partial discharge measurements.

Unit 5:

Lightning and Switching Over-voltages (7 Hours) Charge formation in clouds, Stepped leader, Dart leader, Lightning Surges. Switching over-voltages, Protection against over-voltages, Surge diverters, Surge modifiers.

Unit 6:

High Voltage Testing of Electrical Apparatus and High Voltage Laboratories (7 Hours) Various standards for HV Testing of electrical apparatus, IS, IEC standards, Testing of insulators and bushings, testing of isolators and circuit breakers, testing of cables, power transformers and some high voltage equipment, High voltage laboratory layout, indoor and outdoor laboratories, testing facility requirements, safety precautions in H. V. Labs.

Text/Reference Books

1. M. S. Naidu and V. Kamaraju, "High Voltage Engineering", McGraw Hill Education, 2013.
2. C. L. Wadhwa, "High Voltage Engineering", New Age International Publishers, 2007.
3. D. V. Razevig (Translated by Dr. M. P. Chourasia), "High Voltage Engineering Fundamentals", Khanna Publishers, 1993.
4. E. Kuffel, W. S. Zaengl and J. Kuffel, "High Voltage Engineering Fundamentals", Newnes Publication, 2000.
5. R. Arora and W. Mosch "High Voltage and Electrical Insulation Engineering", John Wiley & Sons, 2011
6. Various IS standards for HV Laboratory Techniques and Testing

Micro electro mechanical systems
EHV AC and DC Transmission
Analog and Digital Communication
Electrical Machine Design
Wind and solar energy

Registrar:RAJEEV KUMAR
Signing Date:14.06.2024
02:26