Department of Electronics and Communication Engineering
Faculty of Engineering & Technology
Jamia Millia Islamia

Course Structure of B. Tech. (E&C)-2025

		III Semester							
S. No.	Subject Code	COURSE NAME	COURSE TYPE		Credits	L	T	P	HRS
1	ASM-301	UHV	Theory	MC-II	3	3	0	0	3
2	ASB-301	Engineering Mathematics III	Theory	BSC	3	3	0	0	3
3	ECC-301	Professional core course I Electronic Devices and Circuits-I	Theory	PCC	3	3	0	0	3
4	ECC-302	Professional core course II Circuit Analysis and Synthesis	Theory	PCC	3	3	0	0	3
5	ECC-303	Professional core course III Logic Design	Theory	PCC	3	3	0	0	3
6	ECC-304	Professional core course IV Signals and Systems	Theory	PCC	3	3	0	0	3
i	ECL-301	Professional core course I Electronic Devices and Circuits-I Lab	Lab	PCC	1	0	0	2	2
ii	ECL-302	Professional core course II Circuit Analysis and Synthesis Lab	Lab	PCC	1	0	0	2	2
iii	ECL-303	Professional core course III Logic Design Lab	Lab	PCC	1	0	0	2	2
iv	ECL-304	Professional core course IV	Lab	PCC	1	0	0	2	2

		Electronics Workshop							
				Total	**22**	18	0	8	26
		IV Semester							
S. No.	Subject Code	COURSE NAME	COURSE TYPE		Credits	L	T	P	HRS
1	ASM-401	Environmental Science	Theory	MC-III	2	2	0	0	2
2	ECC-401	Professional core course V Electronic Devices and Circuits-II	Theory	PCC	3	3	0	0	3
3	ECC-402	Professional core course VI Computer Architecture	Theory	PCC	3	3	0	0	3
4	ECC-403	Professional core course VII Analog Communication	Theory	PCC	3	3	0	0	3
5	AST-401	Operations Research	Theory	HSMC (OEC I)	3	3	0	0	3
6	AST-402	Economics	Theory	HSMC (OEC II)	3	3	0	0	3
i	ECL-401	Professional core course V Electronic Devices and Circuits-II Lab	Lab	PCC	1	0	0	2	2
ii	ECL-402	Professional core course VI Computer Architecture Lab	Lab	PCC	1	0	0	2	2
iii	ECL-403	Professional core course VII Analog Communication Lab	Lab	PCC	1	0	0	2	2

iv	ASL-401	Numerical and Scientific Computing lab		ESC	2	0	0	4	4
				Total	**22**	19	0	10	29
		V Semester							
S. No.	Subject Code	COURSE NAME	COURSE TYPE		Credits	L	T	P	HRS
1	ECC-501	Professional core course VIII Active Filters and Signal Processing	Theory	PCC	3	3	0	0	3
2	ECC-502	Professional core course IX Digital Communication	Theory	PCC	3	3	0	0	3
3	ECC-503	Professional core course X Microprocessors and Applications	Theory	PCC	3	3	0	0	3
4	ECC-504	Professional core course XI Electromagnetic Field Theory	Theory	PCC	3	3	0	0	3
5	ECC-505	Professional core course XII Instrumentation and Control Systems	Theory	PCC	3	3	0	0	3
6	ECE-50x ECE-501 ECE-502 ECE-503	Professional Elective Course I 1. Digital Circuits and Systems 2. Bio-medical Electronics 3. High Speed Electronics	Theory	PEC	3	3	0	0	3
i	ECL-501	Professional core course VIII Active Filters and Signal Processing Lab	Lab	PCC	1	0	0	2	2

