Rajiv Gandhi Proudyogiki Vishwavidyalaya, Bhopal

Electronics and Communication (Advanced Communication Technology), IV Semester

ES401	**Energy & Environmental Engineering**	**3L-1T-0P**	**4 Credits**

The objective of this Course is to provide *an introduction to energy systems and renewable energy resources, with a scientific examination of the energy field and an emphasis on alternative energy sources and their technology and application.*

Module 1: Introduction to Energy Science:

Introduction to energy systems and resources; Introduction to Energy, sustainability & the environment; Overview of energy systems, sources, transformations, efficiency, and storage; Fossil fuels (coal, oil, oil-bearing shale and sands, coal gasification) - past, present & future, Remedies & alternatives for fossil fuels - biomass, wind, solar, nuclear, wave, tidal and hydrogen; Sustainability and environmental trade-offs of different energy systems; possibilities for energy storage or regeneration (Ex. Pumped storage hydro power projects, superconductor-based energy storages, high efficiency batteries)

***Module2*: Ecosystems**

- Concept of an ecosystem; Structure and function of an ecosystem; Producers, consumers and decomposers; Energy flow in the ecosystem; Ecological succession; Food chains, food webs and ecological pyramids; Introduction, types, characteristic features, structure and function of the following ecosystem (a.)Forest ecosystem (b) Grassland ecosystem (c) Desert ecosystem (d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

***Module 3*: Biodiversity and its conservation**

- Introduction – Definition: genetic, species and ecosystem diversity; Bio-geographical classification of India; Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values; Biodiversity at global, National and local levels; India as a mega-diversity nation; Hot-sports of biodiversity; Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts; Endangered and endemic species of India; Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

***Module 4:* Environmental Pollution**

- Definition, Cause, effects and control measures of Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards; Solid waste Management: Causes, effects and control measures of urban and industrial wastes; Role of an individual in prevention of pollution; Pollution case studies; Disaster

management: floods, earthquake, cyclone and landslides.

Module 5: **Social Issues and the Environment**

- From Unsustainable to Sustainable development; Urban problems related to energy; Water conservation, rain water harvesting, watershed management; Resettlement and rehabilitation of people; its problems and concerns. Case Studies
  Environmental ethics: Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies Wasteland reclamation; Consumerism and waste products; Environment Protection Act; Air (Prevention and Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act; Issues involved in enforcement of environmental legislation; Public awareness.

Module 6: Field work

- Visit to a local area to document environmental assets-river/forest/grassland/hill/mountain
- Visit to a local polluted site-Urban/Rural/Industrial/Agricultural
- Study of common plants, insects, birds.
- Study of simple ecosystems-pond, river, hill slopes, etc.

REFERENCE

1. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc.
2. Clark R.S., Marine Pollution, Clanderson Press Oxford (TB).
3. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumabai,
4. De A.K., Environmental Chemistry, Wiley Eastern Ltd.
5. Trivedi R.K., Handbook of Environmental Laws, Rules Guidelines, Compliances and Standards', Vol I and II, Enviro Media (R)
6. Boyle, Godfrey, Bob Everett, and Janet Ramage (Eds.) (2004), Energy Systems and Sustainability: Power for a Sustainable Future. Oxford University Press.
7. Schaeffer, John (2007), Real Goods Solar Living Sourcebook: The Complete Guide to Renewable Energy Technologies and Sustainable Living, Gaiam

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

New Scheme Based On AICTE Flexible Curricula

Electronics and Communication (Advanced Communication Technology), IV Semester

EA 402 – Signals and Systems

Unit-1 Introduction of Signals and Systems: Definition of signal, Classification of Signal and representation: Continuous time and discrete time, even/odd, periodic/aperiodic, random/deterministic, energy/power, one/multidimensional, some standard signals, , Basic Operations on Signals for CT/DT signal, transformation of independent & dependent variables,

Definition of system and their classification: CT/DT, linear/non-linear, variant/non-variant, causal and non-causal system state/dynamic system, interconnection of systems. System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, realizability.

