Curriculum Framework
for

P.G. and Pre-PhD Programmes
Electronic Science and Technology
2020

Berhampur University, Bhanja Bihar,
Berhampur-760007, Odisha, India

Curriculum

The preparation of this curriculum involves an appropriate statutory body of the University consisting of senior faculty members of the University, selected faculty members of autonomous and affiliated colleges under the University and subject experts from other Universities/ Institutions of National repute. These members focus on developing this curriculum keeping in mind research conducted in the University and other places to prepare students for attaining **Expected Program Effect (EPE)** with identified **Student Competency Potential (SCP)**.

Background

Members' cohesive interaction at different times with people in professional bodies, academia, R&D organisations as well as industry help them understand the recent trends of new technologies, ideas and principles necessary behind the required skill and scientific orientation of manpower for the field of electronic science and technology. Accordingly, they put their experience in designing flexible, adaptive and progressive programs for which planning formulation takes into account course content as well as learning activities and internal assessment methods to instil in students not only knowledge but also aptitudes of self-learning, critical thinking, problem solving skills, adaptability, work ethics, communication skills, professional attitude, interpersonal skills and group works. The expertise of the members:

- Enable prospective students, parents, employers and other to understand the nature and level of different abilities expected from students successfully completing a departmental program.
- Maintain international/ national academic standards of programs to ensure universal acceptance for facilitating student mobility.
- Provide an important point of reference for periodic review of program and academic research.

Nature of Courses

Each course offered in a program has course objectives in resonance with selected Student Competency Potential (SCP) from the following:

a) capacity to apply knowledge of mathematics, science, and technology
b) capacity to perform (and/or design) experiments followed by analysis and interpretation of data
c) capacity to design need based system, component, or process within realistic constraints like health and safety, ethical, economic, sustainability, social, environmental, manufacturability and political
d) Instil capabilities of leadership, team work in multidisciplinary environment
e) capacity to identify, formulate, and solve technical problems
f) a knowledge of professional and ethical responsibility
g) minimum understanding of the impact of technical solutions in a societal, economic, environmental, and global context
h) understanding the need for, and ability to engage in life-long learning
i) capacity to use techniques, skills, and modern tools necessary for technologists.
j) Preparing students for thrust areas like RF and wireless communication, semiconductors, microcontrollers, VLSI, Telematics, Programming (C++, MATLAB, Python, etc), Cognitive Technology, Signal Processing, etc.

General Course Framework and Structure
(M.Sc. in Electronic Science and Technology)

SEMESTER- I: Total credits/core/electives/practical (22/4/1/2); Total marks: 700

Course No.	Course title	Credits	Hrs/ Week	Marks		
				Mid Sem	**End Sem**	**Total**
ELST C101	Electromagnetic Theory	4	4	20	80	100
ELST C102	Network Analysis	4	4	20	80	100
ELST C103	Semiconductor Devices	4	4	20	80	100
ELST C104	Signals and Systems	3	3	20	80	100
	Elective	3	3	20	80	100
ELST P105	Device and Network Practical	2	4	00	100	100
ELST P106	Modern Programming Tools	2	4	00	100	100

Sl. No.	**Course No.**	Electives (Any One)	Credits	Hrs/Week
1	ELST E107	Applied Quantum and Statistical Physics	3	3
2	ELST E108	Electronic Computing Methods	3	3

Sl. No.	**Course No.**	Add-On Courses	Credits	Hrs/Week
1	ELST P109	Group Project: Networks	2	4
2	ELST P110	Fresher Seminar	1	2

SEMESTER- II: Total credits/core/electives/practical/VAC (22/3/2/2/1); Total marks: 700

Course No.	Course title	Credits	Hrs/Week	Marks		
				Mid Sem	**End Sem**	**Total**
ELST C201	Linear IC	4	4	20	80	100
ELST C202	Switching Circuits	4	4	20	80	100
ELST C203	Digital Signal Processing	4	4	20	80	100
	Elective-1	3	3	20	80	100
	Elective-2	3	3	20	80	100
ELST P207	Analog and RF Practical	2	4	00	100	100
ELST P208	Digital Circuits and Signal Processing Practical	2	4	00	100	100
	Value-Added Course	2	4	20	80	100

Sl. No.	**Course No.**	Electives (Any Two)	Credits	Hrs/Week
1	ELST E204	Control Systems	3	3
2	ELST E205	High Speed Communication Circuits	3	3
3	ELST E206	Light Wave Theory	3	3

Sl. No.	**Course No.**	Value-Added Course (Any One)	Credits	Hrs/Week
1	ELST V209	Cyber Physical Systems	2	4
2	ELST V210	Physics for Solid State Application	2	4

SEMESTER- III: Total credits/core/electives/practical/VAC (24/3/2/2/1); Total marks: 700

Course No.	Course title	Credits	Hrs/ Week	Marks		
				Mid Sem	End Sem	Total
ELST C301	Microprocessor	4	4	20	80	100
ELST C302	Communication System	4	4	20	80	100
ELST C303	VLSI Technology	4	4	20	80	100
	Elective	4	4	20	80	100
ELST CT300	Basic Signals and Systems	4	4	20	80	100
ELST P307	Microprocessor and VLSI Practical	2	4	00	100	100
ELST P308	Communication System Practical	2	4	00	100	100
	Value-Added Course	2	4	20	80	100

Sl. No.	Course No.	Electives (Any One)	Credits	Hrs/Week
1	ELST E304	Instrumentation	3	3
2	ELST E305	Radiating System	3	3
3	ELST E306	Power Electronics	3	3

Sl. No.	Course No.	Value-Added Course (Any One)	Credits	Hrs/Week
1	ELST V309	Electronic System Design	2	4
2	ELST V310	Computer System Architecture	2	4
3	ELST V311	Communication System using ICs	2	4

SEMESTER- IV: Total credits/special electives/practical /VAC(20/2/3/1); Total marks: 500

Course No.	Course title	Credits	Hrs/Week	Marks		
				Mid Sem	End Sem	Total
ELST D401	Dissertation	6	12	00	100	100
ELST P402	Seminar Presentation	3	6	00	100	100
ELST G403	Grand Viva Voce	3	6	00	100	100
	Special Elective-1	4	4	20	80	100
	Special Elective-2	4	4	20	80	100

Sl. No.	Course No.	Special Electives (Any Two)	Credits	Hrs/Week
1	ELST SE404	Wireless Communication and Networks	4	4
2	ELST SE405	Embedded System	4	4
3	ELST SE406	Optical Fiber Technology and Applications	4	4
4	ELST SE407	Radar and Satellite Communications	4	4

Sl. No.	Course No.	Value-Added Course	Credits	Hrs/Week
1	ELST V408	Cultural Heritage of South Odisha	2	4

Note:

- **ELST: Electronic Science and Technology, C – Core, E – Elective, SE – Special Elective, P – Practical/ Mini Project/ Group Project/ Seminar Presentation, D – Dissertation, G – Grand Viva Voce, V- Value Added Course, CT- Credit Transfer Course**
- **Course No.: ELST – Paper Type – Semester - Paper Sl. No., e.g., ELST C102.**
- **Value-Added Courses are elective in nature, but optional, *i.e.* a student may opt for any such course only if he/she has interest in it and wants to acquire additional skills. Apart from referencing to journals/magazines, a student can follow the provided syllabus. The credits for these courses shall not be added in calculating CGPA/ SGPA.**

Details of the Syllabus

SEMESTER- I: Total credits/core/electives/practical (22/4/1/2); Total marks: 700

ELST C101 Electromagnetic Theory Credits-4

Prerequisites: Introductory Electromagnetics and vector calculus.

Course Objectives: To obtain an understanding of Maxwell's equations and develop an understanding of material and wave interaction.

Course Outcomes: Be able to calculate transmission/reflection co-efficient, power of EM wave, field at boundaries, radiation potential, and propagating wave parameters in different medium.

Outcome Measurement: Course outcomes will be measured via internal assessment (quiz, assignment, attendance, written test) and end semester examination.

Course Topics:

Unit – I: Transmission Lines: Transmission lines: Circuit models of transmission lines and the coaxial line; the relationship of the coaxial transmission line to Ampere's and Gauss' Laws; basic derivations of L and C; transmission and reflection coefficients, pulses and transients; the capacitively loaded line and implications for high speed-digital systems; sinusoidal waves; standing wave ratio; expressions for impedance, transmission, and reflection coefficient and power flow; Smith chart relating complex reflection coefficient and impedance; scattering parameters and the Smith chart; single and double stub tuning; quarter wave tuning; lossy transmission lines; basic concept of resonance on transmission lines; Gaussian pulse propagation: group and energy velocity

Unit – II: Introduction to Maxwell's Equations: Review of vector analysis and coordinate systems; gradient, orthogonality, and wave phase fronts; surface and volume integrals; Gauss' law; Gauss' law for magnetism; line integrals, currents and Ampere's law; divergence of a vector and Gauss' law in differential form; the divergence theorem; curl of a vector field and Ampere's law in differential form; Stoke's theorem; the Laplacian operator; Maxwell's equations; displacement current, continuity and Maxwell's equations; charges, conduction, convection, and diffusion currents; introduction to magnetic and electric potentials; Faraday's law

Unit – III: Intermediate Aspects of Maxwell's Equations: Scalar and vector potentials; generalizations of the potentials to include retardation; boundary conditions; capacitance and inductance; Poynting's theorem, power flow, and stored energy; Maxwell's equations for the sinusoidal steady-state (phasors); polarization; the steady-state Poynting vector and theorem; propagation in lossy media; forces, torque, and work

Unit – IV: Reflection and Transmission at Interfaces: EM waves at boundaries and the transmission line analog; Snell's "laws" and the critical angle; oblique incidence; Brewster's angle; TEM modes and the coaxial cable; ray model of guided waves: TE and TM waves, cut-off, and phase velocity; general formulation of wave-guide fields; hollow metallic wave guides with guiding in one dimension; planar transmission lines; general properties two dimensional-rectangular guides; power transfer; dielectric, slab-wave guides; periodic structures; optical fibres; loss and dispersion; resonators

Unit – V: Antennas, Radiation, Diffraction, and Wireless Systems: Basic antenna parameters for single and arrays of antennas; directivity and gain; effective area; Friis formula and its relation to uncertainty; signal to noise and the Friis equation; basic radar equation as extension of Friis equation; review of potentials and the Hertzian dipole; long-wire antenna; radiation resistance; arrays; far field, near field and the Fourier transform; circuit approach to arrays; Yagi-Uda arrays; integrated antennas; imaging, geometrical optics, and Gaussian beams

Additional Suggested Reading (not for examination): Electromagnetic Properties of Materials (as time permits), Linear isotropic media; anisotropic media; introduction to electro-optics

Text Book:

David J. Griffiths: Introduction to Electrodynamics, PHI 3rd Edition

References:

1. Engineering Electromagnetics: Shen, Kong, Patnaik, Cengage Learning Publications, India Edition
2. J. D. Jackson: Classical Electrodynamics.
3. E. C. Jordan, K. G. Balman: Electromagnetic Waves & Radiating Systems by PHI 2nd Edition.
4. Hyatt: Engineering Electromagnetics, TMH.
5. Paul, Whites, Nasar: Introduction to E.M. Fields, TMH.

ELST C102 Network Analysis Credits-4

Prerequisites: None.

Course Objectives: To make the students capable of analysing any given electrical network.

Course Outcomes: Apply the knowledge of basic circuital law and simplify the network using reduction techniques. Analyse the circuit using Kirchhoff's law and Network simplification theorems. Infer and evaluate transient response, Steady state response, network functions. Evaluate two-port network parameters.

Outcome Measurement: Course outcomes will be measured via internal assessment (quiz, assignment, attendance, written test) and end semester examination.

Course Topics:

Unit-1: Circuit elements: Resistance, inductance and capacitance parameters, active element conventions, Transformation of energy sources, loop variable and node variable analysis, Y-Δ transformation, Transfer impedance/admittance, **Network theorems**: Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum Power transform theorem, Millman's theorem. Coupled Circuits, Dot Convention for representing coupled circuits, Coefficient of coupling, Band Width and Q-factor for series and parallel resonant circuits.