ii	ECL-502	Professional core course IX Digital Communication Lab	Lab	PCC	1	0	0	2	2
iii	ECL-503	Professional core course X Microprocessors and Applications Lab	Lab	PCC	1	0	0	2	2
iv	ECL-504	Professional core course X Instrumentation and Control Systems Lab XI	Lab	PCC	1	0	0	2	2
				Total	**22**	18	0	8	26
		VI Semester							
S. No.	Subject Code	COURSE NAME	COURSE TYPE		Credits	L	T	P	HRS
1	ECC-601	Professional core course XIII VLSI Design	Theory	PCC	3	3	0	0	3
2	ECC-602	Professional core course XIV DSP	Theory	PCC	3	3	0	0	3
3	ECC-603	Professional core course XV Microwave Engineering	Theory	PCC	3	3	0	0	3
4	ECC-604	Professional core course XVI DCCN	Theory	PCC	3	3	0	0	3
5	ECE-60x ECE-601 ECE-602	Professional Elective Course II 1. Antenna and Wave Propagation 2. Adaptive Signal Processing	Theory	PEC	3	3	0	0	3

	ECE-603	3. Digital System Design							
i	ECL-601	Professional core course XII VLSI Design Lab	Lab	PCC	1	0	0	2	2
ii	ECL-602	Professional core course XIII DSP Lab	Lab	PCC	1	0	0	2	2
iii	ECL-603	Professional core course XIV Microwave Engineering Lab	Lab	PCC	1	0	0	2	2
iv	ECL-604	Professional core course XV DCCN Lab	Lab	PCC	1	0	0	2	2
	ECP-601	Seminar (Literature Review)		PROJ	1	0	0	2	2
				Total	**20**	15	0	10	25
		VII Semester							
S. No.	Subject Code	COURSE NAME	COURSE TYPE		Credits	L	T	P	HRS
1	ECE-70x ECE-701 ECE-702 ECE-703	Professional Elective Course III 1. Embedded Systems 2. Digital Image Processing 3. Organic Electronics	Theory	PEC	3	3	0	0	3
2	ECE-70x ECE-704 ECE-705 ECE-706	Professional Elective Course IV 1. Information Theory and Coding 2. High Speed Communication Networks 3. MIMO Wireless Communication	Theory	PEC	3	3	0	0	3

3	ECE-70x ECE-707 ECE-708 ECE-709	Professional Elective Course V 1. Optical Fiber Communication 2. Fuzzy Logic and Neural Networks 3. Wireless Sensor Networks	Theory	PEC	3	3	0	0	3
4	ECE-71x ECE-710 ECE-711 ECE-712	Professional Elective Course VI 1. Mobile Communication 2. Radar Systems 3. Satellite Communication	Theory	PEC	3	3	0	0	3
5	ECO-70x ECO-701 ECO-702 ECO-703	Open Elective Course III 1. Internet of Things (IoT) 2. Probability and Stochastic Process 3. RF Circuits Design	Theory	OEC	3	3	0	0	3
i	ECP-701	Summer Internship	Project-II	PROJ	2	0	0	4	4
ii	ECP-702	Project	Project-III	PROJ	3	0	0	6	6
				Total	**20**	15	0	10	25
		VIII Semester							
S. No.	Subject Code	COURSE NAME	COURSE TYPE		Credits	L	T	P	HRS
1	 ECO-801 ECO-802 ECO-803	Open Elective Course IV* 1. Introduction to MEMS and NEMS 2. Nano-electronics Devices 3. Device Modeling and Circuit Simulation	Theory	OEC	3	3	0	0	3
2	ECO-80x	Open Elective Course V*	Theory	OEC	3	3	0	0	3

	ECO-804 1. Wireless Communication ECO-805 2. Information Theory for Cyber Security ECO-806 3. Introduction to AI and ML							
i	Project	Project-IV	PROJ	6	0	0	12	12
			Total	**12**	6	0	12	18
			Grand Total	**163**				

***In case of semester long project work done in industry or internship,**

the OECs in VIII semester may be offered in online mode.

