AKU B.E./B.Tech EE Sem 5 syllabus

Power Systems-I

Power Systems-I

Credits - 03

Module 1: Basic Concepts

EvolutionofPowerSystemsandPresent-DayScenario.Structureofapowersystem: Bulk Power Grids and Micro-grids. Generation: Conventional and Renewable Energy Sources. Distributed Energy Resources. Energy Storage. Transmission and Distribution Systems: Line diagrams, transmission and distribution voltage levels and topologies (meshed and radial systems). Synchronous Grids and Asynchronous (DC) interconnections. Review of Three-phase systems. Analysis of simple three-phase circuits. Power Transfer in AC circuits and Reactive Power. Skin effect and Ferranti effect

Module 2: Power System Components

Overhead Transmission Lines and Cables: Electrical and Magnetic Fields around conductors, Corona. Parameters of lines and cables. Capacitance and Inductance calculations for simple configurations. Travelling-wave Equations. Sinusoidal Steady state representation of Lines:
Short, medium and long lines. Power Transfer, Voltage profile and Reactive Power. Characteristics of transmission lines. Surge Impedance Loading. Series and Shunt Compensation of transmission lines.

Transformers: Three-phase connections and Phase-shifts. Three-winding transformers, auto-transformers, Neutral Grounding transformers. Tap-Changing in transformers. Transformer Parameters. Single-phase equivalent of three-phase transformers.

Synchronous Machines: Steady-state performance characteristics. Operation when connected to infinite bus. 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.

Module 3: Over-voltages and Insulation Requirements
Generation of Over-voltages: Lightning and Switching Surges. Protection against Over-voltages, Insulation Coordination. Propagation of Surges. Voltages produced by traveling surges. Bewley Diagrams.

Module 4: Introduction to DC Transmission & Renewable Energy Systems
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. Solar PV systems: I-V and P-V characteristics of PV panels, power electronic interface of PV to the grid. Wind Energy Systems: Power curve of wind turbine. Fixed and variable speed turbines. Permanent Magnetic Synchronous Generators and Induction Generators. Power Electronics interfaces of wind generators to the grid.

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.

Control Systems

Control Systems

Credits - 03

Module 1: Introduction to control problem
Industrial Control examples. Mathematical models of physical systems. Control hardware and their models. Transfer function models of linear time-invariant systems. Feedback Control: Open-Loop and Closed-loop systems. Benefits of Feedback. Block diagram algebra. Signal flow graph

Module 2: Time Response Analysis
Standard test signals. Time response of first and second-order systems for standard test inputs. Application of initial and final value theorem. Design specifications for second-order systems based on the time-response. Concept of Stability. Routh-Hurwitz Criteria. Relative Stability analysis. Root-Locus technique. Construction of Root-loci.

Module 3: Frequency-response analysis
Relationship between time and frequency response, Polar plots, Bode plots. Nyquist stability criterion. Relative stability using Nyquist criterion – gain and phase margin. Closed-loop frequency response.

Module 4: Introduction to Controller Design
Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness of control systems. Root-loci method of feedback controller design. Design specifications in frequency-domain. Frequency-domain methods of design. Application of Proportional, Integral and Derivative Controllers, Lead and Lag compensation in designs. Analog and Digital implementation of controllers.

Module 5: State variable Analysis
Concepts of state variables. State space model. Diagonalization of State Matrix. Solution of state equations. Eigen values and Stability Analysis. Concept of controllability and observability. Pole-placement by state feedback. Discrete-time systems. Difference Equations. State-space models of linear discrete-time systems. Stability of linear discrete-time systems.

Text/References:

- M. Gopal, “Control Systems: Principles and Design”, McGraw Hill Education, 1997.