Unit-2 Characterization of linear time invariant two port network, Open circuit Impedance Parameter, Short circuit Admittance parameter, Transmission parameter, Inverse transmission parameter, Hybrid parameter, Inverse hybrid parameter, Hybrid parameter in terms of other parameter, Reciprocity and symmetry, Output impedance, Image impedance, interconnection of two port networks.

Unit-3 Introduction to Laplace Transform, Laplace transform of some basic functions, Laplace transform of periodic functions, Inverse Laplace transform, Laplace transform of Unit step, Shifted unit step, Ramp and Impulse function, Transform impedance and transform circuits.

Unit-4 Network functions: Network functions for one port and two port networks, calculation of network functions Ladder network and general network, Poles and Zeros of network function, restriction of Poles and Zeros Location on transfer function and driving function.

Unit-5 Network of Basic Electronic Elements: Circuits with Non-linear Elements; Diode; Design and Analysis of Diode Circuits, BJT, Op Amp, Fundamental Amplifier Circuits; Input/ Output Impedance; Active Filters; Super diode, Log, Antilog Filters; Control Fundamentals; Positive Feedback; Schmitt Trigger; Digital Circuits

(Further reading: Hurwitz polynomial, Properties of Hurwitz polynomial, Positive real functions and their properties, Concepts of network synthesis, Realization of simple R-L, R-C and L-C functions in Cauer-I, Cauer-II, Foster-I and Foster-II forms.)

Web Resources:

https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-071j-introduction-to-electronics-signals-and-measurement-spring-2006/lecture-notes/

Books and References:

1. Valkenburg V., “Network Analysis”, 3rd Ed., Prentice Hall International Edition, 2007.
2. Valkenburg V., “Network Synthesis.
3. Kuo F. F., “Network Analysis and Synthesis”, 2nd Ed., Wiley India, 2008.

ELST C103 **Semiconductor Devices** **Credits-4**

Course Objective:

- To provide basic knowledge and concepts of the characteristics and principles of operation of semiconductor devices.

Course Outcomes:

- Ability to apply basic concepts of semiconductor materials and devices in modern electronic industry.
- Holistic view in low-dimensional (2D, 1D, and 0D (nano)) materials and devices.

Outcome Measurement: Course outcomes will be measured via internal assessment (quiz, assignment, attendance, written test) and end semester examination.

Course Topics:

Unit – 1: Carrier Transport Phenomena: Conductivity, Mobility and Hall Effect, Diffusion and Drift of Excess Carriers, Generation and Recombination Mechanism, Trapping, Shockley–Read–Hall theory, Continuity and Diffusion Equation.

Unit-2: P-N Junction Diode: Built in potential barrier, Electric field, Space charge width of the Depletion region, Junction capacitance for an abrupt junction. Current Voltage Characteristics - Shockley diode equation, Equivalent circuit. Photo-Voltaic effect in pn junction, Junction Break down: I-V characteristics of Zener diode and Tunnel diode.

Unit-3: Bipolar Junction Transistor (BJT): Principle of operation, Basic current-voltage characteristics, Modes of operation, current gain, Device Modelling: Ebers-Mol model.

Junction Field Effect Transistor (JFET): Basic JFET operation, Device characteristics, Ideal DC current-voltage characteristics, Equivalent circuit of JFET and frequency limitations.

Unit 4: Metal semiconductor junction and MOSFET: Metal semiconductor junction, Schottky effect**,** Ohmic contacts, Heterojunction, 2DEG, HEMT, I-V and C-V characteristics.

MOSFET: Two terminal MOS structure, Basic MOSFET operation**,** Current voltage relationship.

Suggested Further Reading (Not to be asked in the theory exam)

Low dimensional semiconductor structures – Quantum wells, Quantum wires, Quantum dots and Devices
Emerging materials for future Devices: Graphene, Carbon Nano Tubes (CNT), ZnO, SiC, GaN.
Optical and Physical Characterisation: Raman spectroscopy, microscopy, transmission spectroscopy, absorption spectroscopy, SEM, TEM, AES, SIMS, Sputtering, XRD, and XPS.

Text Book:

1. Donald A. Neamen, “Semiconductor Physics and Devices Basic Principles”, 4th edn. McGraw-Hill, 2012

References:

1. B.G. Streetman and Sanjay Banerjee, “Solid State Electronic Devices”, 7th edn., Prentice Hall, 2016.
2. S. M. Sze and K. K. Ng, “Physics of Semiconductor Devices”, 3rd edn. Wiley, 2007.
3. U. Mishra and J. Singh, “Semiconductor Device Physics and Design”, Springer, 2008.
4. J. H. Davies, “The Physics of Low Dimensional Semiconductors: An Introduction”, Cambridge University Press, 1998.
5. C. Lamberti and G. Agostini, “Characterization of semiconductor heterostructures and nanostructures”, Elsevier, 2013.

ELST C104 **Signals and Systems** **Credits-3**

Prerequisites: None.

Course Objectives: To explain signals and systems representations/classifications, frequency and time domain analysis of signals, calculating system response using convolution integral/sum and understand sampling theorem.

Course Outcomes: Be able to understand mathematical description and representation of continuous and discrete time signals and systems. Develop input output relationship for linear shift invariant system and understand the convolution operator for continuous and discrete time system. Understand and resolve the signals in frequency domain using Fourier series and Fourier transforms. Understand the limitations of Fourier transform and need for Laplace transform and develop the ability to analyse the system in s- domain.

Outcome Measurement: Course outcomes will be measured via internal assessment (quiz, assignment, attendance, written test) and end semester examination.

Course Topics:

Unit-I: Signals (continuous-time): Signal classification (analog-digital, energy-power, even-odd, periodic-aperiodic, deterministic-random etc.), standard signals (unit step, unit impulse, ramp, exponential, sinusoids), transformations of the independent variable.

Systems (continuous-time): System classification (memory, causal, stable, linear, time-invariant, invertible etc.).

Natural and forced response, zero-input and zero-state solutions, step response, system stability. Impulse response of an LTI system, convolution integral, graphical convolution, system properties from impulse response, interconnection of LTI systems, evaluating impulse response from the step response.

Unit-II: Discrete-time signals and systems: Emphasize similarities and differences with continuous-time counterpart, transformations of signals, discrete-time convolution.
Continuous-time Fourier series: Periodic signals and their properties, complex exponential as eigen function of LTI systems, exponential and trigonometric FS representation of periodic signals, convergence, FS of standard periodic signals, salient properties of Fourier series, FS and LTI systems, some applications of FS (e.g. filtering).

Unit-III: Continuous-time Fourier transform: Development of Fourier representation of aperiodic signals, convergence, FT of standard signals, FT of periodic signals, properties of FT, some applications of FT (e.g. Modulation).

Laplace transform: Unilateral and Bilateral transform, ROC, relation between Fourier and Laplace transform, properties, poles and zeros of rational transfer function, frequency response from pole zero locations, Bode plots, solution of ODEs using Laplace transform, zero-state and zero-input response.

Unit-IV: Sampling (Bridge continuous and discrete): Sampling theorem and signal reconstruction, notion of aliasing with examples, discrete-time processing of continuous-time signals, continuous-time processing of discrete-time signals.

Text Book:

1. Principles of Linear Systems and Signals: B.P. Lathi (2nd Ed)

References:

1. Signals and Systems: Oppenheim, Willsky and Nawab (2^{nd} Ed).

ELST E107 Applied Quantum and Statistical Physics Credits-3

Prerequisites: Quantum mechanics concept.

Course Objective:

- To provide basic knowledge and concepts of the quantum mechanics and its applications.
- The basic knowledge about electronic materials such as bond and band picture, statistics of carrier concentrations in the energy band.

Course Outcomes:

- Ability to apply basic concepts of quantum mechanics for the solution and implementation for the semiconductor devices.

Outcome Measurement: Course outcomes will be measured via internal assessment (quiz, assignment, attendance, written test) and end semester examination.

Unit – 1: Introduction: Classical and Quantum Mechanics; Probability Amplitudes and Development of Quanta; Dispersion, Wave packets; Operators and Ehrenfest's Theorem; Eigenfunctions, Eigenvalues, Superposition
(Skill: Fourier Transforms / MATLAB®, Examples of Operators and Ehrenfest's Theorem)

Unit – 2: Finite Well and 1D Box; Tunneling Barriers; Simple Harmonic Oscillator; Raising and Lowering Operators; LC Circuit & SHO Wave packets
(Skills: Tunneling Examples, STM, SHO)

Unit – 3: WKB Approximation, Variational Method; Finite Basis Set Approximation; Two-level System (dc Drive); Two-level System: Dynamic Drive
(Skills: Examples of Two-level Systems);

Unit – 4: Coupled Systems: Coupled Systems; 2D and 3D; Density of States; Quantization of the E and M Fields; Fermi's Golden Rule
(Skills: Two-level Examples and Coupled System, Examples and Periodic Boundary Conditions)

Unit – 5: Statistical Physics: Introduction; Metals and Semiconductors; H-Atom
(Skills: Examples of Statistical Physics, Thermionic Emission, Examples of Metals and Semiconductors, H-Atom Examples)

Web Resources:
https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-728-applied-quantum-and-statistical-physics-fall-2006/syllabus/

Text Books:

1. Hagelstein, Peter L., Stephen D. Senturia, and Terry P. Orlando. *Introduction to Applied Quantum and Statistical Physics*. New York, NY: Wiley, 2004. ISBN: 0471202762
2. Ghatak and Lokanathan: Quantum Mechanics (Unit-1 and 2)
3. Introduction Solid State Physics: C. Kittel (Unit-2 and 3)
4. Solid State Electronic Devices B. G. Streetman (PHI). (Unit-4)

References:

1. Schiff: Quantum mechanics
2. Mathews and Venkatesan: A text Book of Quantum Mechanics.
3. Merzabacher: Quantum Mechanics
4. Semiconductor Optoelectronic devices, P. Bhattacharya (PHI).
5. Polkinghorne, J. *Quantum Theory: A Very Short Introduction*. New York, NY: Oxford University Press, 2002. ISBN: 0192802526.
6. Liboff, R. L. *Introductory Quantum Mechanics*. 3rd ed. Reading, MA: Addison-Wesley Longman, 1998. ISBN: 0201878798.
7. Greenstein, George, and Arthur G. Zajonc. *The Quantum Challenge: Modern Research on the Foundations of Quantum Mechanics*. 2nd ed. Sudbury, MA: Jones and Bartlett Publishers, 2006. ISBN: 076372470X.

8. Gasiorowicz, Stephen. *Quantum Physics*. 2nd ed. New York, NY: John Wiley, 1996. ISBN: 0471857378.
9. Griffiths, David J. *Introduction to Quantum Mechanics*. Englewood Cliffs, NJ: Prentice Hall, 1995. ISBN: 0131244051

ELST E108 Electronic Computing Methods Credits-3

Course Objective: To acquire the basic knowledge of high-level programming language and implement in various numerical problems in scientific research and studies.
Learning Outcome: After completion of course, the students will have enough ideas:
- Fundamentals of C Programming
- Study of solution of linear algebraic equations, differentiation, integration, differential equation using Numerical Approach
- Finally implementing Numerical Solutions using C Programming.

Outcome Measurement: Course outcomes will be measured via internal assessment (quiz, assignment, attendance, written test) and end semester examination.

Course topics:

Unit-1: Elementary ideas on C: Data Types, Constants & Variables, Arithmetic & Logical Operators, Loops & Control, Function, Array and Pointers, Structure, Union, File Handling.

Unit-2: Solution of linear algebraic equations (Gauss-Jordan Elimination, Gaussian Elimination with Back-substitution, LU Decomposition, Iterative Method: Jacobi's Method), Measure of Accuracy, Root Finding (Bisection, Secant Method, False Position Method, Newton-Raphson Method Using Derivative, Newton-Raphson Method for Nonlinear Systems of Equations).

Unit-3: Interpolation: Finite Difference (Forward Differences, Backward Differences, Forward Difference Table, Backward Difference Table), Newton's Method of Interpolation (Forward Difference Interpolation Formula, Backward Difference Interpolation Formula), Differentiation of a function of single variable, Differentiating a Tabulated Function.