For Students from Outside of Department

		Minor Degree: Emerging Semiconductor Devices: Design and Modeling							
		IV Semester							
S. No.	Subject Code	COURSE NAME	COURSE TYPE		Credits	L	T	P	HRS
1	ECD-411	Minor Degree Course 1 VLSI Technology/NEMS & MEMS	Theory		3	3	0	0	3
		V Semester							
S. No.	Subject Code	COURSE NO. & NAME	COURSE TYPE		Credits	L	T	P	HRS
2	ECD-511	Minor Degree Course 2 CMOS Digital VLSI Design	Theory		3	3	0	0	3
i	ECL-522	Minor Degree Lab 1	Lab		1	0	0	2	2

		CMOS Digital VLSI Design Lab							
		VI Semester							
S. No.	Subject Code	COURSE NO. & NAME	COURSE TYPE		Credits	L	T	P	HRS
3	ECD-611	Minor Degree Course 3 CMOS Analog VLSI Design	Theory		3	3	0	0	3
ii	ECL-622	Minor Degree Lab 2 CMOS Analog VLSI Design Lab	Lab		1	0	0	2	2
		VII Semester							
S. No.	Subject Code	COURSE NO. & NAME	COURSE TYPE		Credits	L	T	P	HRS
4	ECD-711	Minor Degree Course 4 CMOS Mixed-Signal VLSI Design	Theory		3	3	0	0	3
iii	ECD-722	Minor Degree Lab 3 CMOS Mixed-Signal VLSI Design Lab	Lab		1	0	0	2	2
		VIII Semester							
S. No.	Subject Code	COURSE NO. & NAME	COURSE TYPE		Credits	L	T	P	HRS
5	ECD-811	Minor Degree Course 5 Semiconductor Device Modeling	Theory		3	3	0	0	3
				Total	**18**	15	0	6	21

For Students of Department

		Honours Degree: Nanoelectronics and VLSI Design							
		IV Semester							
S. No.	Subject Code	COURSE NAME	COURSE TYPE		Credits	L	T	P	HRS
1	ECH-411	Minor Degree Course 1 VLSI Technology/NEMS & MEMS	Theory		3	3	0	0	3
		V Semester							
S. No.	Subject Code	COURSE NO. & NAME	COURSE TYPE		Credits	L	T	P	HRS
2	ECH-511	Minor Degree Course 2 CMOS Digital VLSI Design	Theory		3	3	0	0	3
i	ECL-521	Minor Degree Lab 1 CMOS Digital VLSI Design Lab	Lab		1	0	0	2	2
		VI Semester							
S. No.		COURSE NO. & NAME	COURSE TYPE		Credits	L	T	P	HRS
3	ECH-611	Minor Degree Course 3 CMOS Analog VLSI Design	Theory		3	3	0	0	3
ii	ECL-621	Minor Degree Lab 2 CMOS Analog VLSI Design Lab	Lab		1	0	0	2	2
		VII Semester							
S. No.	Subject Code	COURSE NO. & NAME	COURSE TYPE		Credits	L	T	P	HRS
4	ECH-711	Minor Degree Course 4 CMOS Mixed-Signal VLSI Design	Theory		3	3	0	0	3
iii	ECL-721	Minor Degree Lab 3	Lab		1	0	0	2	2

		CMOS Mixed-Signal VLSI Design Lab						
		VIII Semester						
S. No.	Subject Code	COURSE NO. & NAME	COURSE TYPE		Credits	L	T	P	HRS
5	ECH-811	Minor Degree Course 5 Semiconductor Device Modeling	Theory		3	3	0	0	3
				Total	**18**	15	0	6	21

SYLLABUS

ELECTRONIC DEVICES AND CIRCUITS-I

Paper Code	**ECC-301**
Course Credits	3
Lectures/ Week	3
Tutorials/ Week	0

Course description **UNIT-I SMALL SIGNAL ANALYSIS OF BJT**

Transistor biasing and stablization, small signal low frequency hybrid-∏ model, design problems, Darlington pair, Frequency response of RC- Coupled amplifiers.

UNIT – IIJFET AND MOSFET AMPLIFIERS

MOSFETS, characteristics of MOS FETs Biasing of MOSFETs, Analysis of low frequency small signal FET amplifiers, CMOS, Design problems.