- B. C. Kuo, “Automatic Control System”, Prentice Hall, 1995.
- K. Ogata, “Modern Control Engineering”, Prentice Hall, 1991.
- I. J. Nagrath and M. Gopal, “Control Systems Engineering”, New Age International,2009

Microprocessors

Microprocessors

Credits- 03

Module 1: Fundamentals of Microprocessors
Fundamentals of Microprocessor Architecture. 8-bit Microprocessor and Microcontroller architecture, Comparison of 8-bit microcontrollers, 16-bit and 32-bit microcontrollers.
Definition of embedded system and its characteristics, Role of microcontroller sin embedded Systems. Overview of the 8051family.

Module 2: The 8051 Architecture
InternalBlockDiagram,CPU, ALU, address, data and controlbus,Working registers, SFRs, Clock and RESET circuits, Stack and Stack Pointer, Program Counter, I/O ports, Memory Structures, Data and Program Memory, Timing diagrams and Execution Cycles.

Module 3: Instruction Set and Programming
Addressing modes: Introduction, Instruction syntax, Data types, Subroutines Immediate addressing, Register addressing, Direct addressing, Indirect addressing, Relative addressing Indexed addressing, Bit inherent addressing, bit direct addressing. 8051 Instruction set, Instruction timings. Data transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Subroutine instructions, Bit manipulation instruction. Assembly language programs, C language programs. Assemblers and compilers. Programming and debugging tools.

Module 4: Memory and I/O Interfacing
Memory and I/O expansion buses, control signals, memory wait states. Interfacing of peripheral devices such as General Purpose I/O, ADC, DAC, timers, counters, memory devices.

Module 5: External Communication Interface

Synchronous and Asynchronous Communication. RS232, SPI, I2C. Introduction and interfacing to protocols like Blue-tooth and Zig-bee.

Module 6: Applications
LED, LCD and keyboard interfacing. Stepper motor interfacing, DC Motor interfacing, sensor interfacing.

Text / References:

- M. A.Mazidi, J. G. Mazidi and R. D. McKinlay, “The8051Microcontroller and Embedded Systems: Using Assembly and C”,Pearson Education,2007.
- K. J. Ayala, “8051 Microcontroller”, Delmar CengageLearning,2004.
- R. Kamal, “Embedded System”, McGraw HillEducation,2009.
- R. S. Gaonkar, “, Microprocessor Architecture: Programming and Applications with the 8085”, Penram International Publishing,1996
- D.A. Patterson and J.H. Hennessy, "Computer Organization and Design: The Hardware/Software interface”, Morgan Kaufman Publishers,2013.
- D. V. Hall, “Microprocessors & Interfacing”, McGraw Hill Higher Education,1991.

Power Electronics

Power Electronics

Credits - 03

Module 1: Power switching devices
Diode, Thyristor, MOSFET, IGBT: I-V Characteristics; Firing circuit for thyristor; Voltage and current commutation of a thyristor; Gate drive circuits for MOSFET and IGBT.

Module 2: Thyristor rectifiers
Single-phase half-wave and full-wave rectifiers, Single-phase full-bridge thyristor rectifier with R- load and highly inductive load; Three-phase full-bridge thyristor rectifier with R-load and highly inductive load; Input current wave shape and power factor.

Module 3: DC-DC converter

Elementary chopper with an active switch and diode, concepts of duty ratio and average voltage, power circuit of a buck converter, analysis and waveforms at steady state, duty ratio control of output voltage. Power circuit of a boost converter, analysis and waveforms at steady state, relation between duty ratio and average output voltage.

Module 4: Single-phase and 3-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 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. Current Source Inverter

Text/References:

- M. H. Rashid, “Power electronics: circuits, devices, and applications”, Pearson Education India, 2009.
- N. Mohan and T. M. Undeland, “Power Electronics: Converters, Applications and Design”, John Wiley & Sons, 2007.
- R. W. Erickson and D. Maksimovic, “Fundamentals of Power Electronics”, Springer Science& Business Media, 2007.
- L. Umanand, “Power Electronics: Essentials and Applications”, Wiley India, 2009.