Unit-4: Integration of a function of single variable using Trapezoidal Rule, Simpson's $1/3^{rd}$ rule, Solution of a differential equation: Euler's Method, Runge-Kutta 2^{nd} Order and 4^{th} Order Method, Predictor-Corrector Method.

Text books:
1. E. Balaguruswamy, "Programming in C", Tata McGraw Hill.
2. R.S. Salaria, "Computer Oriented Numerical Methods", KBP Publication.

References:
1. C. Xavier, "C Language and Numerical Methods", New Age International.
2. H. Schildt. "C The Complete Reference", Tata McGraw Hill
3. Y. Kanetkar, "Let us C", BPB Publications.
4. Stephen Prata, "C Primer Plus", Sams Publishing
5. W. H. Press, S. A. Tukolsky, W. T. Vetterling & B. P. Flannery, "Numerical Recipes in C", Cambridge University Press.

6. Anne Greeanbaum, Trimothy P Charter, “Numerical methods: Design, Application and Computer Implementation”
7. Richard Hamming, “Numerical Methods for Scientists and Engineers”

ELST P105 Device and Network Practical Credits-2

(Perform any 8 experiments)

Objective and brief description on course and expectations: Source, Devices and passive components are fundamental building blocks of any electronic circuit. This course is designed to impart necessary skills to understand them in a practical environment. The students will learn characteristics of semiconductor devices, their inter connection and analysis of circuit containing the components. Also, they will learn design and stabilization of source for electronic circuits.

Section-A (Device)

1. To study V-I characteristics of diode, and its use as a capacitance.
2. Study of Half wave & full wave rectifiers.
3. Study of Diode as clipper & clamper.
4. Study of Zener diode as a voltage regulator.
5. Study of the characteristics of transistor in CB and CE mode.
6. Study of CC amplifier as a buffer.
7. Graphical determination of small signal hybrid parameters of bipolar junction transistor.
8. Study of V-I characteristics of a photo-voltaic cell.
9. Study of characteristics of MOSFET/JFET is CS configuration.
10. Characteristics of Thyristor, UJT, Diac and Triac.
11. Study of loss factor in a dielectric by an impedance bridge.

Section-B (Network)

1. Verification of Network Theorems (Superposition, Thevenin, Norton & Maximum Power).
2. Study of AC & DC Transients.
3. Determination of circuit parameters: Open Circuit & Short Circuit Parameters.
4. Determination of circuit parameters: Hybrid & Transmission Parameters.
5. Frequency response of Low Pass & High Pass Filters.
6. Frequency response of Band Pass & Band Elimination Filters.
7. Study of resonance in R-L-C series Circuit.
8. Study of resonance in R-L-C Parallel Circuit.
9. Spectral analysis of non-sinusoidal waveform

ELST P106 Modern Programming Tools Credits-2

Prerequisites: None, this is a first-year course.

Course Objectives: To develop good programming skills, to understand numerical solution of continuous phenomena via C-programming language and to visualize electrical and EM signals using MATLAB/scilab/octave/python.

Course Outcomes: At the completion of the course, the student should be able to do the following: Numerically solve any continuous phenomena using programming, operations on signals & systems and EM field interaction.

Outcome Measurement: Course outcomes will be measured via practical examination, viva-voce and report.

Course Topics:

No theory examination on the following tools. These are only indicative of the requirement for writing a program.

MATLAB: Getting Started: Scripts; Making Variables; Manipulating Variables; Basic Plotting; Functions in MATLAB: Flow Control; Line Plots; Image/Surface Plots; Efficient Codes; Debugging; Linear Algebra with MATLAB: Polynomials; Optimization; Differentiation/Integration; Differential Equations; Probability and Statistics with MATLAB: Data Structures; Images; File I/O; Documentation using MATLAB: Miscellaneous Useful Functions; Graphical User Interfaces; Simulink; Symbolic Toolbox; Image Processing; Hardware Interface

PYTHON: Introduction to PYTHON; Conditionals, loops, commenting; Functions; Strings, lists, list comprehensions: How to use while-else loops (suggestion: don't use them at all, but if you do be aware they work differently than you might think); Recursion; Tuples, dictionaries, common Python mistakes; Class; Inheritance

Web resources:

https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-057-introduction-to-matlab-january-iap-2019/lecture-notes/index.htm

Section-A (Signals and Systems)

1. To demonstrate some simple signal.
2. To explore the commutation of even and odd symmetries in a signal with algebraic operations.
3. To explore the effect of transformation of signal parameters (amplitude-scaling, time-scaling and time-shifting).
4. To explore the various properties of the impulse signals.
5. To visualize the complex exponential signal and real sinusoids.
6. To identify a given system as linear or non-linear.
7. To explore the time variance and time invariance property of a given system.
8. To explore causality and non-causality property of a system.
9. To visualize the relationship between the continuous-time Fourier series and Fourier transform of a signal.
10. To visualize the relationship between the discrete-time Fourier series and Fourier transform of a signal.
11. To visualize the relationship between continuous-time and discrete-time Fourier transform of a signal.
12. To visualize the relationship among Fourier analysis methods.
13. To demonstrate the time domain sampling of bandlimited signals (Nyquist theorem).
14. To demonstrate the time domain sampling of non-bandlimited signals and antialiasing filter.
15. To demonstrate the signal reconstruction using zero-order hold and first-order hold filters.
16. To demonstrate the sampling in frequency domain (Discrete Fourier Transform).
17. To demonstrate the spectral analysis using Discrete Fourier Transform.
18. To demonstrate the convolution and correlation of two continuous-time signals.
19. To demonstrate the convolution and correlation of two discrete-time signals.

Section-B (EM Theory)

1. Program to verify conservation of Charge.
2. Program to verify Faraday's Law.
3. Program to verify concept of Scalar Potential.
4. Program to verify concept of Vector Potential.
5. Program to verify Ampere's Law, including Displacement Current.
6. Program to determine reflection coefficient for normal incidence on dielectric interface.
7. Program to determine Program to determine transmission coefficient for normal incidence on dielectric interface.
8. Program to determine reflection coefficient for oblique incidence on dielectric interface.
9. Program to determine transmission coefficient for oblique incidence on dielectric interface.
10. Program to determine the skin depth of a good conductor.
11. Program to determine the skin depth of an insulator.
12. Program to determine reflection coefficient for normal incidence on dielectric-conductor interface.
13. Program to determine transmission coefficient for normal incidence on dielectric-conductor interface.

Section-C (Numerical Computation)

1. To Find out the root of the Algebraic and Transcendental equations using Bisection, Regula-falsi, Newton Raphson and Iterative Methods. Also find the rate of convergence of roots in tabular form for each of these methods.
2. To develop computer programs for solution of system of simultaneous linear equations using Gauss Elimination Technique, without and with specified boundary conditions, for full as well as bounded symmetric and unsymmetrical matrices.
3. Solution of a system of simultaneous algebraic equations using the Gauss-Seidel iterative method employing the technique of successive relaxation.
4. To implement Newton's Forward and Backward Interpolation formula.
5. Linear and Non-Linear curve fitting technique.
6. To Integrate numerically using Trapezoidal rule.
7. To Integrate numerically using Simpson's rules.
8. To find the largest eigen value of a matrix by power-method.
9. To find numerical solution of ordinary differential equations by Euler's method.
10. Numerical solution of an ordinary differential equation using the Predictor – corrector method.
11. To find numerical solution of ordinary differential equations by Runge-Kutta method.
12. Numerical solution of a system of two ordinary differential equation using Numerical integration.
13. Numerical solution of an elliptic boundary value problem using the method of Finite Differences.
14. Numerical solution of an elliptic boundary value problem using the method of Finite Elements.
15. To find the numerical solution of Laplace equation.
16. To find numerical solution of wave equation.
17. Solution of difference equations.

ELST P109 **Group Project: Networks** **Credits-2**

Stage- 1: Introduction to Social, Economic, and Technological Networks

Stage- 2 Network Representations, Measures, and Metrics

Directed and undirected graphs, adjacency matrix. Paths, cycles, connectivity, components. Trees, rings, stars, bipartite graphs, hyper graphs. Centrality measures (degree, closeness, betweenness), clustering, structural balance, homophily, and assortative mixing. Applications: Structural properties of Facebook graph.

Stage 3: Linear Dynamical Systems, Markov Chains, Centralities

Discrete-time, linear time-invariant systems with constant inputs. Eigenvalue decomposition. Convergence to equilibrium. Lyapunov function. Positive linear systems, Markov chains, and Perron-Frobenius. Random walk on graph. Eigen centrality. Katz centrality. Page rank. Applications: Web search.

Stage 4: Dynamics Over Graph: Spread of Information and Distributed Computation

Algebraic properties of graphs, Cheeger's inequality, information spread and consensus. Applications: social agreement, synchronization, distributed optimization.

Stage 5: Graph Decomposition and Clustering

Decomposing networks into clusters. Modularity. Spectral clustering and connectivity.

Stage 6: Random Graph Models

Erdos-Renyi graphs. Review of branching processes. Degree distribution, phase transition, connectedness, giant component. Applications: tipping, six degrees of separation, disease transmissions.

Stage 7: Generative Graph Models

Preferential attachment: rich get richer phenomena, power laws. Small world models: clustering and path lengths. Applications: Internet topology, Facebook and Twitter degree distributions, firm size distributions.

Stage 8: Introduction to Game Theory

Games, pure and mixed strategies, payoffs, Nash equilibrium, Bayesian games. Applications: tragedy of the commons, peer effects, auctions.

Stage 9: Traffic Flow and Congestion Games

Stage 10: Network Effects (I)

Negative externalities, congestion, Braess' paradox, routing. Application: pricing traffic.

Stage 11: Network Effects (II)

Key players and the social multiplier. Applications: criminal networks, public good provision, oligopoly.

Stage 12: Networked Markets

Matching markets, markets with intermediaries, platforms. Applications: clearinghouses, ad exchanges, labour markets.

Stage 13: Repeated Games, Cooperation, and Strategic Network Formation

Stable networks, Nash networks, efficient networks. Applications: co-authorship, R&D networks.

Stage 14: Diffusion Models and Contagion

Positive externalities, strategic complements, coordination games, tipping, lock in, path dependence. Applications: diffusion of innovation.

Stage 15: Games with Incomplete Information and Introduction to Social Learning, Herding, and Informational Cascades

Rule of thumb and Bayesian learning, social influence, benefits of copying, herd behaviour, informational cascades. Applications: consumer behaviour, financial markets.

Project Resources:
https://ocw.mit.edu/courses/economics/14-15j-networks-spring-2018/lecture-and-recitation-notes/

1. Newman, Mark. *Networks: An Introduction*. Oxford University Press, 2010. ISBN: 9780199206650. (1-7, 11-15 chap)
2. Easley, David and Jon Kleinberg. *Networks, Crowds, and Markets: Reasoning about a Highly Connected World.* Cambridge University Press, 2010. ISBN: 9780521195331. (chap 1-6,8,10,11,17,19)
3. . Jackson, Matthew. *Social and Economic Networks*. Princeton University Press, 2010. ISBN: 9780691148205. (chap 6-7,9-11)
4. . Osborne, Martin. *Introduction to Game Theory*. Oxford University Press, 2003. ISBN: 9780195128956. (chap 1-6,9,14,15)

ELST P110 Fresher Seminar Credit-1

Course objectives: To stimulate curiosity and interest of students in understanding the principles behind popular consumer electronics items.

Society of Mind
Each student must prepare a short presentation from the following unit:

Unit – 1: Introduction; Falling in Love; Cognitive Architectures; From Panic to Suffering; Layers of Mental Activities; Layered Knowledge Representations; Common Sense; Mind vs. Brain: Confessions of Defectors

Web Resources
https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-868j-the-society-of-mind-fall-2011/syllabus/

http://web.media.mit.edu/~minsky/

Textbooks:

1. Minsky, Marvin. *The Emotion Machine: Common sense Thinking, Artificial Intelligence, and the Future of the Human Mind*. Simon & Schuster, 2007. ISBN: 9780743276641
2. *Society of the Mind*. Simon & Schuster, 1988. ISBN: 9780671657130

SEMESTER- II: Total credits/core/electives/practical/VAC(22/3/2/2/1); Total marks: 700

ELST C201 **Linear IC** **Credits-4**

Prerequisites: Semiconductor Devices and Network Theory.