UNIT- IIITHE TRANSISTOR AT HIGH FREQUENCY

The hybrid-∏ CE transistor model, CE configuration gain with resistive load, frequency response, single stage CE transistor amplifier, the gain band width products, emitter follower at high frequencies.

UNIT- IV LARGE SIGNAL AMPLIFIERS

Power dissipation in transistor, amplifiers Classification (Class A, Class B, Class AB and Class C) efficiency, Push-pull and complementary push-pull amplifiers, Introduction to tuned amplifiers.

UNIT-V FEED BACK AMPLIFIERS AND OSCILLATORS

Ideal feedback configuration, Voltage-series and shunt feedback, current-series and tuned oscillators (Hartley and Colpitt's), Introduction to crystal oscillators.

Pre-requisite Basic Electronics

Text books

1. Millman and Grabel, “Microelectronics”, Mc Graw Hill, 2nd edition
2. Sedra and Smith, “Microelectronic circuits”, Oxford University Press, 7th edition
3. R. Boylestad and Nashelsky, “Electronic devices and Circuit Theory”, Pearson,10th edition.
4. Horenstein, “Microelectronic circuits and Devices”, PHI, 1996.
5. Jacob Millman and Christos. C. Halkias ‘Integrated Electonics’, Tata Mc Graw Hill, 1991

Reference Book

P. Gray, R. Meyer, S.Lewis and P. Hurst, “Analog Integrated Circuits”, 3rd edition, JohnWiley, 2007.

Course Outcomes

CO1: To understand and analyze the different biasing techniques used in BJTs andanalyze different amplifier circuits using h-parameter ac equivalent models.

CO2: A thorough understanding ofa working principles, characteristics and basic applications of FET and analyze low frequency small signal FET amplifier circuits.

CO3: Student should be able to analyze high frequency response of BJT amplifier using hybrid-π model and derive the gain under loaded and unloaded conditions. Understand high frequency response and gain bandwidth relationship for amplifier design.

CO4: Student should be able to classify the power amplifiers such as class A class B etc. and interpretation of performance characteristics of these transistors amplifiers

CO5: Student should be able to understand the effect of negative feedback and positive feedback and apply the knowledge gained in the design of transistorized circuit amplifiers and Oscillators.

Computer Usage/ Software required:

PSPICE

CIRCUIT ANALYSIS AND SYNTHESIS

Paper Code **ECC-302**

Course Credits 3

Lectures/ Week 3

Tutorials/ Week 0

Course description

UNIT- I BASIC CIRCUIT FUNDAMENTALS

Circuit elements: passive and active elements, independent circuit elements, Independent and dependent sources, Source transformation, Review of Ohm's law, Kirchoff's law, Node and mesh-current method compared. The dot-convention in magnetically coupled circuits, Dual circuits, The phasor concept, DC analysis using PSPICE, Analysis of RLC circuits.

UNIT- II NETWORK FUNCTION AND TWO PORT PARAMETERS

The concept of complex frequency, Review of Laplace transform(LT), step impulse, ramp, sinusoidal and exponential function and their LT's, initial conditions in circuits, time-domain analysis of circuits using LT, poles and zeros of a network function, restrictions on poles and zeros location, stability of active network, two-port parameters, inter-connection of two-port networks, PSPICE analysis of RLC circuits.

UNIT- III CIRCUIT THEOREMS AND OTHER APPLICATIONS

Superposition theorem, Reciprocity theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem, Millman's theorem, Substitution theorem, Tellegen's theorem- and their application to linear, AC and DC, active and passive circuits, Use of PSpice for DC analysis.

UNIT- IV GRAPH THEORY AND STATE VARIABLE ANALYSIS

Terminology and definitions: graph and sub-graph, tree and co-tree, twig and link, cut-set matrices, circuit analysis using graph theory concept. State variable analysis of circuits: state variables, formation of state equations for circuits and their solution.

