SEMESTER V

S.No.	CODE	COURSE OF STUDY	L	T	P	C
1.	EE301	Power System Analysis	3	1	0	4
2.	EE303	Control Systems	3	1	0	4
3.	EE305	Linear Integrated Circuits	3	0	0	3
4.	EE307	Signals and Systems	3	0	0	3
5.	EE309	Analog Electronic circuits	3	0	0	3
6.	EE311	Microprocessor and Microcontroller	3	0	0	3
7.	EE313	Integrated Circuits Laboratory	0	0	3	2
8.	EE315	Analog Electronics Circuits Laboratory	0	0	3	2
		Total	**18**	**2**	**6**	**24**

SEMESTER V

EE301 POWER SYSTEM ANALYSIS

Course Objectives
The objective of this course is

- To model the power system under steady state operating condition. To apply efficient numerical methods to solve the power flow problem.
- To model and analyze the power systems under abnormal (or) fault conditions.
- To model and analyze the transient behavior of power system when it is subjected to a fault.

Unit I: Modelling of power system components - single line diagram –per unit quantities – bus impedance and admittance matrix.

Unit II: Power flow analysis methods - Gauss-Seidel, Newton - Raphson and Fast decoupled methods of load flow analysis.

Unit III: Fault studies - Symmetrical fault analysis, Analysis through impedance matrix, Current limiting reactors.

Unit IV: Fault analysis - Unsymmetrical short circuit analysis- LG , LL, LLG; Fault parameter calculations.

Unit V: Stability studies - Steady state and transient stability – Swing equation - Equal area criterion – multi machine stability analysis.

Text Books

1. John J.Grainger and Stevenson.W.D, “Power System Analysis”, Tata McGraw Hill, 2003.
2. Wadhwa.C.L, “Electrical Power Systems”, New Age International Private Limited, 2009.
3. Stagg.C.W and Elabiad.A.H, “Computer Methods in Power System Analysis”, Tata McGraw Hill International Book Company, 1990.

Reference Books

1. Hadi Saadat, “Power System Analysis”, Tata McGraw Hill, 2002 .
2. Duncan Glover, Mulukutla.J, Sarma.S and Thomas J. Overbye, “Power System Analysis and Design”, Cengage Learning, 4th Edition, 2009.
3. Nagrath I.J and Kothari D.P, “Modern Power System Analysis”, Tata McGraw Hill, 4th Reprint, 2011.
4. Kundur P, “Power System Stability and Control”, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 10th Reprint 2010.
5. Pai M A, “Computer Techniques in Power System Analysis”, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2nd Edition, 2007.

Course Outcomes

At the end of the course the student will be able to

1. Understand the concept of power system components and its modeling.
2. Configuration of Y-Bus matrix and Z-Bus matrix using bus building algorithms.
3. Understand the concept of iterative methods for calculation of power system parameters.
4. Understand the concept of symmetrical/unsymmetrical faults in power system studies.
5. Determination of critical clearing angle and time using equal area criterion/ iterative methods.

EE303 CONTROL SYSTEMS

Course Objectives

The objective of this course is

- To understand the methods of representation of Systems and to derive their Transfer function and State space models.
- To provide adequate knowledge in the Time Response of Systems and Steady State Error Analysis.
- To accord basic knowledge in obtaining the frequency responses of systems.
- To understand the concept of Stability of Control System and methods of Stability Analysis.
- To study the ways of designing Compensation for a Control System.

Unit I : Introduction to control system : Open and closed loop control system – Basic components - Mathematical model of physical systems – Electrical analogy of physical systems – Transfer functions - Block diagram algebra – Signal flow graph.

Unit II : Time response analysis: Test Signals- Analysis of transient and steady state response - Time domain specifications - Steady state errors and error constants – Performance indices – Asymptotic stability and relative stability - Routh Hurwitz Stability criterion - Root Locus Technique – construction of root loci - Effect of pole zero additions on the root loci- Root contours – Systems with transportation lag.