Course Objectives: To obtain an understanding of BJT/FET biasing and their use as amplifier, OP-Amp parameters and its applications, effect of load and source resistance on circuits, effect of negative feed-back and oscillator design.

Course Outcomes: Be able to design amplifier circuits using BJT/FET/OP-Amp and observe the amplitude and frequency responses. Observe the effect of negative feedback on different parameters of an Amplifier and different types of negative feedback typologies. Observe the effect of positive feedback and able to design and working of different Oscillators using BJTS. Develop the skill to build, and troubleshoot Analog circuits.

Outcome Measurement: Course outcomes will be measured via internal assessment (quiz, assignment, attendance, written test) and end semester examination.

Course Topics:

Unit-I: Biasing of BJTs: Load lines (AC and DC), Operating Points, Fixed Bias and Self Bias, DC Bias with Voltage Feedback, Bias Stabilization, Design Operation. Biasing of FETs and MOSFETs: Fixed Bias Configuration and Self Bias Configuration, Voltage Divider Bias and Design.

Small Signal Modelling of BJT and Analysis: The re transistor model, hybrid model, graphical determination of h-parameters. Low frequency small signal analysis of CE, CC and CB configurations without feedback.

Small Signal Modelling and Analysis of FETs: Small Signal Model, Analysis of JFET C-S and C-D configuration.

System Approach: Effects of RS and RL: Two-port system, Individual and combined effects of RS and RL on CE, Emitter follower and C-S networks.

Unit-II: BJT and JFET Frequency Response: General frequency considerations. Low-frequency analysis of R-C combination in single stage BJT and FET amplifier - Bode Plot. Lower Curt Off frequency for the system. Low frequency response of BJT and FET amplifiers. Miller Effect Capacitance. High -frequency modelling of BJT and FET. High frequency analysis of BJT and FET amplifiers - Bode plot. Square Wave testing of amplifiers.

Compound Configurations: Cascade, Cascode and Darlington connections, C-MOS Circuit, Current Source Circuits, Current mirror ckt, Differential amplifier circuit.

Unit-III: Ideal Operational Amplifiers: Differential and Common mode operation, OP-AMP basics. Equivalent Circuit Analysis of Inverting and Non - inverting OP - AMP circuits. Input impedance.

Practical OP-AMPS: OP-AMP Specifications, DC offset parameters, frequency parameters, gain - bandwidth. OP-AMP applications on constant gain multiplier, Voltage summing, Integrator, Differentiator and Controlled sources. Instrumentation Amplifier and Active Filters-low, high and band pass.

Power Amplifiers: Definition of A, B and C types. Conversion efficiency, Distortion analysis. Push - pull configuration.

Unit-IV: Feedback and Oscillator Circuit: Feedback and Oscillator Circuit: Feedback concept, Type of feedback circuits, Practical feedback circuit. Analysis of only voltage-series feedback type amplifier. Effects of negative feedback. Positive feedback, Barkhausen Criterion of Oscillation. Oscillator Operation. R-C phase shift oscillator. Crystal Oscillator.

Text Books:

1. Boylested and Nashelsky, “Electronic Devices & Circuit Theory”, PHI Publications

References:

2. Millman, Halkies & Satyabrata Jit, “Electronic Device & Circuits”, TMH Publications.
3. Sedra and Smith, “Microelectronics Circuits”, Oxford University Press, New Delhi.

ELST C202 Switching Circuits Credits-4

Course Objective:
To acquire the basic knowledge of digital logic levels and application of knowledge to understand digital electronics circuits.

Learning Outcome: After completion of course, the students will have enough ideas:

- Binary systems, Boolean Function and their Minimization for Circuit Implementation
- Combination and Sequential Circuit Implementation
- Memory organization in Digital Systems

Outcome Measurement: Course outcomes will be measured via internal assessment (quiz, assignment, attendance, written test) and end semester examination.

Course topics:

Unit-1: Digital Systems, Binary Numbers, Signed Binary Numbers, Boolean algebra, De-Morgan’s Law, Standard and K-map representation of logic functions, Simplification of Logical functions Using K-map, minimization of logical function specified in Minterms/Maxterms, don’t care condition, NAND & NOR DTL Gates, NAND and NOR implementation. AOI, OAI implementation, Hardware Description Language (HDL).

Unit-2: Combinational Circuits, Analysis and Design Procedure; Binary Adder-Sub tractor, Decimal Adder, Binary Multiplier, Magnitude Comparator, Decoders/De-multiplexers, Encoders/Multiplexers, Multipliers, BCD-to-7-segment Decoder/ Driver, HDL for Combinational Circuits.

Unit-3: Sequential Circuits, Latches, Flip-Flops, Clocked S-R Flip Flop, J-K Flip flop, Master slave Flip Flop, T and D type Flip Flop, Characteristic Tables, Characteristic Equations, Analysis of Clocked Sequential Circuits, State Equations, State Table, State Diagram, Excitation table of Flip Flop, Conversion of Flip Flop, Ripple counter, Synchronous counter, applications of counters, Shift register. HDL for Sequential Circuits.

Unit-4: Registers, Shift Registers, Universal Shift Registers, Binary Ripple Counter, BCD Ripple Counter, Synchronous Counters, Up-Down Counter, BCD Counter, Ring Counter, Johnson Counter, HDL for Registers and Counters, Memory and Programmable Logic: Classification of Memory, Read Only Memory (ROM), Random-Access Memory (RAM), Memory Decoding, Programmable Logic Array (PLA). Memory Description in HDL.

Web Resources:
https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-374-analysis-and-design-of-digital-integrated-circuits-fall-2003/syllabus/

Text Book:

1. M. Morris Mano, Michael D. Ciletti, "Digital Design", 5th Edition, Pearson

References:

1. Rabaey, Jan, Anantha Chandrakasan, and Bora Nikolic. Digital Integrated Circuits: A Design Perspective. 2nd ed. Prentice Hall, 2002
2. R. P. Jain, "Modern Digital Electronics", 3rd edition, (TMH)
3. T. L. Floyd and R. P. Jain, "Digital Fundamentals", 5th Edition, Pearson Education, New Delhi.
4. Anil K. Jain, "Digital Electronics, Principles and Integrated Circuit", Wiley India Edition
5. John F. Wokerly, "Digital Design – Principle & Practice", 3rd Edition, Pub. Pearson Education.
6. Donald P. Leach, Albert Paul Malvino and Goutam Saha, "Digital Principles and Applications", 6th Edition, Tata McGraw Hill Publishing Company Ltd., New Delhi.
7. S. Salivahanan, S. Arivazhagan, "Digital Electronics", Vikash Publication

ELST C203 Digital Signal Processing Credits-4

Prerequisites: Fourier, Laplace and Z-transforms.

Course Objectives:
A thorough understanding and working knowledge of design, implementation and analysis DSP systems.

Course Outcomes:

- Interpret, represent and process discrete/digital signals and systems.
- Ability to design and analyse DSP systems like FIR and IIR Filters.

Outcome Measurement:
Course outcomes will be measured via internal assessment (quiz, assignment, attendance, written test) and end semester examination.

Course Topics:
Unit-I: Signals, Transformation of independent variables, Basic continuous time signals, Basic discrete time signals, Systems, properties of systems, Representation of signals in terms of impulses, continuous time systems, convolution integral, properties of LTI systems, Digital signal processing and its benefits, Discrete time LTI systems, Convolution sum.

Unit-II: DFT and its inverse, properties of the DFT, computational complexity of the DFT, The decimation in time FFT algorithm: the butterfly, computational advantage in FFT, Inverse FFT.

Unit-III: Structure for the Realization of Discrete-Time Systems, Structure for FIR Systems: Direct-Form Structure, Cascade-Form Structures, Frequency-Sampling Structures; Structure for IIR Systems: Direct-Form Structures, Signal Flow Graphs and Transposed Structures, Cascade-Form Structures, Parallel-Form Structures.

Unit-IV: Design of Digital Filters: General Considerations: Causality and Its Implications, Characteristics of Practical Frequency-Selective Filters; Design of FIR Filters: Symmetric and Antisymmetric FIR Filters, Design of Linear-Phase FIR Filters by using Windows, Design of Linear-Phase FIR Filters by the Frequency-Sampling Method; Design of IIR Filters from Analog Filters: IIR Filter Design by Impulse Invariance, IIR Filter Design by the Bilinear Transformation.

Text Book:

1. Digital Signal Processing – Principles, Algorithms and Applications by J. G. Proakis and D. G. Manolakis, 4th Edition, Pearson.

References:

1. Fundamentals of Signals and Systems - M. J. Roberts, TMH
2. Digital Signal Processing: S. Salibhanaan, A. Vallavaraj, C. Gnanapriya, TMH
3. Adaptive signal processing: Bernard Widrow, Samuuel D. Sterns, Pearson Education

ELST E204 **Control Systems** **Credits-3**

Prerequisites: Electromagnetic theory and network theory.

Course Objectives: To introduce different types of system and identify a set of algebraic equations to represent and model a complicated system into a more simplified form for analysis. To employ time domain analysis to predict and diagnose transient performance parameters of the system for standard input functions and identify the needs of different types of controllers and compensator to ascertain the required dynamic response from the system. Formulate different types of analysis in frequency domain to explain the nature of stability of the system.

Course Outcomes: After completion of the course the students will be able to: a. develops the mathematical model of the physical systems. b. analyses the response of the closed and open loop systems. c. analyse the stability of the closed and open loop systems. d. design the various kinds of compensator

Outcome Measurement: Course outcomes will be measured via internal assessment (quiz, assignment, attendance, written test) and end semester examination.

Unit-I: Concept of control systems - Open & closed loop systems, Linear & Non-linear Systems, Difference between open & closed loop systems.
Mathematical models of physical systems: Electrical systems, Mechanical systems & their conversions, Transfer function, Block diagrams and signal flow graph, Mason’s gain formula, Application of SFG.
Types of Feedback, Difference between positive and negative feedbacks, effects of feedback on control systems.
Unit-II: Time Domain Analysis - Types of standard signals (step, ramp, impulse & parabolic), 1st

& 2nd Order Systems, Time response of 1st & 2nd order systems to Unit Step and Ramp input signals, Time Specifications, Steady State and transient response of systems, steady state error.

Unit-III: Stability Analysis of Control System - Necessary conditions of stability, Hurwitz stability criterion, Routh stability criterion and its applications. Root Locus concepts, Rules for construction of root loci.

Unit-IV: Frequency domain analysis - Bode plot, Stability from bode plots, Nyquist criterion & its application to determine stability. Gain & phase margin.

Web Resources

https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-302-feedback-systems-spring-2007/recitations/

Text Book

1. Modern Control Engineering by K. Ogata (PHI)

References:

1. Control System Engineering - Dr. R. Anandanatarajan & P. Ramesh Babu, Scitech Publications (India) Pvt. Ltd. 92008)
2. Automatic Control System by B. C. Kuo (PHI)
3. Control Engineering by Nagarath & Gopal (New Age)
4. Modern Control Engineering by D. Roy Choudhury (PHI)
5. Control Systems, Theory and Applications by S. Ghos (Pearson Education).

ELST E205 High Speed Communication Circuits Credits-3

Prerequisites: Electromagnetic theory and network theory.

Course Objectives: Microwave Engineering introduces the student to RF/microwave analysis methods and design technique. Scattering parameters are defined and used to characterize devices and system behaviour.

Course Outcomes: Have knowledge of how transmission and waveguide structures and their uses. Gain knowledge and understanding of microwave analysis methods. Be able to apply analysis methods to determine circuit properties of passive microwave devices.

Outcome Measurement: Course outcomes will be measured via internal assessment (quiz, assignment, attendance, written test) and end semester examination.