Unit-2 Linear Time- Invariant Systems: Introduction, Impulse Response Representation for LTI Systems, Convolution, Properties of the Impulse Response Representation for LTI Systems, Difference Equation for LTI Systems, Block Diagram Representations(direct form-I, direct form-II, Transpose, cascade and parallel). Impulse response of DT-LTI system and its properties.

Unit-3 z-Transform: Introduction, ROC of finite duration sequence, ROC of infinite duration sequence, Relation between Discrete time Fourier Transform and z-transform, properties of the ROC, Properties of z-transform, Inverse z-Transform, Analysis of discrete time LTI system using zTransform, Unilateral z-Transform.

Unit-4 Fourier analysis of discrete time signals: Introduction, Properties and application of discrete time Fourier series, Representation of Aperiodic signals, Fourier transform and its properties, Convergence of discrete time Fourier transform, Fourier Transform for periodic signals, Applications of DTFT.

Unit-5 State-space analysis and multi-input, multi-output representation. The state-transition matrix and its role. The Sampling Theorem and its implications- Spectra of sampled signals. Reconstruction:

Reference Books:

1. Simon Haykin, “Signals and Systems”, John Wiley.
2. Simon Haykin, “Analog and Digital Communications”, John Willey.
3. Bruce Carlson, “Signals and Systems”, TMH.
4. Oppenheim & Wilsky, “Signals & Systems”, PHI.
5. Taub and Schilling "Principles of communication signals", 2nd ed. New York: Mcgraw-Hill, 1986.

LIST OF EXPERIMENTS

1. Introduction to MATLAB Tool.
2. To implement delta function, unit step function, ramp function and parabolic function for continuous-time.
3. To implement delta function, unit step function, ramp function and parabolic function for discrete-time.
4. To implement rectangular function, triangular function, sinc function and signum function for continuous-time.
5. To implement rectangular function, triangular function, sinc function and signum function for discrete-time.
6. To explore the communication of even and odd symmetries in a signal with algebraic operations.
7. To explore the effect of transformation of signal parameters (amplitude-scaling, time-scaling & shifting).
8. To explore the time variance and time invariance property of a given system.
9. To explore causality and non-causality property of a system.
10. To demonstrate the convolution of two continuous-time signals.
11. To demonstrate the correlation of two continuous-time signals.
12. To demonstrate the convolution of two discrete-time signals.
13. To demonstrate the correlation of two discrete-time signals.
14. To determine Magnitude and Phase response of Fourier Transform of given signals.

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Electronics and Communication (Advanced Communication Technology), IV Semester

EA 403– Communication Theory

Unit 1: Introduction to Communication Systems and Fourier Transform

Overview of Communication Systems; Objectives; Types: Analog and Digital, Block Diagrams, Functions of Each Block, Need for Modulation, Comparison.

Concept of Frequency Domain; Frequency Domain Representation of Continuous-Time Signals: Fourier Transform and Its Properties; Fourier Transform of Some Useful Signals: Impulse, Step, Signum, Cosine, Sine, Gate Pulse, Constant; Properties of Impulse (Dirac Delta) Function.

Time Autocorrelation Function; Energy Spectral Density; Power Spectral Density.

Unit 2: Essentials of Analog Communication

Amplitude Modulation (AM): Principles of AM, DSB, VSB, Introduction to SSB with Brief Hilbert Transform Explanation; Modulation Index, Power Considerations; AM Demodulation Techniques (Envelope Detector, Coherent Detection); Spectral Analysis of AM Signals, such as Single-Tone AM Signals; Superheterodyne Receiver: Basic Block Diagram, Functionality, Characteristics.

Angle Modulation (FM and PM): Frequency Modulation (FM) and Phase Modulation (PM) Principles; Narrowband and Wideband FM; Modulation Index; Carson's Rule; Demodulation of FM and PM (Discriminator, PLL); Spectral Analysis of Single-Tone FM Signals; Comparison of AM, FM, and PM.