Unit III: Frequency response analysis : Time and frequency response correlation – Frequency domain specifications - Polar plot – Bode plot – Nyquist plot – Frequency response of systems with transportation lag - Stability in frequency domain - Nyquist stability criterion.

Unit IV: Design of Compensators: Proportional (Constant gain), Lead, Lag, Lag –lead and Lead-lag compensator design using root loci and Bode plot.

Unit V: State Variable Analysis : Introduction of state, state variables and state model - Relationship between State equations and Transfer functions - Characteristic equation, Eigen values, Eigen vectors - Canonical forms - Diagonalization – Solution of state equations – State Transition Matrix - Controllability and Observability.

Text Books

1. Nagrath.I.J and Gopal.M, "Control System Engineering", New Age International (P) Limited Publishers, 5th Edition, 2012.
2. Richard Dorf and Robert Bishop, "Modern control system", Pearson Education, 12th Edition, 2014.

Reference Books

1. Dingyu Xue, YangQuan Chen, Derek P. Atherton, "Linear Feedback Control Analysis and Design with MATLAB", Society for Industrial and Applied Mathematics, 1st Edition, 2008.
2. Norman S. Nise, "Control System Engineering", Wiley Student Edition, 6th Edition, 2012.
3. B.C Kuo, "Automatic control systems", Prentice Hall, New Delhi, 7th Edition, 2002.

Course Outcomes

At the end of the course the student will be able to**:**

1. Understand different types of control system and analogous system.
2. Estimate the response of system and the time domain specifications.

3. Implement the frequency domain concepts for the determination of stability of the system.
4. Implement the time domain concept for the determination of stability of the system.
5. Design the compensators

EE305 LINEAR INTEGRATED CIRCUITS

Course Objectives

The objective of this course is

- To introduce the basic building blocks of linear integrated circuits.
- To teach the linear and non-linear applications of operational amplifiers.
- To introduce the theory and applications of analog multipliers and PLL.
- To teach the theory of ADC and DAC
- To introduce a few special function integrated circuits.

Unit I: Block diagram of a typical op-amp - characteristics of ideal and practical op amp - parameters of op-amp -Inverting and Non-inverting amplifier configurations - Frequency response, circuit stability.

Unit II: Op- amps- DC and AC amplifiers - summing amplifier - difference amplifier - voltage follower - Differentiator - Integrator - clamper - clipper - Precision Rectifier, Instrumentation Amplifier, Grounding And Shielding Problem in Instrumentation Amplifier, filters, comparators, schmitt trigger.

Unit III: Oscillators using opamp- sine wave, square wave, triangular wave, saw tooth wave generation.

Unit IV: Converters- Analog to digital, digital to analog, sample and hold circuits - voltage controlled oscillator-phase locked loop-operating principles, application of PLL.

Unit V: IC555 Timer- monostable and astable modes of operation; voltage regulators - fixed voltage regulators, adjustable voltage regulators - switching regulators.

Text Books

1. Gayakwad.R.A, "Op-amps and Linear Integrated Circuits", Prentice Hall of India, New Delhi, 4th Edition, 2002.
2. Sergio Franco, "Design with operational amplifiers and Analog Integrated circuits", Tata McGraw Hill, 3rd Edition 2002.
3. Tobey, Grames and Huelsman, "Operational Amplifiers : Design and Applications", McGraw Hill, 1971.

Reference Books

1. Millman.J and Halkias. C.C, "Integrated Electronics : Analog and Digital, Systems", McGraw Hill, 9th Reprint, 1995.
2. Roy Choudhery.D and Sheil B. Jain, "Linear Integrated Circuits", New Age Publishers, 2nd Edition, 2011.
3. Robert F Coughlin, Fredrick F. Driscold, " Op amp and linear ICs", Pearson Education, 4th Edition, 2002.
4. David A Bell, "Op amp and linear ICs", Prentice hall of India, 3nd Edition, 2011

Course Outcome

On completion of this course, the students will have a thorough understanding of operational amplifiers with linear integrated circuits. Also students will be able to design circuits using operational amplifiers for various applications.