Course Topics:

Unit – 1: Communication Systems Overview; Transceiver Architectures; Wave Guides and Transmission Lines; S-Parameters and Impedance Transformers; Generalized Reflection Coefficient, Smith Chart;

Unit- 2: Dividers & Couplers: Basic Properties - 3 & 4 Port Networks; T-Junction Divider - Loss Less, Resitive; Wilkinson Divider - Even-Odd Mode Analysis; Quadrature (90^0) Hybrid; Coupled Line: Directional Coupler (Excluding Multi section Coupler), Lange Coupler; The 180^0 Hybrid (only Ring Type).

Unit – 3: MOS Transistors, Passive Components, Gain-Bandwidth Issue for Broadband Amplifiers; High Frequency, Broadband Amplifiers; Enhancement Techniques for Broadband

Amplifiers, Narrowband Amplifiers; Noise Modeling in Amplifiers; Noise Figure, Impact of Amplifier Nonlinearities

Unit – 4: Low Noise Amplifiers; LNA Design Examples and Recent Techniques; Voltage Controlled Oscillators; VCO Examples and Mixers; Noise in Voltage Controlled Oscillators

Unit – 5: ABC's of Power Amplifiers; Other Classes of Power Amplifiers, Modulation of Power Amplifiers; Linearization Techniques for Power Amplifiers, Adaptive Biasing; Overview of Phase-Locked Loops and Integer-N Frequency Synthesizers; Noise in Integer-N and Fractional-N Frequency Synthesizers; Design of Fractional-N Frequency Synthesizers and Bandwidth Extension Techniques

Web Resources
https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-776-high-speed-communication-circuits-spring-2005/lecture-notes/

Text Books and References:

2. Microwave Engineering – D. M. Pozar, Wiley Publication
3. Microwave Engineering – R. E. Collin, McGraw Hill Publication.
4. Lee, Thomas H. *The Design of CMOS Radio-Frequency Integrated Circuits*. Cambridge, UK: Cambridge University Press, 1997. ISBN: 0521835399.
5. Razavi, Behzad. *RF Microelectronics*. Upper Saddle River, NJ: Prentice Hall, 1997. ISBN: 0138875715.

ELST E206 | Lightwave Theory | Credits-3

Course Objective:

- This course provides a complete overview of the principle of operation of LED and Lasers leading to optoelectronic devices principles of optical processes leading to design of optical devices.

Course Outcomes:

- Acquire knowledge on the working principle of operation of light wave sources such as LED and Lasers in the development/design of optoelectronic devices.

Outcome Measurement: Course outcomes will be measured via internal assessment (quiz, assignment, attendance, written test) and end semester examination.

Course topics:

Unit – I: Optical processes in semiconductors: Electron-hole pair formation, radiative and non-radiative recombination, band-to-band recombination, absorptions in semiconductors, Effect of electric field on absorption, absorption in quantum wells, radiation in semiconductors.

Unit – II: Light emitting diode: Electro-luminescent process, LED materials, Device configuration and efficiency, Coupling Loss, Light output from LED, LED structures, LED performance characteristics.

Unit – III: LASER Operating Principles: Spontaneous emission, stimulated emission and absorption of radiation in a two-level system, Einstein coefficients, population inversion, Gain in a two-level lasing medium; need for optical resonators, threshold condition for lasing, properties of laser light.

Unit – IV: Semiconductor LASER: - Lasing condition and gain coefficient in a semiconductor, junction laser and operating principles, threshold current density for semi-conductor laser, threshold current density from spontaneous emission rate, power output, heterojunction lasers, and quantum well lasers.

Suggested Further Reading (Not to be asked in the theory exam)

Properties of LASER beam and Types of LASER: - Line shape function and line broadening mechanism, modes of rectangular cavity and open resonator., Doped insulator LASER (Ruby, Nd, YAG); Gas LASER: He-Ne, CO_2), Liquid dye LASER.

Text book:

1. P. Bhattacharya, “Semiconductor Optoelectronic Devices”, 2nd edition, Prentice-Hall, 1997. (Unit 3, 5, 6, and 7)

References:

2. J. Willson & J. F. B. Hawakakis, “Optoelectronics: An introduction”, 3rd edition, Prentice Hall, 1998.
3. J. Singh, “Semiconductor Optoelectronics: Physics and Technology”, 1st edition, McGraw Hill, 1995.
4. S. O. Kasap, “Optoelectronics and Photonics: Principles and Practices,” Prentice-Hall, 2001.
5. K. Thyagarajan & A. Ghatak, “LASERS-Theory and Applications: 1st edition, Springer, 1981.
6. C. K. Sarkar and D. C. Sarkar, “Optoelectronics and Fiber Optics Communications”, 1st edition, New Age International Publisher, 2001.

ELST P207 **Analog and RF Practical** **Credits-2**

Prerequisites: Device and EM theory.

Course Objectives: To develop skills, to understand BJT, FET and OPAMP based circuits and Microwave components.

Course Outcomes: At the completion of the course, the student should be able to do the following: a. Implement and analyse basic analog circuits and b. basic operation of microwave bench

Outcome Measurement: Course outcomes will be measured via practical examination, viva-voce and report.

Course Topics:

Section-A (Analog Circuits)

At least 8 Experiments depending on the facilities available in the Laboratory.

1. Study emitter bias and fixed bias BJT and JFET circuits, and determine quiescent conditions.

1. Study of common emitter amplifier using self-biasing and study the effect of variation in emitter resistor on voltage gain, input and output impedance.
2. Determine the frequency response of Vo/Vs for CE BJT amplifier. Study the effect of cascading of two stages on band width.
3. Study of Darlington pair amplifier circuit and determine dc bias and output ac voltage.
4. To study Phase Shift Oscillator with and without buffer between RC Section.
5. To study operation of Hartley Oscillator.
6. To study operation of Instrumentation Amplifier.
7. To study the operation of Half wave voltage doubler.
8. To study Wein Bridge Oscillator and the effect on Output frequency of variation in RC combination.
9. To determine CMRR of a differential amplifier.
10. To study op-amp based inverting and non-inverting amplifiers, voltage comparator and zero crossing detector.
11. To study op-amp based Adder and integrator circuits.
12. To study RC low pass and high pass active filters and draw out put voltage waveform for square wave input.
13. To study Op-Amp based triangular wave generator.
14. To study operation of IC74123 as monostable multivibrator.
15. To design and fabricate Op-Amp. Base Astable multivibrator and verify experimentally frequency of oscillation.
16. To study operation of IC NE/SE 566 voltage-controlled oscillator and determine output frequency for various voltage levels.
17. To study Op-Amp. Based V to I and I to V converters.
18. To study a PLL circuit and determine the free running frequency.
19. To study Op-Amp. based sample and hold circuit.
20. Study an operational amplifier and find out: CMMR, gain band width product, slew rate, 3-db frequency, and input offset voltage.
21. Study of active low pass, high pass, and band pass filters.
22. Study of class A, B, C, and AB amplifier.
23. To study the operation of 555 timer oscillator.

Section-B (RF and Microwave)

1. Study of wave guide components.
2. To study the characteristics of reflex Klystron and determine its timing range.
3. To measure frequency of microwave source and demonstrate relationship among guide dimensions, free space wave length and guide wavelength.
4. To measure VSWR of unknown load and determine its impedance using a smith chart.
5. To match impedance for maximum power transfer using slide screw tuner.
6. To measure VSWR, insertion losses and attenuation of a fixed and variable attenuator.
7. To measure coupling and directivity of direction couplers.
8. To measure insertion loss, isolation of a three-port circulator.
9. To measure the Q of a resonant cavity.
10. To study the V-I characteristics of GUNN diode.

ELST P208 Digital Circuits and Signal Processing Practical Credits-2

Prerequisites: None, this is a first-year course.

Course Objectives: To develop skills, to understand digital circuits, digital filters and LASER.

Course Outcomes: At the completion of the course, the student should be able to do the following: a. Implement basic digital circuits both on bread board using ICs and FPGA Boards, b. Filter implementation using DSP processor and c. LASER calculation.

Outcome Measurement: Course outcomes will be measured via practical examination, viva-voce and report.

Course Topics:

Section-A (Digital Circuits)

1. Study of TTL gates – AND, OR, NOT, NAND, NOR, EX-OR, EX-NOR.
2. Design & realize a given function using K-maps and verify its performance.
3. To verify the operation of multiplexer & Demultiplexer.
4. To verify the operation of comparator.
5. To verify the truth tables of S-R, J-K, T & D type flip flops.
6. To verify the operation of bi-directional shift register.
7. To design & verify the operation of 3-bit synchronous counter.
8. To design and verify the operation of synchronous UP/DOWN decade counter using J K flip-flops & drive a seven-segment display using the same.
9. To design and verify the operation of asynchronous UP/DOWN decade counter using J K flip-flops & drive a seven-segment display using the same.
10. To design & realize a sequence generator for a given sequence using J-K flip-flops.
11. Study of CMOS NAND & NOR gates and interfacing between TTL and CMOS gates.
12. Design a 4-bit shift-register and verify its operation. Verify the operation of a ring counter and a Johnson counter.
13. Design all gates using computer simulations.
14. Write programs for the following circuits, check the wave forms and the hardware generated
    a. half adder, b. full adder
15. Write programs for the following circuits, check the wave forms and the hardware generated
    a. multiplexer, b. demultiplexer
16. Write programs for the following circuits, check the wave forms and the hardware generated
    a. decoder, b. encoder
17. Write a program for a comparator and check the wave forms and the hardware generated
18. Write a program for a code converter and check the wave forms and the hardware generated
19. Write a program for a FLIP-FLOP and check the wave forms and the hardware generated
20. Write a program for a counter and check the wave forms and the hardware generated.
21. Write programs for the following circuits, check the wave forms and the hardware generated
    a. register, b. shift register
22. Implement any three (given above) on FPGA/CPLD kit.
23. Simulate logic expressions and determine their truth tables.
24. Simulate logic expression of full adder circuit and determine its truth table.

25. Simulate a synchronous 4-bit counter and determine its count sequence.
Simulate a master-slave flip-flop using NAND gates and study its operation. Study the operation of asynchronous preset and clear.

Section-B (Signal Processing)

1. Convolution of sequences (Linear Convolution, Circular Convolution)
2. Correlation of two sequences (Auto correlation and Cross Correlation).
3. To design digital IIR filters (Low-Pass, High Pass, Band-Pass, Band-Stop).
4. To design FIR filters using windows technique.
5. Design and simulation of DFT and IDFT.
6. Implementation of FFT algorithm by decimation in time and decimation in frequency.
7. Implementation of FIR (Lowpass And High pass) Filters using DSP kit.
8. Implementation of linear phase FIR (Lowpass And High pass) Filters using DSP kit.
9. Implementation of IIR (Lowpass And High pass) Filters DSP kit.
10. Implementation of IIR (Band Pass and band stop) Filters DSP kit.
11. Implementation of noise cancellation using adaptive filters on a DSP kit.

Section-C (Light Wave Signal Processing)

1. Write a program to calculate efficiency of LED.
2. Write a program to calculate Einstein Coefficients.
3. Write a program to calculate threshold population for a LASER.
4. Write a program to calculate gain coefficient for a LASERS-Theory.
5. Write a program to draw spectrum of due to Natural Broadening.
6. Write a program to draw spectrum of due to Collision Broadening.
7. Write a program to draw spectrum of due to Doppler Broadening.
8. Write a program to calculate efficiency of semiconductor LASER.
9. Write a program to calculate coupling loss between optical fibre and LED.
10. Write a program to calculate to calculate threshold current density of semiconductor LASER.