Unit 3: Random Processes and Noise in Communication

Review of Probability Theory, Random Variables, PDF, CDF, and Expectation; Introduction to Random Processes: Stationary (WSS) and Ergodic Processes; Autocorrelation Function, Power Spectral Density (PSD); Noise: Classification, Sources of Noise, Signal-to-Noise Ratio (SNR), Noise Figure, Noise Temperature, Noise Bandwidth; Properties of White Noise, Gaussian Noise; Filtering of Random Signals through Linear Time-Invariant (LTI) Systems; Hilbert Transform and Complex-Baseband Representation of Real-Passband Signals and Systems.

Unit 4: Essentials of Digital Communication

Pulse Code Modulation (PCM) and Delta Modulation: Sampling Theorem, Ideal and Practical Sampling, Aliasing, Quantization, Quantization Noise, Companding, Pulse Code Modulation (PCM); 6-dB Rule; Differential PCM (DPCM) and Delta Modulation; Line Coding.

Inter-Symbol Interference (ISI); Nyquist Criterion for ISI-Free Transmission; Introduction to Pulse Shaping and Equalization.

Digital Modulation Techniques: Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), and Phase Shift Keying (PSK); Quadrature Amplitude Modulation (QAM); Spectral Efficiency and

Bandwidth Considerations; Matched Filter, MAP and ML Detection Techniques, Gram–Schmidt Orthonormalization and the Concept of Signal Space; Bit Error Rate (BER) and Signal-to-Noise Ratio (SNR) for Digital Modulation Techniques.

Unit 5: Introduction to Information Theory and Coding

Definition of Information, Entropy, Source Coding Theorem; Shannon–Fano and Huffman Coding; Discrete Memoryless Channels, Mutual Information; Channel Capacity: The Shannon-Hartley Theorem and SNR–Bandwidth Trade-Off; Channel-Coding Theorem; Introduction to Channel Coding: Hamming Distance, Error Detection, and Correction (Hamming Codes, CRC)

Textbooks

1. S. Haykin and M. Moher, *Communication Systems*, 5th Edition, Wiley.
2. U. Madhow, *Introduction to Communication Systems*, Cambridge University Press.

Reference Books

1. B. P. Lathi, *Modern Digital and Analog Communication Systems*, 4th Edition, Oxford University Press.
2. J. G. Proakis and M. Salehi, *Communication Systems Engineering*, 2nd Edition, Pearson Education.
3. H. Taub and D. L. Schilling, *Principles of Communication Systems*, 3rd Edition, Tata McGraw-Hill.
4. Hwei P. Hsu, *Schaum's Outline of Analog and Digital Communications*, 2nd Edition, McGraw-Hill.
5. R. P. Singh and S. D. Sapre, *Communication Systems: Analog and Digital*, 3rd Edition, McGraw Hill.
6. P. R. Rao, *Communication Systems*, McGraw Hill, 2013.

SUGGESTED LIST OF EXPERIMENTS

1. Amplitude Modulation (AM) and Demodulation
2. Frequency Modulation (FM) and Demodulation
3. Pre-emphasis and De-emphasis Circuits
4. Phase-Locked Loop (PLL)
5. AM Superheterodyne Radio Receiver
6. Frequency-Division Multiplexing (FDM) and Demultiplexing
7. Sampling and Reconstruction: Oversampling and Undersampling
8. PCM Transmitter and Receiver
9. Time-Division Multiplexing and Demultiplexing
10. Study of ASK, FSK, PSK, QPSK
11. Delta Modulation and Demodulation

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EA 404 Control Systems

Unit-1 Introduction to Control system: Terminology and classification of control system, examples of control system, mathematical modeling of mechanical and electrical systems, differential equations, transfer function, block diagram representation and reduction, signal flow graph techniques.