Microprocessors and Microcontrollers (PE1)

EC110 Microprocessors and Microcontrollers

3 Credits

1 Introduction to Microprocessor Systems: Architecture and Pin diagram of 8085, Timing Diagram, Memory organization, Addressing modes, Interrupts. Assembly Language Programming, 8085 interrupts, Additional I/O concepts and processes.

2 Interfacing of 8085 with 8255, 8254/ 8253, 8251, 8259: Introduction, Generation of I/O Ports, Programmable Peripheral Interface (PPI)-Intel 8255, Sample-and- Hold Circuit and Multiplexer, Keyboard and Display Interface, Keyboard and Display Controller (8279), Programmable Interval timers (Intel 8253/8254), USART

(8251), PIC (8259), DAC, ADC, LCD, Stepper Motor.

3 Introduction to 8086, 80286, 80386 and 80486 Microprocessor: 8086 Architecture, Generation of physical address, Pin diagram of 8086, Minimum Mode and Maximum mode, Bus cycle, Memory Organization, Memory Interfacing, Addressing Modes, Assembler Directives, Instruction set of 8086, Assembly Language Programming, Hardware and Software Interrupts. Introduction of 80286, 80386, and 80486 microprocessor

4 Overview of Microcontroller 8051: Introduction to 8051 Microcontroller, Architecture, Memory organization, Special function registers, Port Operation, Memory Interfacing, I/O Interfacing, Programming 8051 resources, interrupts, Programmer's model of 8051, Operand types, Operand addressing, Data transfer instructions, Arithmetic instructions, Logic instructions, Control transfer instructions, Timer and Counter Programming, Interrupt Programming.

Name of Authors / Books /Publishers

1 "Microprocessors and Microcontrollers", Muhammad Ali Mazidi, Pearson, 2006
2 "Microprocessors and Interfacing, Programming and Hardware", Douglas V Hall, Tata McGraw Hill, 2006
3 "MicroProcessor Architecture, Programming and Applications with the 8085", Ramesh Gaonkar, PHI
4 "The 8051 Microcontroller and Embedded Systems", Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D. MCKinlay, 2nd Edition, Pearson Education, 2008
5 "The 8086 Microprocessor: Programming and Interfacing The PC", Kenneth J. Ayala, Delmar Publishers, 2007
6 "Advanced Microprocessors and Peripherals", A K Ray, K M Bhurchandi, Tata McGraw Hill, 2007

Linear Integrated Circuits and Applications (PE1)

EC112 Linear Integrated Circuits and Applications

3 Credits

1 IC Fabrication: IC classification, fundamental of monolithic IC technology, epitaxial growth, masking and etching, diffusion of impurities. Realization of monolithic ICs and packaging. Fabrication of diodes, capacitance, resistance and FETs

2 Characteristics of OPAMP : Ideal OP-AMP characteristics, DC characteristics, AC characteristics, differential amplifier; frequency response of OP- AMP; Basic applications of Op-Amp – Inverting and Non-inverting Amplifiers, V/I and I/V converters, Summer, Differentiator and Integrator

3 Applications of OPAMP : Instrumentation amplifier, Log and Antilog Amplifiers, first and second order active filters, comparators, multivibrators, wave- form generators, clippers, clampers, peak detector, S/H circuit, D/A converter (R- 2R ladder and weighted resistor types), A/D converters using Op-Amps.

4 Special ICs: Functional block, characteristics and application circuits with 555 Timer IC-566 voltage controlled oscillator IC; 565- phase lock loop IC, Ana- log multiplier ICs. 9 Hrs.

5 Application ICs : IC voltage regulators –LM78XX, 79XX Fixed voltage regulators- LM317, 723 Variable voltage regulators, switching regulator- SMPS- LM 380 power amplifier- ICL 8038 function generator IC.