ELST V209 Cyber Physical Systems Credits-2

- Chapter 1: Introduction, also watch video "Cyber-Physical Systems: A Fundamental Intellectual Challenge," December 11, 2013, College de France, Paris, France (Introduction in French, Presentation in English).
- Chapter 7: Sensors and Actuators, Chapter 2: Continuous Dynamics.
- Chapter 9, Memory Architectures, Chapter 10, Input and Output
- Chapter 10, Input and Output, Chapter 3: Discrete Dynamics
- Chapter 3: Discrete Dynamics, Chapter 4: Hybrid Systems (Note: You may skim Sections 4.2.2 and 4.2.3 for now)
- Chapter 5: Composition of State Machines.
- Chapter 13: Invariants and Temporal Logic, Chapter 14: Equivalence and Refinement.
- Chapter 15: Reachability Analysis and Model Checking.
- Chapter 11: Multitasking.
- Review for Midterm 1; Chapter 12: Scheduling (up to Sec. 12.3)
- Chapter 12: Scheduling (Sec. 12.4 to the end); Chapter 16: Quantitative Analysis

- Chapter 6: Concurrent MoCs (Sections 6.1, 6.2, 6.3.1, 6.3.2 only required; rest optional)
- Chapter 17: Security & Privacy

Project Resources:

Resource Book (Above chapters are from this book):

Edward A. Lee and Sanjit A. Seshia, *Introduction to Embedded Systems, A Cyber-Physical Systems Approach*, Second Edition, MIT Press, ISBN 978-0-262-53381-2, 2017.

Others:

1. Jensen, Lee, and Seshia- An Introductory Lab in Embedded and Cyber-Physical Systems https://ptolemy.berkeley.edu/books/leeseshia/lab/
2. Vahid, F. and T. Givargis (2010). Programming Embedded Systems - An Introduction to Time-Oriented Programming, UniWorld Publishing.
3. An eBook focused on a timed version of synchronous state machines as a programming model for embedded systems.
4. Schaumont, P. R. (2010). A Practical Introduction to Hardware/Software Codesign, Springer.
5. Excellent book with disciplined design of hardware and software for embedded applications.
6. E. A. Lee and P. Varaiya, *Structure and Interpretation of Signals and Systems*, Addison-Wesley, 2003.
7. Background material on signals and systems. Review of EECS 20. Available in PDF in pre-publication version.
8. M. Barr, Anthony Massa, *Programming Embedded Systems*, second edition, O'Reilly, 2006. Available on line at http://www.oreilly.com/catalog/embsys2/.

ELST V210 Physics for Solid State Application Credits- 2

Course Objective:

- To provide basic knowledge and concepts of the characteristics and principles of operation of solid-state physics and devices.

Course Outcomes:

- Ability to apply basic concepts of solid-state materials and devices in modern electronic industry.

Outcome Measurement: Course outcomes will be measured via internal assessment (quiz, assignment, attendance, written test) and end semester examination.

Unit – 1: Molecules–the Simple Solid; Vibrational and Rotational States in Hydrogen; Metal as a Free Electron Gas; Vibrations in Solids; Specific Heat of Lattice Waves

Unit – 2: Lattice Waves in 1D Monatomic Crystals; Lattice Waves in 1D with Diatmomic Basis; Specific Heat of Discrete Lattice; Electrons in a Periodic Solid

Unit – 3: Nearly Free Electron Bands; Nearly Free Electron Bands (Part III); Properties of Bloch Functions; Motion of Electronic Wavepackets; Impurity States

Unit – 4: Semi Classical Equations of Motions & Electrons and Holes I; Effective Mass; Chemical Potential and Equilibrium; Chemical Potential and Non-equilibrium; Inhomogeneous Solids; Scattering of Bloch Functions; Electron-phonon Scattering

Web Resources:
https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-730-physics-for-solid-state-applications-spring-2003/lecture-notes/

Textbook:
Lundstrom, M. *Fundamentals of Carrier Transport*. Second Edition Cambridge, UK: Cambridge University Press (2000)

Reference books:
1. Ashcroft, N. W., Mermin, N. D. *Solid State Physics* Washington, DC: Holt, Rinehart & Wilson
2.Silsbee, R. H., Drager, J. *Simulations for Solid State Physics* Cambridge, UK: Cambridge University Press (1997)

SEMESTER- III: Total credits/core/electives/practical/VAC (24/3/1/2/1); Total marks: 800

ELST C301 **Microprocessor** **Credits-4**

Course Objectives: It will provide fundamental idea about architecture and functionality of microprocessor, its interfacing with peripheral devices and machine label programming language.

Learning Outcomes: After completion, the students will have knowledge:

- The Intel 8085 and 8086 Microprocessor and their application
- Interfacing of microprocessor with peripheral devices
- Application of Microprocessor and Microcontroller in industrial application

Outcome Measurement: Course outcomes will be measured via internal assessment (quiz, assignment, attendance, written test) and end semester examination.

Course topics:

Unit-1: Microprocessor and Microprocessor-Based System: Fundamental of Microprocessor, Organization of Microprocessor-Based System, Architecture of 8085 Microprocessor, Bus Organization of 8085 Microprocessor, Memory Interfacing, Interfacing I/O Devices.

Unit-2: Programming the 8085: Introduction to 8085 Instruction, Stack and Subroutines, Counter and Time Delay: Hexadecimal Counter, Writing Assembly Language Programming, and Timing Diagram

Unit-3: Interfacing Peripherals (I/Os): The 8255A Programmable Peripheral Interface, Direct Memory Access (DMA) and 8237 DMA Controller.

Unit-4: The 16-bit Microprocessor: Architecture of 8086, Signal Description of 8086, Register Organization of 8086, Physical Memory Organisation, Addressing Modes of 8086, Instruction Set of 8086 and Assembly Language Programming.

Suggested further reading (Not to be asked in the theory exam)

Interfacing of 8279 Programmable Keyboard/Display Interface, 8259A Programmable Interrupt Controller, 8254 Programmable Interval Timer.

Text Books:

1. R. S. Gaonkar, “Microprocessor Architecture, Programming, and Applications with the 8085”, 5^{th} Edition, Prentice Hall
2. K. M. Bhurchandi, A. K. Ray, “Advanced Microprocessors and Peripherals”, 3^{rd} Edition, Tata McGraw Hill

References:

1. D. Hall, “Microprocessor and Digital Systems”, McGraw-Hill
2. B. Ram, “Fundamental of Microprocessor and Microcontroller”.
3. S. I. Ahson, “Microprocessor”.

ELST C302 **Communication System** **Credits-4**

Prerequisites: Basic Electronics.

Course Objectives:

- To introduce the concepts of analogue and digital communication systems.
- To equip students with various issues related to communication such as modulation, demodulation, transmitters and receivers and noise performance.

Course Outcomes:

- Gain the knowledge of components of communication systems.
- To analyse various methods of transmission and detection.
- Analyse and allocate performance objectives to components of a communication system.
- To evaluate the performance of communications in the presence of noise.

Outcome Measurement: Course outcomes will be measured via internal assessment (quiz, assignment, attendance, written test) and end semester examination.

Course Topics:

Unit-I: Transmission through Linear System; Ideal and Practical Filters; Distortion over a channel; Energy and Energy Spectral Density; Power and Power Spectral Density.

Linear Modulation: Principle, Generation, and Detection of DSB, DSB-SC, AM, and SSB; **Exponential Modulation:** Concept of Instantaneous Frequency, Bandwidth of Angle Modulated Wave, Indirect (Armstrong) and Direct Generation of FM, FM Demodulation.

Unit-II: Low Pass Signal Sampling approximations, Quantization, PCM, DPCM, Delta Modulation, Adaptive Delta Modulation, ASK, PSK, DPSK, and FSK.

Unit-III: AM receiver SNR, Noise in DSB-SC & SSB using coherent receiver, Noise in AM using envelop detection, Noise in FM system, FM threshold effects, Pre-emphasis and De-emphasis in FM, BW requirements for CW Modulation.

Unit-IV: Discrete message, Concept of Information amount, Entropy, Information Rate, Coding to increase Average Information per Bit, Shannon's Theorem, Channel capacity, Gaussian Channel Capacity, BW-S/N Trade off, Orthogonal Signals for Shannon's Limit, Orthogonal Signal Transmission efficiency.

Text Book:

B. P. Lathi, "Modern Digital and Analog Communication Systems", OXFORD University Press, 3rd Edition.

References:

1. Taub & Scheiling, "Principles of Communication Systems", TMH – 2nd Edition.
2. Symon Hykins, "Communication Systems", New Age International.
3. Kennedy, "Electronic Communication System", TMH Publication.

ELST C303 **VLSI Technology** **Credits-4**

Course Objective: To provide basic knowledge and concepts of the design flow, characteristics, and principles of operation of CMOS. To impact in depth knowledge on different MOS logic circuit and modelling of MOS transistor using SPICE.

Course Outcomes: Understand the fabrication process of IC technology. Analysis of the operation of MOS transistors.

Outcome Measurement: Course outcomes will be measured via internal assessment (quiz, assignment, attendance, written test) and end semester examination.

Course topics:
Unit-I: Introduction: Historical Perspective, VLSI Design Methodologies, VLSI Design Flow, Design Hierarchy, Concept of Regularity, Modularity and Locality, VLSI Design Styles, Computer-Aided Design Technology.

MOS Transistor: The Metal Oxide Semiconductor (MOS) Structure, The MOS System under External Bias, Structure and Operation of MOS Transistor (MOSFET), MOSFET Current-Voltage Characteristics, MOSFET Scaling and Small-Geometry Effects, MOSFET Capacitance. (Chapter 1 to 3 of Text Book 1 and for Stick Diagram Text Book 2)

Unit-II: Fabrication of MOSFETs: Introduction, Fabrication Processes Flow – Basic Concepts, The CMOS n-Well Process, Layout Design Rules, Stick Diagrams, Full-Customs Mask Layout Design.

MOS Inverters – Static Characteristics: Introduction, Resistive-Load Inverters, Inverters with n-Type MOSFET Load, CMOS Inverter.

Unit-III: Combinational MOS Logic Circuits: Introduction, MOS Logic Circuits with Depletion MOS Loads, CMOS Logic Circuits, Complex Logic Circuits, CMOS Transmission Gates (Pass Gates).

Unit – IV: Sequential MOS Logic Circuits: Introduction, Behaviour of Bistable Elements, SR Latch Circuits, Clocked Latch and Flip-Flop Circuits, CMOS D-Latch and Edge-Triggered Flip-Flop.

Suggested Further Reading (Not to be asked in the theory exam)

Modelling of MOS Transistors using SPICE: Basic concept, The LEVEL 1, 2, and 3 Model Equations, State-of-the-Art MOSFET Models, Capacitance Models, Comparison of the SPICE MOSFET Models.

Text Book:

1. Sung-Mo Kang and Yusuf Leblebici, "CMOS Digital Integrated Circuits: Analysis and Design", 3rd Edn., Tata McGraw-Hill Publishing Company Limited, 2003.

References:

1. K. Eshraghian and N.H.E. Weste, "Principles of CMOS VLSI Design – a Systems Perspective", 2nd Edn., Addison Wesley, 1993.

ELST CT300 **Basic Signals and Systems** **Credits:4**

Course Objectives: To explain signals and systems representations/classifications, frequency and time domain analysis of signals, calculating system response using convolution integral/sum and understand sampling theorem.

Course Outcomes: Be able to understand mathematical description and representation of continuous and discrete time signals and systems. Understand and resolve the signals in frequency domain using Fourier series and Fourier transforms.

Outcome Measurement: Course outcomes will be measured via internal assessment (quiz, assignment, attendance, written test) and end-semester examination.

Unit –1

Signals, Transformation of independent variables, Basic continuous time signals, Basic discrete time signals, Systems, properties of systems, Representation of signals in terms of impulses, continuous time systems, convolution integral, properties of LTI systems, Digital signal processing and its benefits, Discrete time LTI systems, Convolution sum.

Unit-2

Response of continuous time LTI system to complex exponentials, representation of periodic signals, the continuous time Fourier series, Approximation of periodic signals using Fourier series, Representation of aperiodic signals: Frequency and impulse response of a LTI system characterized by differential equation, First order systems.

Unit-3

Discrete Transform: introduction, Fourier series, The Fourier transform, DFT and its inverse, properties of the DFT, computational complexity of the DFT, The decimation in time FFT algorithm: the butterfly, computational advantage in FFT, Inverse FFT.

Unit- 4

Discrete time signals and systems, The z-transform, The inverse z-transform: power series method, partial fraction expansion method, properties of the z-transform, some applications of the z-transform in signal processing.

BOOKS & REFERENCES:

1. Fundamentals of Signals & Systems – M. J. Roberts (TMH)

2. Digital Signal processing A practical approach, by Emmanuel C. Ifeachor, Barrie W. Jervis, Pearson education 2nd edition.