Feedback characteristics of control systems Open loop and closed loop systems, effect of feedback on control system and on external disturbances, linearization effect of feedback, regenerative feedback

.**Unit-2 Time response analysis** Standard test signals, time response of 1st order system, time response of 2nd order system, steady-state errors and error constants, effects of additions of poles and zeros to open loop and closed loop system.

Time domain stability analysis Concept of stability of linear systems, effects of location of poles on stability, necessary conditions for stability, Routh-Hurwitz stability criteria, relative stability analysis, Root Locus concept, guidelines for sketching Root-Locus.

Unit-3 Frequency response analysis Correlation between time and frequency response, Polar plots, Bode Plots, all-pass and minimum-phase systems, log-magnitude versus Phase-Plots, closed-loop frequency response.

Frequency domain stability analysis : Nyquist stability criterion, assessment of relative stabilityusing Nyquist plot and Bode plot (phase margin, gain margin and stability).

Unit-4 Approaches to system design Design problem, types of compensation techniques, design of phase-lag, phase lead and phase lead-lag compensators in time and frequency domain, proportional, derivative, integral and Composite Controllers.

Unit-5 State space representation of systems, block diagram for state equation, transfer function decomposition, solution of state equation, transfer matrix, relationship between state equation and transfer function, controllability and observability.

Text/Reference Books:

1. Albert D. Helfrick, William David Cooper, "Modern electronic instrumentation and measurement techniques", TMH 2008.
2. Oliver Cage, "Electronic Measurements and Instrumentation", TMH, 2009.
3. Alan S. Morris, "Measurement and Instrumentation Principles", Elsevier (Buterworth Heinmann), 2008.
4. David A. Bell, "Electronic Instrumentation and Measurements", 2nd Ed., PHI, New Delhi2008.
5. H.S. Kalsi, "Electronics Instrumentation", TMH Ed. 2004
6. A.K.Sawhney, "A Course in Electrical and Electronic Measurements and Instrumentation", Dhanpat Rai.
7. MMS Anand, "Electronic Instruments & Instrumentation Technology", PHI Pvt. Ltd., NewDelhi Ed. 2005

CONTROL SYSTEM LAB

Control System performance analysis and applications of MATLAB in Control system performance analysis & design.

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EA 405 Analog Circuits

COURSE CONTENTS:

Feedback Amplifier and Oscillators: Concept of feedback and their types, Amplifier with negative feedback and its advantages. Feedback Topologies.

Oscillators: Concept of Positive feedback, Classification of Oscillators, Barkhausen criterion, Types of oscillators: RC oscillator, RC Phase Shift, Wien Bridge Oscillators. LC Oscillator: Hartley, Colpitt's, Clapp and Crystal oscillator.

Introduction to integrated circuits: Advantages and characteristic parameters of IC's, basic building components, data sheets

Operational Amplifier: Differential amplifier and analysis, Configurations- Dual input balanced output differential amplifier, Dual input Unbalanced output differential amplifier, Single input balanced output differential amplifier, Single input Unbalanced output differential amplifier Introduction of op-amp, Block diagram, characteristics and equivalent circuits of an ideal opamp, Power supply configurations for OP-AMP.

Characteristics of op-amp: Ideal and Practical, Input offset voltage, offset current, Input bias current, Output offset voltage, thermal drift, Effect of variation in power supply voltage, common-mode rejection ratio (CMRR), Slew rate and its Effect, PSRR and gain bandwidth product, frequency limitations and compensations, transient response, analysis of TL082 datasheet.

OP-AMP applications: Inverting and non-inverting amplifier configurations, Summing amplifier, Integrators and differentiators, Instrumentation amplifier, Differential input and differential output amplifier, Voltage-series feedback amplifier, Voltage-shunt feedback amplifier, Log/ Antilog amplifier, Triangular/rectangular wave generator, phase-shift oscillators, Wein bridge oscillator, analog multiplier-MPY634, VCO, Comparator, Zero Crossing Detector. OP-AMP AS FILTERS: Characteristics of filters, Classification of filters, Magnitude and frequency response, Butterworth 1st and 2nd order Low pass, High pass and band pass filters, Chebyshev filter characteristics, Band reject filters, Notch filter; all pass filters, self-tuned filters, AGC,AVC using op-AMP.