EE307 SIGNALS AND SYSTEMS

Course Objectives

The objective of this course is to introduce the concepts and techniques associated with the understanding of signals and systems and to familiarize with techniques suitable for analyzing and synthesizing both continuous-time and discrete time systems which provides foundation for more advanced subjects like signal processing, system theory, control and robotics.

Unit I: Introduction to signals and systems: Introduction to signals, classification of signals, basic continuous- time and discrete- time signals, step and impulse functions, transformation of independent variable. Introduction to systems, properties of systems, classification of systems, mathematical model for systems, normal form of system equations, initial conditions – Laplace transform – system transfer function.

Unit II: Impulse response of a physical system, introduction to convolution, system impulse response and convolution integral, numerical convolution. Sampling theorem, Z-transform, convergence of Z-transform, properties of Z-transform, inversion of Z-transform , evaluation of system frequency response, applications of Z-transform – bilinear transformation.

Unit III: Representation of signals in terms of elementary signals, condition for orthogonality, representation of signals by elementary sinusoids, Fourier series representation, power spectrum, Fourier Transform, system function, energy spectrum. Calculation of simple transforms, Discrete Fourier Transform (DFT), properties of Discrete Fourier Transform.

Unit IV: Statistical Signal Analysis: Classification of random signals, auto correlation function, properties of auto correlation function, measurement of auto correlation function, application of autocorrelation functions, cross correlation functions, properties of cross correlation functions, sum of random processes.

Unit V: Spectral density, relation of spectral density to autocorrelation function. Auto correlation function of system output, cross- correlation between input and output, white noise, generation of pseudo-random binary noise, analysis of linear systems in time domain using white noise, mean and mean square value of system output, analysis in the frequency domain.

Text Books

1. Gabel.R.A and Robert.R.A, "Signals and Linear Systems", 3rd Edition, John Wiley and Sons, New York, 2009.
2. Oppenheim, Wilsky and Nawab, "Signals and Systems", 2nd Edition, Prentice Hall, New Delhi, 1997.
3. Chen.C.T, "Systems and Signal Analysis", Oxford University Press, India, 3rd Edition, 2004, ISBN 100195156617.

Reference Books

1. Cooper.G.R and McGillem.C.D, "Probabilistic Methods of Signals and System Analysis", 3rd Edition, Oxford University Press, Cambridge, 2007.
2. Chesmond, Wilson and Lepla, "Advanced Control System Technology", ISBN-8176490326, Viva Books, India, 1998.
3. Ziemer R.E, Tranter W.H and Fannin D.R, "Signals and Systems", 4th Edition, Pearson Education Asia, Singapore, 1998.

Course Outcomes

On completion of this course the student will be able to:

1. Determine the mathematical representations of systems and analyse systems in order to calculate, estimate and classify their impulse, step, frequency response and evaluate their stability.
2. Determine the properties of continuous time domain signals using Laplace transform and discrete time signals using Z-transform and their transformation to treat a class of signals broader than what the Fourier transform can handle.
3. Classify and analyse the random/noise signals.

EE309 ANALOG ELECTRONIC CIRCUITS

Course Objectives

- The aim of this course is to familiarize the student with the analysis and design of basic transistor amplifier circuits and power supplies.

Unit I: Small signal amplifiers -Biasing circuits of BJT and FET transistors, analysis and design of BJT and FET amplifiers. Chopper stabilized amplifiers.

Unit II: Large signal amplifiers - Analysis and design of class A and class B power amplifiers; class C and class D amplifiers; thermal considerations; Tuned amplifiers.

Unit III: Feedback amplifiers – Gain with feedback - Effect of feedback on gain stability, distortion - bandwidth - Input and output impedances - Topologies of feedback amplifiers.

Unit IV: Oscillators – Barkhausen Criterion for oscillation - Hartley and Colpitts oscillators - phase shift, Wien bridge and crystal oscillators - clapp oscillator - Oscillator amplitude stabilization.

Unit V: Rectifiers and switched mode power supplies - theory and design, filter circuits, applications - Pulse circuits – attenuators, RC Integrator and differentiator circuits – Diode clampers and clippers - multivibrators, Schmitt Trigger- UJT Oscillator.