3. Digital Signal Processing Principles, Algorithms and Applications by J. Prokais and D. G. Manolakis (PHI 3rd edition)

ELST E304 **Instrumentation** **Credits-4**

Course Objectives: To understand concepts of various electrical and electronic measuring instruments and familiarize with different electronic instruments. Introduce instruments for power and energy measurements. To be able to measure different physical parameters with the help of AC bridges.

Course Learning Outcomes:
After completion of the course student will be able to:

- Explain the working of different electromechanical indicating instruments.
- Elucidate the concept of several AC bridges for inductance and capacitance & elucidate cardiovascular system and related measurements.
- Measure power and energy with the help of wattmeter and energy meter.
- Describe the construction and working of various electronic instruments.
- Describe basic working of instrument transducer.

Outcome Measurement: Course outcomes will be measured via internal assessment (quiz, assignment, attendance, written test) and end semester examination.

Course topics:
Unit -I: Classification of Instrument, Errors in measurement, accuracy, precision, significant figures, statistical analysis, probability of error, limiting error. DC volt meter, DC Ammeters, Ohm meter, analogue multimeter (VOM), digital multimeter, electrodynamometer in power measurement, power factor meter.

Unit-II: Wheatstone bridge, A.C bridge and their application, Maxwell bridge, Hay bridge, Schering bridge, Wien bridge. Digital frequency meter, Biomedical Instrument - ECG, EEG, Blood pressure measurement.

Unit-III: CRO: CRT, electron gun, electrostatic focusing, electrostatic deflection, post deflection acceleration, Screen of CRT, Graticule, Acquadag, time base generator, oscilloscope amplifier, measurement of voltage, current, phase and frequency in CRO. Digital storage oscilloscope, spectrum analyser.

Unit-IV: Transducers: Classification of transducer, Displacement transducers, LVDT, strain gauge, resistance thermometer, thermistor, thermocouple, tachogenerators, Inductance, Capacitance, Piezoelectric, thermo electric, Hall Effect & Photoelectric transducer.

Text Book:

1. A. K. Sawhney Puneet Sawhney, “A Course in Electrical and Electronic Measurements and Instrumentation”, Dhanpat Rai & Co, 2013.

References:

1. A. Helfrick, W. Cooper, “Modern Electronic Instrumentation and Measurement techniques”
2. E. O. Deoblin, “Measurement Systems, Applications & Design”
3. D. Patronbis, “Principles of Industrial Instrumentation”.
4. Oliver and Cage, “Electronics Measurement and Instrumentation”.
5. Rajan & Sharma, “Electronic Instrumentation”.
6. Rangan, Sarma, “Instrumentation: Devices & Systems”, Mani (TMH 3rdEd.)

ELST E305 **Radiating System** **Credits-4**

Prerequisites: Electromagnetics.

Course Objectives:

- To lay a background on the fundamentals of antenna theory and various types of antennas including linear wire antennas, antenna arrays, aperture antennas and microstrip antennas.
- To understand propagation characteristics of wave propagation in ionosphere.

Course Outcomes: At the completion of the course, the student should be able to do the following: a. Identify, analyse and interpret the fundamental parameters of antennas, b. Formulate the radiation fields of an antenna, at both near-and far-zone; and identify the duality and reciprocity principles, c. Formulate and analyse the radiation from wire and aperture antennas, and d. Formulate and analyse the antenna arrays,

Outcome Measurement: Course outcomes will be measured via practical examination, viva-voce and report.

Course Topics:

Unit-I: Antennas: radiation concepts (diploes, infinitesimal current element, half-wave current element), Antenna parameters (gain, efficiency, directivity, beam-width, bandwidth).

Unit-II: Analysis and synthesis of simple linear arrays (Array Factor, Pattern Multiplication, Array Directivity).

Unit-III: Principle of Reciprocity, Equivalence theorems and application to horns. Microstrip Antenna - Transmission Line Model.

Unit-IV: Ionospheric Propagation: Elementary ideas on formation of ionospheric layers, Ionosphere as a Plasma medium (determination of its dielectric constant), Skip Distance, Maximum Usable Frequency, Virtual Height, Secant Law, effects of earth's magnetic field.

Text Book:

1. R. E. Collin, Antennas and Radiowave Propagation, McGraw Hill.

References:

1. C. A. Ballanis, Antenna Theory: Analysis and Design, John Willey and Sons.
2. Raju, Antennas and Wave Propagation, Pearson Education.

ELST E306 **Power Electronics** **Credits-4**

Course Objectives: To expose students about various power semiconductor devices and circuits.

Course Outcomes: At the completion of the course, the student should be able to do the following:

- Characterization of various Power Diodes and Power Transistors.
- Design and implementation of different Triggering Circuits.
- Design and implementation of different Thyristor Commutation Circuits.

Outcome Measurement: Course outcomes will be measured via internal assessment (quiz, assignment, attendance, written test) and end semester examination.

Course topics:

Unit-I: Power Diodes: Characteristics**,** Thyristors: SCR, Static V-I characteristics of SCR, two transistor analogy of SCR, dynamic characteristics of SCR, Gate characteristics of SCR, Thyristor ratings, DIAC, TRIAC, GTO, UJT.

Unit-II: Power Transistors, Power BJT, Power MOSFETS, IGBT, Characteristics.

Unit-III: Triggering Circuits, R- Triggering, R-C Triggering, UJT triggering, Design of UJT triggering circuit, Cosine law triggering, triggering circuit using pulse train.

Unit-IV: Thyristor commutation circuits, Class-A, Class-B, Class-C, Class-D, Class-E, Class-F commutation circuits. Series and parallel operation of thyristors, protection of thyristors: di/dt protection, dv/dt protection, design of snubber circuit, overvoltage protection, over current protection.

Text Books:

1. M H Rashid, "Power Electronics: Circuits, Devices and Applications", 3rd Edition, Pearson.
2. P. S. Bhimbra, "Power Electronics", Khanna Publications.

References:

1. J. Vithayathil, "Power Electronics: Principles and Applications", TMH Edition.

ELST P307 Microprocessor and VLSI Practical Credits-2

Section-A

Prerequisites: Basic Idea about digital circuits and programming.

Course Objectives: To familiarize with 8-Bit Microprocessor kit and its application.

Course Outcomes: At the completion of the course, the student should be able to do the following:

- Familiarize with the machine level language used in microprocessor.
- Implementation of various arithmetic and logical algorithms in 8085 Microprocessor with machine level language.

Outcome Measurement: Course outcomes will be measured via practical examination, viva-voce and report.

Course Topics:
At least 8 Experiments depending on the facilities available in the Laboratory.

1. Introduction to 8085kit.
2. Addition of 2-8-bit number, sum 8-bit.
3. Addition of 2-8-bit number, sum 16-bit.

4. Subtraction of 2-8-bit number.
5. a) Find 1s complement of 8-bit number.
   b) Find 1s complement of 16-bit number.
6. a) Find 2s complement of 8-bit number.
   b) Find 2s complement of 16-bit number.
7. a) Shift an 8 -bit no. by one bit.
   b) Shift a 16 -bit no. by one bit.
8. Find Largest of two 8-bit numbers.
9. Find Largest among an array of ten numbers(8-bit).
10. Sum of series of 8-bit numbers.
11. Find Ascending & Descending order of 8-bit numbers.
12. Multiplication of two 8-bit numbers and result should be 8-bit.
13. Division of two 8-bit numbers.
14. BCD to HEX Conversion.
15. HEX to BCD Conversion.
16. HEX to ASCII Conversion.

8051 Micro Controller

1. Write an Assembly language Programme (ALP) to generate 10kHz square wave.
2. Write an ALP to generate 10 kHz frequency using interrupts.
3. Write an ALP to interface one Microcontroller with other wring serial/parallel communication.
4. Write an ALP for temperature & pressure measurement & to display on intelligent LCD display.

Section-B

Prerequisites: Basic Idea about MOS technology and programming using VHDL.

Course Objectives: To familiarize with Xilinx software to realize CMOS realization and its implications.

Course Outcomes: At the completion of the course, the student should be able to do the following:

- Familiarize with the machine level language used in Xilinx.
- Implementation of various arithmetic and logical algorithms in Xilinx for CMOS inverter.

Outcome Measurement: Course outcomes will be measured via practical examination, viva-voce and report.

Course Topics:

1. VHDL based design entry and simulation of simple counters, state machines, adders (min 8 bit) and multipliers (4-bit min).
2. Synthesis, P&R and post P&R simulation of the components simulated in (I) above. Critical paths and static timing analysis results to be identified. Identify and verify possible conditions under which the blocks will fail to work correctly.
3. Hardware fusing and testing of each of the blocks simulated in (I). Use of either chipscope feature (Xilinx) or the signal tap feature (Altera) is a must. Invoke the PLL and demonstrate the use of the PLL module for clock generation in FPGAs. IC DESIGN EXPERIMENTS: (BASED ON CADENCE / MENTOR GRAPHICS / EQUIVALENT)

4. Design and simulation of a simple 5 transistor differential amplifier. Measure gain, ICMR, and CMRR.
5. Layout generation, parasitic extraction and re-simulation of the circuit designed in (I).
6. Synthesis and Standard cell-based design of a circuits simulated in 1(I) above. Identification of critical paths, power consumption.
7. For experiments above, P&R, power and clock routing, and post P&R simulation.
8. Depletion and Enhancement Mode Circuit Simulation and Adjustment of critical voltage points of VLSI parameters for NMOS inverter.

ELST P308 Communication System Practical Credits-2

Prerequisites: None, this is a first-year course.

Course Objectives: To practice the basic theories of analog and digital communication system.

Course Outcomes:

- Be able to develop practical knowledge about theories of analog communication.
- Demonstrate various pulse modulation techniques.
- Evaluate analog modulated waveform in time/frequency domain and also find modulation index.
- Gain the knowledge of components of communication systems.
- To evaluate the performance of communications in the presence of noise

Outcome Measurement: Course outcomes will be measured via practical examination, viva-voce and report.

Course Topics:

At least 8 Experiments/ Simulations depending on the facilities available in the Laboratory.

1. To study amplitude modulation and determine depth of modulation.
2. To study generation of DSB-SC signal using balanced modulator.
3. To study generation of SSB signal
4. To study envelope detector for demodulation of AM signal and observe diagonal peak clipping effect.
5. To study super heterodyne AM receiver and measurement of sensitivity, selectivity and fidelity.
6. To study frequency modulation using voltage-controlled oscillator.
7. To study operation of phased lock loop.
8. To detect FM signal using Phase Locked Loop.
9. To study PAM, PWM and PPM.
10. To realize PCM signal using ADC and reconstruction using DAC and 4 bit/8bit system. Observe quantization noise in each case.
11. To study Delta Modulation and Adaptive Delta Modulation.
12. To study PSK-modulation system.
13. To study FSK-modulation system.
14. To study sampling through a Sample-Hold circuit and reconstruction of the sampled signal and observe the effect of sampling rate & the width of the sampling pulses.

ELST V309 Electronic System Design Credit: 2

Course Objective:

- To provide basic knowledge and concepts of programming and EDA tools.

Course Outcomes:

- Ability to apply basic concepts in system modelling.

Outcome Measurement: Course outcomes will be measured via internal assessment (quiz, assignment, attendance, written test), mini project, and end-semester examination.