Sl. No. Name of Authors / Books /Publishers

1 “Op-amp and Linear ICs”, David A. Bell, Oxford, 2013
2 “Linear Integrated Circuits”, D. Roy Choudhary, Sheil B. Jani, II edition, New Age, 2003
3 “Op-amps and Linear Integrated Circuits”, Ramakant A. Gayakward, IV edition, Pearson Education, PHI, 2000
4 “Opamps and Linear Integrated Circuits Concepts and Applications”, Fiore, Cengage, 2010
5 “Fundamentals of Analog Circuits”, Floyd and Buchla, Pearson, 2013
6 “Integrated Electronics - Analog and Digital circuits system”, Jacob Millman, Christos C.Halkias, Tata McGraw Hill, 2003
7 “Op-amp and Linear ICs”, Robert F. Coughlin, Fredrick F. Driscoll, PHI Learning, 6th edition, 2012

Digital Signal Processing (PE1)

EC109 Digital Signal Processing

3 Credits

1 Overview of DSP, Basic Elements of DSP system, Advantages of DSP over Analog, Classification of signals, Concept of frequency in

continuous time and discrete time, Continuous time and Discrete time sinusoidal signals.

2 Discrete time systems : Linear time invariant, Response of LTI system convolution sum, description of discrete time system by difference equation and complete solution of difference equation, Implementation of discrete time systems, Correlation of discrete time signals

3 Transform and its applications to the analysis of LTI Systems

4 Discrete Time Fourier Transform, Properties of DTFT

5 Frequency domain representation of LTI Systems

6 Sampling and reconstruction of Analog signals

7 Discrete Fourier series, Discrete Fourier transform, Properties of DFT, FFT

8 Digital filter structure: FIR and IIR designs

Name of Authors / Books /Publishers

a. “Digital Signal Processing” by Proakis and Manolakis, Pearson
b. “Digital Signal Processing” by Ingle and Proakis, Thomson
c. “Digital Time Signal Processing” by Oppenheim and Schafer, Pearson
d. “Digital Signal Processing : Computer Based Approach” by Mitra, TMH

Computer Networks and Security (PE1)

EC114 Computer Networks and Security

3 Credits

1 Data communication Components : Representation of data and its flow Networks , Various Connection Topology, Protocols and Standards, OSI model, Transmission Media, LAN: Wired LAN, Wireless LANs, Connecting LAN and Virtual LAN, Techniques for Bandwidth utilization: Multiplexing - Frequency division, Time division and Wave division, Concepts on spread spectrum

2 Data Link Layer and Medium Access Sub Layer : Error Detection and Error Correction Fundamentals, Block coding, Hamming

Distance, CRC; Flow Control and Error control protocols - Stop and Wait, Go back - N ARQ, Se- lective Repeat ARQ, Sliding Window, Piggybacking, Random Access, Multiple access protocols -Pure ALOHA, Slotted ALOHA, CSMA/CD,CDMA/CA

3 Network Layer : Switching, Logical addressing – IPv4, IPv6; Address mapping –ARP, RARP, BOOTP and DHCP–Delivery, Forwarding and Unicast Routing protocols. Transport Layer: Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm.

4 Application Layer: Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls, Basic concepts of Cryptography

5 Network Security: Passive and Active Attacks, Symmetric Encryption, Encryption Algorithms, Key Distribution, Traffic Padding, Message Authen- tication, Hash function, Secure Hash function, Public-key Encryption, Digital Signature, RSA Public Key Encryption algorithm, Key Management, Secure Socket Layer and Transport layer Security, SSL Architecture, SSL Record Pro- tocol, Change Cipher Spec Protocol, Alert Protocol, handshake Protocol, IP level security IPSEC, Application layer security PGP, Firewall, Virtual Private Networks.