UNIT-V PASSIVE NETWORK SYNTHESIS

Analysis versus synthesis, positive real function, properties of passive network, synthesis of RC, RL and LC network (foster and Cauer forms) Use of PSPICE for analysis and synthesis of circuits.

Pre-requisite Basic Circuit Theory

Course/Paper:

Text Book: Hayt Jr. and Kemmerly, “Engineering Circuit Analysis”, Mc Graw Hill Book Co. 1987

Reference Books:

1. M L Van Valkenburg, “Network Analysis”, Prentice Hall of India, New Delhi, 1985
2. FF Kuo, “Network Analysis and Synthesis”, John Wiley and Sons Inc. , 1985
3. Sudhakar A. Shyammohan, “Circuits and Network Analysis and Synthesis”, Tata McGraw Hill Publishing Company Ltd. New Delhi, IIIrd edition, 2007

<u>CO Statements</u>

CO1. Analyze various electrical components in networks & understand application of KCL and KVL in electrical networks.

CO2. Understand the Thevenin and Norton Theorem, Nodal and Mesh analysis to express complex circuits in their simpler equivalent forms.

CO3. Understand linearity and superposition concepts and use them to analyse RL, RC & RLC circuits in time and frequency domains.

CO4. Understand the concepts of Graph Theory and use them in solving electrical circuits.

CO5. Learn the method of synthesizing an electrical network from a given Impedance/Admittance function.

Computer usage/ Software required: Simulations using PSPICE

LOGIC DESIGN

Paper Code **ECC-303**

Course Credits 3

Lectures/ Week 3

Tutorials/ Week 0

Course description **UNIT- I** **SWITCHING ALGEBRA AND COMBINATIONAL LOGIC**

Development of Boolean Algebra, truth functions, AND OR and NOT operators, laws of algebra, reducing Boolean expressions, universal building blocks, Karnaugh mapping, minterms, maxterms, solving digital problems using sum of the products and product of sums reduction hybrid functions, incompletely specified functions (don't care combinations).

UNIT-II **SEQUENTIAL CIRCUITS (FLIP-FLOP AND RIPPLE COUNTERS)**

Introduction to asynchronous systems, flip-flop: RS, T, D, JK, master slave JK, Ripple counters-shortened modulus, up and down counter designs, few application of ripple counter.

UNIT-III **SEQUENTIAL CIRCUITS (PARALLEL COUNTERS AND ASYNCHRONOUS CIRCUITS)**

Parallel counters, type T counter design, up and down counters, non-sequential counting (skipping states), type D counter design, shift registers, ring counters, type JK counter design, controlling the counter to count through more than one set of states.

UNIT-IV **LOGIC FAMILIES**

Diode transistor logic (DTL), Transistor-Transistor logic (TTL) as derived from DTL, typical TTL NAND gate, function of the input transistor, volt-ampere characteristics, fan-in and fan-out calculations, output stage: totem-pole and modified totem-pole, introduction to Emitter Coupled Logic (ECL), Integrated Injection Logic (IIL), and MOSFET, Comparison of various logic families.

UNIT-V **ADDERS, SUBTRACTORS, ADC AND DAC**

Binary half adder, full adder design, parallel adder, BCD adder, addition of more than two numbers, subtractor, fast adder (look-ahead carry), parity checker/generator, multiplexer/ demultiplexer, some applications, Digital to analog converter - weighted register, R-2R ladder network, Analog to digital converter, successive approximation type, dual slope type.

Pre-requisite Fundamentals of Abstract Algebra

Course/Paper:

Text Book: Herbert Taub and Donald Schilling, “Digital Integrated Electronics” Tata MC Graw Hill. 1988

Reference Books: 1. Willam H. Gothman, “Digital electronics –An Introduction to Theory and Practice”, 2nd Edition PHI. 1992

2. Thomas L Floyd, “Digital Fundamentals” Pearson Education, 2011

3. Morris Mano, “Digital Circuits and Logic Design”, PHI. 1987

CO Statements

CO1. A thorough understanding of basic building blocks of Digital Circuits and Boolean Algebra and ability to design simple combinational circuits by using K-Maps

CO2. A thorough understanding of basic storage units and their need in sequential circuits, and the ability to design ripple counters and the appreciation of their limitations.