Unit-I

Embedded C and SPICE Programming

Unit-II

Identify and test various electronic components, Draw circuit schematics with EDA tools, Assemble and test electronic circuits on boards

Unit-III

Embedded System Design using Arduino

Unit-IV

Android App Design

References:

The Art of Electronic by Horowitz and Hill, Cambridge University Press

ELST V310 Computer System Architecture Credits-2

Unit – 1:

History of Calculation and Computer Architecture; Influence of Technology and Software on Instruction Sets: Up to the dawn of IBM 360; Complex Instruction Set Evolution in the Sixties: Stack and GPR Architectures; Microprogramming; Simple Instruction Pipelining; Pipeline Hazards

Unit – 2:

Multilevel Memories – Technology; Cache (Memory) Performance Optimization; Virtual Memory Basics; Virtual Memory: Part Deux

Unit – 3:

Complex Pipelining; Out of Order Execution and Register Renaming; Branch Prediction and Speculative Execution; Advanced Superscalar Architectures; Microprocessor Evolution: 4004 to Pentium 4

Unit – 4:

Synchronization and Sequential Consistency; Cache Coherence; Cache Coherence (Implementation); Snoopy Protocols; Relaxed Memory Models

Unit – 5:

VLIW/EPIC: Statically Scheduled ILP; Vector Computers; Multithreaded Processors; Reliable Architectures; Virtual Machines

Web Resources

https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-823-computer-system-architecture-fall-2005/lecture-notes/

Textbooks

1.Hennessy, J. L., and D. A. Patterson. *Computer Architecture: A Quantitative Approach*, 3rd ed. San Mateo, CA: Morgan Kaufman, 2002. ISBN: 1558605967

2.Patterson, D. A., and J. L. Hennessy. *Computer Organization and Design: The Hardware/Software Interface*, 3rd ed. San Mateo, CA: Morgan Kaufman, 2004. ISBN: 1558606041

ELST V311 Communication System using ICs Credits-2

Course objectives: To Establish the principals involved in realizing electronic circuit functions for communication applications and to gain design experience in realizing appropriate specifications.

Topics:

- High frequency amplifiers. Analysis of tuned amplifiers, matching networks, and feedback amplifiers. Analysis of optimal gain and matching using 2-port theory.
- Distortion in amplifiers and its reduction. Harmonic distortion, intermodulation, cross-modulation. Effect of feedback on distortion. Sources of distortion in devices. Modeling.
- Noise analysis.
- Power amplifiers. Class A, B, AB and C. Integrated circuit realizations. Cross-over distortion. Efficiency. RF power output stages.
- Mixers (frequency converters), Bipolar, FET and IC realizations. Conversion gain and spurious response.
- Oscillator analysis. Amplitude and frequency stability. Waveform distortion. Relaxation oscillators.
- Analog multipliers and phase-locked loops.
- AM and FM detectors.

SEMESTER- IV: Total credits/special electives/practical/VAC (20/2/3/1); Total marks: 500

ELST SE404 **Wireless Communication and Networks** **Credits-4**

Course Objectives:
Fundamental ideas about various wireless communication networks and protocols.

Learning Outcomes: After completion of course, the students will have enough ideas:
- Architecture of Local Area Network, Switching Techniques
- Transfer Control Protocol
- Multiple Access Techniques in various wireless communication

Outcome Measurement: Course outcomes will be measured via internal assessment (quiz, assignment, attendance, written test) and end semester examination.

Course topics:
Unit-1: Communication Networks: Local Area Network (LAN), Switching Techniques, Circuiting Switching, Packet Switching, Asynchronous Transfer Mode (ATM)

Unit 2: Protocol and the TCP/IP Suite: Need of protocol, TCP/IP: Architecture and application, OSI Model: Architecture and application

Unit-3: Multiple Access Techniques: FDMA, TDMA, SDMA, Spread Spectrum Multiple Access Techniques, CSMA,

Unit-4: Cellular Concept: Cellular concept, Frequency Reuse, Channel Assignment Strategies, Handoff Strategies, Interferences and System Capacity, Trunking and Grade of Service, Improving Coverage and Capacity in Cellular Systems: Cell Splitting, Sectoring.

Text Books:

1. T S Rappaport, "Wireless Communications- Principles and Practice", Pearson Education India, Second Edition 2003
2. W. Stallings, "Wireless Communications & Networks", Pearson Education India

References:

1. Upen Dalal, "Wireless Communication and Networks", Oxford university Press, First Edition, 2015.
2. Iti Saha Misra, "Wireless Communication and Networks 3G and Beyond", Tata McGraw Hill Education Pvt. Ltd, Second Edition, 2009
3. W C Y Lee, "Mobile Communication Engineering – Theory and Applications", TMH Publication, Second Edition, 2008.
4. David Tse and Pramod Viswanath, "Fundamentals of Wireless communication", Cambridge University Press, 2005.

ELST SE405 **Embedded System** **Credits-4**

Prerequisites: Microprocessor and programming knowledge.
Course Objectives: Develop an understanding of the technologies behind the embedded computing systems. To introduce students to the design issues of embedded systems. Enable

students to analyse software programs for embedded systems

Course Outcomes: Understand hardware and software design requirements of embedded systems. Analyse the embedded systems' specifications. Evaluate the requirements of programming Embedded Systems and related software architectures.

Outcome Measurement: Course outcomes will be measured via internal assessment (quiz, assignment, attendance, written test) and end semester examination.

Course Topics:

Unit – I: **Embedded Computing:** Introduction, Complex Systems and Microprocessor, The Embedded System Design Process, Formalisms for System Design, Design Examples.

The 8051 Architecture: Introduction, 8051 Micro controller Hardware, Input/ Output Ports and Circuits, External Memory, Counter and Timers, Serial data Input/ Output, Interrupts.

Unit – II: **Basic Assembly Language Programming Concepts:** The Assembly Language Programming Process, Programming Tools and Techniques, Programming the 8051. Data Transfer and Logical Instructions.

Arithmetic Operations, Decimal Arithmetic. Jump and Call Instructions, Further Details on Interrupts.

Unit – III: **Introduction to Real – Time Operating Systems:** Tasks and Task States, Tasks and Data, Semaphores, and Shared Data; Message Queues, Mailboxes and Pipes, Timer Functions, Events, Memory Management, Interrupt Routines in an RTOS Environment.

Unit – IV: **Basic Design Using a Real-Time Operating System :** Principles, Semaphores and Queues, Hard Real-Time Scheduling Considerations, Saving Memory and Power, An example RTOS like uC-OS (Open Source); Embedded Software Development Tools: Host and Target machines, Linker/Locators for Embedded Software, Getting Embedded Software into the Target System; Debugging Techniques: Testing on Host Machine. **(Programs on RTOS not to be asked in the Exam)**

Text Books:

1. Wayne Wolf, "Computers as Components-principles of Embedded computer system design", Elsevier. (Ch-1)
2. Kenneth J. Ayala, "The 8051 Microcontroller", Third Edn., Thomson. (Ch. 3, 4, 5, 6, 7, 8).
3. David E. Simon, "An Embedded Software Primer, Pearson Education", Twelfth Indian reprint, 2005. (Ch. 6, 7, 8, 9, 10, 11**)**

ELST SE406 Optical Fiber Technology and Applications Credits-4

Course Objective:

- To expose the students about the optical fibre communication (OFC) technology and explain the importance and advantages of OFC, basic problems and possible mitigations.

Course Outcomes:

- Acquire fundamental understanding of the optical fibre communication technology and its applications.
- Develop basic understanding of new technology such as WDM and its importance in the communication industry.

Outcome Measurement: Course outcomes will be measured via internal assessment (quiz, assignment, attendance, written test) and end semester examination.

Course topics:

Unit – 1: Introduction and advantage of fibre optics technology, salient features of optical fibres, ray theory of light transmission, total internal reflection, and acceptance angle, numerical aperture, skew rays.

Unit – 2: Modes of a fibre, Electromagnetic (Modal) theory for optical propagation, single and multimode fibres, step-index and graded-index fibres.

Unit – 3: Transmission characteristics of optical fibres, attenuation, material absorption losses, linear and non-linear scattering losses, fibres bend loss, dispersion.

Unit – 4: Operational principle of WDM, passive components, 2×2 fibres coupler, scattering matrix representation, 2×2 wave guide coupler, star couplers, Mach-Zehnder Interferometer Multiplexers.

Suggested Further Reading (Not to be asked in the theory exam)

Optical detectors: PIN photodiodes, Avalanche photodiodes (APD). Fundamentals of Internet of Things (IoT) for optical sensors.

Text Books:

1. J. M. Senior, Optical Fibre Communication, Prentice Hall, 1999. (Unit-1, 2 and 3)
2. G. Keiser, Optical Fibre Communications, McGraw Hill, 2000. (Unit-4)

References:

1. F. Graham Smith, Terry A. King and Dan Wilkins, "Optics and Photonics: An Introduction", Second Edition, John Wiley, 2007.
2. A. Ghatak and K. Thyagarajan, "Introduction to Fibre Optics", Cambridge University Press, 2006.

ELST SE407 Radar and Satellite Communication Credits-4

Course Objectives: -

The goal of the course is to introduce students to the fundamentals of radar and satellite communication. Expose them to examples of applications and trade-offs that typically occur in engineering system design. This course contributes to the educational objectives - Fundamental knowledge, specialization, design skills, and self – learning.

Course Learning Outcomes: - On completion of this course, the students will be able to

- Learn the communication satellite mechanics and about radar technology.
- Analyse and evaluate various parameters to design the power budget for satellite links.
- Compare Earth station technology and Satellite navigation & the global positioning system.

Outcome Measurement: Course outcomes will be measured via internal assessment (quiz, assignment, attendance, written test) and end semester examination.

Course topics:

Unit-1: Radar Performance factors; Pulsed System – Basic pulsed radar system, antennas & scanning, display methods.

Unit-2: MTI Radar; Radar Beacons; CW Doppler Radar, Frequency modulated CW Radar.

Unit-3: Satellite orbit & position; Up-Down & Cross Links; Assignable Frequencies; Inside the Satellite - Transponder, Antenna System, Power package; Station keeping – Aligning the satellite dish, ground station, forms of modulation, free path space losses.

Unit-4: Satellite Parameters & Configurations; Capacity allocation: Frequency Division & Time Division.

Text Books and References:

1. Merril. I. Skolnik, "Introduction to Radar Systems", 2/e, MGH, 1981.
2. Electronic Communication Systems – George Kennedy.
3. Electronic Communications – R. E. Schoenback

ELST D401 **Dissertation** **Credits-6**

Pre-requisites: All semesters theory and practical papers.

Outcome Measurement: Course outcomes will be measured via the work carried out by the students, his/her envelopment in the work, results/publications, report writing and presentation.

Objective and brief description on course and expectations: The student and supervisor shall decide upon the topic, prepare a plan of work. The student shall make an open presentation in the Department. Following the presentation, the work-plan shall be approved by a committee of faculties, present on the day at the time of presentation, Chaired by the Head of the Department. The student shall carry out the project for the whole semester and on completion of the project submit a dissertation report along with the Evaluation Report (Template of the Thesis and Format of the Report shall be provided by the HoD, Department of Electronic Science and Technology, Berhampur University) duly signed by the supervisor to the Department. The student shall thereafter make the final presentation (open in nature) in the Department.

Course Details

Chapter	**Contents**	Hours/ Semester
1	Literature review	20
2	Learning objectives	20
3	Dissertation work along with instrumental technique	100
4	Report writing in proper format	40
Total		180

Assessment and Expectations from Class: Tutorial, Quiz, attendance, Punctuality, doubt clearing class.

ELST P402 **Seminar Presentation** **Credits-3**

Pre-requisites: All semesters theory and practical papers. Recent technology adopted in electronic industry.

Outcome Measurement: Course outcomes will be measured via presentation style, depth of the knowledge of the topic, contents of the presentation and reply of the queries asked by the audience.

Course Topics:
The student may decide upon a topic in consultation with one or more faculties. Then the student shall submit a report and make an open presentation in the Department.

ELST G403 **Grand Viva Voce** **Credits-3**

Pre-requisites: All semesters theory and practical papers.

Outcome Measurement: Student shall be evaluated, for his/her overall knowledge of the subject through Viva-Voce.

ELST V408 **Cultural Heritage of South Odisha** **Credits-2**

Course outcomes:
The teaching impated to P.G students of Berhampur university on the various dimensions of the literary and cultural heritage of South Odisha will help them to acquire the valuable understanding of the same . They will be inspired adequately to take the positive learnt from the course and use them in future in their personal literary and cultural pursuits and their by promote the literature and culture of the odisha on a Global Scale.

Unit-I:

Literary work of Kabi Samrat Upendra Bhanja

Unit-II:

Other Literatures of South Odisha

Unit-III:

Cultural Heritage of South Odisha

Unit-IV:

Folk and Tribal Traditions of South Odisha