Text Books

1. Millman.J and Grabel.A, "Micro electronics", Tata McGraw Hill, 2nd Edition, 2001.
2. Allen Mottershead, "Electronic Devices and Circuits - An Introduction", Prentice Hall of India, 18th Reprint, 1996.
3. Robet.L.Boylestad, "Electronic Circuits and Circuit Theory", Pearson, 10th Edition, 2009.

Reference Books

1. Sedra Smith, "Microelectronic Circuits", Oxford university Press, 6th Edition, 2013.
2. David A. Bell, "", Prentice Hall of India Learning Private Limited, Electronic Devices and Circuits 5th Edition 2008.

Course Outcomes

On completion of this course the student will understand the

1. Methods of biasing transistors & Design of simple amplifier circuits
2. Mid – band analysis of amplifier circuits using small - signal equivalent circuits to determine gain input impedance and output impedance
3. Method of calculating cutoff frequencies and to determine bandwidth
4. Design of power amplifiers and heat sinks

EE311 MICROPROCESSOR AND MICROCONTROLLER

Course Objectives

The objective of this course is

- To study the Architecture of 8085 & 8086.
- To study the addressing modes & instruction set of 8085 & 8086.
- To introduce the need & use of Interrupt structure 8085.
- To develop skill in simple program writing for 8085 and applications
- To introduce commonly used peripheral / interfacing ICs

Unit I: Architecture and Programming of 8085 - functional Block diagrams, bus systems, instruction set, addressing modes - timing diagram and assembly level programmes; Interfacing RAM and ROM sections.

Unit II: Programmable peripheral interface (8255); Data transfer schemes -interfacing of simple keyboards and LED displays.

Unit III: Interrupts and DMA - Interrupt features, types of interrupts-methods of servicing interrupts programmable interrupt controller, Need for Direct memory access - programmable DMA controller.

Unit IV: Interfacing applications- ADC, DAC, motor control, waveform generation, Seven segment LED display systems-stepper motor control -speed control of DC motor using thyristor converters.

Unit V: Microcontrollers - architecture of 8051- memory organizations, addressing modes - instruction set -simple programs - interrupt structure-Interfacing with external ROM and RAM, Typical applications -MCS 51 family features- RISC and ARM Processors.

Text Books

1. Ramesh Gaonkar, "Microprocessor Architecture, Programming and applications with the 8085/8080A", Penram International Publishing House, 3rd Edition, 2002
2. Muhammad Ali Mazidi, Janice Gillispie Mazidi, "The 8051 Microcontroller and Embedded Systems", Pearson, 2011.
3. Kenneth J.Ayala, "The 8051 Micro controller", Penram International Publishing, 2010.

Reference Books

1. Douglas V. Hall, "Microprocessors and interfacing", Tata McGraw Hill, 3rd Edition, New Delhi, 2012.
2. Ray A.K and Bhurchandi.K.M, "Advanced Microprocessor and Peripherals", Tata McGraw Hill, 3rd Edition, 2012.
3. Sencer Yeralan, "Programming and Interfacing the 8051 Microcontroller", Addison Wesley Publications.

Course Outcomes

At the end of the course the student will be able to

1. Understand the Architecture of 8085 and programming of 8085 microprocessor.
2. Implement the Memory & Peripheral Devices interface with 8085 Processor and design 8085 based system.
3. Understand the architecture and instruction set of 8085 microprocessor

EE313 INTEGRATED CIRCUITS LABORATORY

1. Analog Filters
2. Sample and Hold Circuit
3. Generation of square and triangular waveforms
4. Analog-to-Digital Converter
5. Digital-to-Analog Converter
6. Ramp Generator
7. Astable multivibrator using IC 555.
8. Monostable multivibrator using IC 555

EE315 ANALOG ELECTRONICS LABORATORY

1. Common emitter amplifier
2. Common collector amplifier
3. RC oscillators
4. Monostable multivibrator
5. Astable multivibrator
6. UJT oscillator
7. FET Amplifier
8. Feedback Amplifier