Name of Authors / Books /Publishers

1 “Data Communication and Networking”, 4th Edition, Behrouz A. Forouzan, McGraw-Hill
2 “Data and Computer Communication”, 8th Edition, William Stallings, Pearson Prentice Hall India
3 “Computer Networks”, 8th Edition, Andrew S. Tanenbaum, Pearson New International Edition.
4 “Internetworking with TCP/IP”, Volume 1, 6th Edition Douglas Comer, Prentice Hall of India.
5 “TCP/IP Illustrated”, Volume 1, W. Richard Stevens, Addison-Wesley, United States of America
6 “Network Security Bible”, by Cole, Krutz and Conley, Wiley dreamtech

Probability Theory and Stochastic Processes (PE1)

EC113 Probability Theory and Stochastic Processes

3 Credits

1. Sets and set operations; Probability space; Conditional probability and Bayes theorem; Combinatorial probability and sampling models.

2. Discrete random variables, probability mass function, probability distribution function, example random variables and distributions; Continuous random variables, probability density function, probability distribution function, example distributions;

3. Joint distributions, functions of one and two random variables, moments of random variables; Conditional distribution, densities and moments; Characteristic functions of a random variable; Markov, Chebyshev and Chernoff bounds.

4. Random sequences and modes of convergence (everywhere, almost everywhere, probability, distribution and mean square); Limit theorems; Strong and weak laws of large numbers, central limit theorem.

5. Random process. Stationary processes. Mean and covariance functions. Er-godicity. Transmission of random process through LTI. Power spectral density, Markov chain and Markov processes.

Sl. No. Name of Authors / Books /Publishers

1 “Probability and Random Processes with Applications to Signal Processing,” H. Stark and J. Woods, Third Edition, Pearson Education
2 “Probability, Random Variables and Stochastic Processes”, A.Papoulis and S. Unnikrishnan Pillai, Fourth Edition, McGraw Hill.
3 “Introduction to Probability Theory with Stochastic Processes”, K. L. Chung, Springer International

Linear Control System

Unit 1. Control Systems: Basics & Components, Introduction to basic terms, Classifications and
types of Control Systems, Block diagrams & Signal flow graphs. Transfer function,
Determination of transfer function using Block diagram re-duction techniques and
Mason’s Gain formula. Control system components: Electrical, Mechanical,
Electronic, AC/DC Servo Motors, Stepper Motors, Tacho Generators, Synchros,

Magnetic Amplifiers, Servo Amplifiers 8 Hrs.

Unit 2. Time-Domain Analysis : Time domain performance specifications, Transient response of first and second order systems, Steady state errors and Static error constants in unity feedback control systems, response with P, PI and PID controllers, Limitations of time domain analysis. 8 Hrs.

Unit 3. Frequency Domain Analysis : Polar and inverse polar plots, Frequency domain specifications and Performance of LTI systems, Logarithmic plots (Bode plots), Gain and Phase Margins, Relative stability. Correlation with time domain performance, Closed loop frequency responses from Open loop response. Limitations of frequency domain analysis, Minimum/Non-minimum phase sys- tems 8 Hrs.

Unit 4. Stability and Compensation Techniques : Concepts, absolute, Asymptotic, Conditional and Marginal stability, Routh–Hurwitz and Nyquist stability criterion, Root locustechnique and its application.Conceptsofcompensation,series/parallel/series-parallel/feedbackcompensation, Lag/Lead/Lag- Lead networks for compensation,Compensation using P, PI, PID controllers .

Unit 5. Control System Analysis using State Variable Methods Control Systems Engineering Syllabus State variable representation-Conversion of state variable models to transfer functions-Conversion of transfer functions to state variable models-Solution of stateequations-Concepts of Controllability and Observability Stability of linear systems-Equivalence between transfer function and state variable representations-Statevariable analysis of digital control system-Digital control design using state feedback.

Name of Authors / Books /Publishers

1 “Automatic Control System”, B. C. Kuo, Prentice Hall of India, 7th edition, 2001

2 “Control Systems Engineering -Principles and Design”, Nagraath and Gopal New Age Publishers

3 “Control systems engineering”, Norman S. Nise, John Wiley and

Sons (Asia) Singapore
4 “Design of Feedback Control System”, Raymond T. Stefani, Oxford University Press
5 “Modern control engineering”, K. Ogata, Pearson, 2002