TIMER:IC-555 Timer concept, Block pin configuration of timer. Monostable, Bistable and AstableMultivibrator using timer 555-IC, Schmitt Trigger, Voltage limiters, Clipper and

clampers circuits, Absolute value output circuit, Peak detector, Sample and hold Circuit, Precision rectifiers, Voltage-to-current converter, Current-to-voltage converter.

Voltage Regulator: simple OP-AMP Voltage regulator, Fixed and Adjustable Voltage Regulators, Dual Power supply, Basic Switching Regulator and characteristics of standard regulator ICs such as linear regulator, Switching regulator andlow-drop out regulator. Study of LM317, TPS40200 and TPS7250

TEXT BOOKS:

1. RamakantA.Gaikward,"OP- Amp and linear Integrated circuits" Third edition 2006, Pearson.
2. B. Visvesvara Rao Linear Integrated Circuits Pearson.
3. http://www.nptelvideos.in/2012/11/analog-ics.html
4. http://nptel.ac.in/courses/117108107/

REFERENCES:

1. David A. Bell: Operational Amplifiers & Linear ICs, Oxford University Press, 2nd edition,2010.
2. D. Roy Choudhury:Linear Integrated Circuits New Age Publication.
3. B. Somanathan Nair: Linear Integrated Circuits analysis design and application Wiley India Pvt. Ltd.
4. Maheshwary and Anand: Analog Electronics, PHI.
5. S.Salivahanan,V S KanchanaBhaaskaran: Linear Integrated Circuits",second edition, McGraw Hill.
6. Gray Hurst Lewis Meyer Analysis and design of analog Integrated Circuits fifth edition Wiley India.
7. RobertF.Coughlin, Frederick,F.Driscoll: Operational Amplifiers and Linear Integrated Circuits, sixth edition, Pearson.
8. Millman and Halkias: Integrated electronics, TMH.
9. Boylestad and Nashelsky: Electronic Devices and Circuit Theory, Pearson Education.
10. Sedra and Smith: Microelectronics, Oxford Press.

List of Experiments :

Apparatus Required –Dual Channel Cathode Ray Oscilloscope (0-20 MHz), Function Generator (10MHz and above), Dual Power Supply, LM741, TL082, MPY634,TPS7250, Probes, digital multimeter.

1. To measure and compare the op-amp characteristics: offset voltages, bias currents, CMRR, Slew Rate of OPAMP LM741 and TL082.
2. To determine voltage gain and frequency response of inverting and non-inverting amplifiers using TL082.
3. To design an instrumentation amplifier and determine its voltage gain using TL082.
4. To design op-amp integrator (low pass filter) and determine its frequency response.
5. To design op-amp differentiator (high pass filter) and determine its frequency response.

6. Design 2nd order Butterworth filter using universal active filter topology with LM741
7. To design Astable, Monostable and Bistablemultivibrator using 555 and analyse its characteristics.
8. Automatic Gain Control (AGC) Automatic Volume Control (AVC)using multiplier MPY634
9. To design a PLL using opampwith MPY634 anddetermine the free running frequency, the capture range and the lock in range of PLL
10. Design and test a Low Dropout regulator using op-amps for a given voltage regulation characteristic and compare the characteristics with TPS7250 IC.

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EA 406 Communication Simulation Lab - I

COURSE CONTENTS:

Simulations using MATLAB, SIMULINK, Python, and GNU Radio:

1. Amplitude Shift Keying
2. Phase Shift Keying
3. Frequency Shift Keying
4. Quadrature Phase Shift Keying
5. Differential Phase Shift Keying
6. ASK Demodulation Using Product Detection
7. FSK Demodulation Using Envelope Detector
8. Noise Generation Using PM Sequence
9. Time Division Multiplexing
10. Implement a complete digital communication system and carry out its performance analysis.

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