CO3. The ability to design synchronous counters using type -T, Type-D and Type-JK design philosophies and the appreciation of how they overcome the limitations of ripple counters.

CO4. A thorough understanding of circuits like Adders, Subtractors, Parity Checkers/Generators , Multiplexers/ De-Multiplexers, A/D and D/A converters etc. and a co-relation with the design insights already gained in CO1 and CO2.

CO5. A thorough understanding of the implementation of basic building blocks in DTL,TTL,MOS,CMOS,ECL and I2L Logic Families and a qualitative comparison of their performance.

SIGNALS AND SYSTEMS

Paper code: ECC -304

Course Credits: 3

Lectures/Week: 3

Tutorials/Week: 0

Course Description:

UNIT-1

INTRODUCTION TO SIGNALS & SYSTEMS : Definition of Signals & Systems, Classification of Signals-Continuous Time & Discrete Time, Elementary Signals, Basic operations on signals, Signal representation, Classification of Systems, System Properties- Causality, Time Variance/Invariance, Memory, Stability and Linearity

UNIT-2

LINEAR-TIME INVARIANT (LTI)SYSTEMS : Time Domain representation of LTI systems, Characterization of LTI systems, Impulse response characterization, Convolution Sum and Convolution Integral, Properties of LTI systems, Stability criteria of LTI systems , Elements of Continuous-time and discrete-time LTI systems.

UNIT-3

FOURIER REPRESENTATION OF SIGNALS: Fourier Representation of Signals, Continuous-time Fourier series and their properties, Application of Fourier series to LTI systems, Fourier Transform and its properties, Applications of Fourier Transform to LTI systems, Circular Convolution

UNIT-4

LAPLACE TRANSFORM: Introduction and Definition, Region of Convergence, Properties of Laplace Transform, Inverse Laplace Transform, Applications of Laplace Transform in analysis of LTI systems, Unilateral Laplace transform and its application to solve differential equations. Analysis of electric circuits.

UNIT-5

Z-TRANSFORM: Z- transform, Region of convergence, properties of z-transform, inverse z-transform, transform analysis of Discrete –Time LTI systems, Unilateral Z-transform & its applications to LTI systems described by difference equations.

Pre-requisite

Course/Paper: Basic Mathematics

Text Book: A.V. Oppenheim, Wilsky&Nawab, “Signals & Systems”, PHI, 1998.

Reference Books:

1. S. Haykin, “Communication Systems”, Wiley Eastern, 1992.

2. A.V. Oppenhiem& R.W. Shafer, “Digital Signal Processing”, Prentice Hall, 1992.

3. G.R. Copper & C.D. McGillen, “Methods of Signals & System Analysis, Holt Renehart&Winstons.

Course Outcome:

CO1. Ability to represent various signals and systems, Ability to perform different operations on continuous time(CT) and Discrete time(DT) signals, analyze CT and DT signals in time domain using convolution, Characterize and analyze properties of CT and DT signals and systems.

CO2. Ability to represent LTI systems in Time Domain, Characterize LTI systems, Ability to determine Impulse response characteristics, Understanding Convolution Sum and Convolution Integral, understanding Properties and Stability criteria of LTI systems.

CO3. Ability to represent periodic signal using Fourier Series, representation of periodic and non-periodic signal using Fourier Transform, ability to determine impulse response & frequency response functions and understanding of properties of Fourier Series and Fourier Transform.

CO4. Ability to analyze CT systems using Laplace Transform , Understanding Region of Convergence, Understanding Properties of Laplace Transform and Inverse Laplace Transform, Ability to apply Laplace Transform in analysis of LTI systems

O5. Ability to analyze and define stability of Discrete time systems using Z-Transform, Understanding of properties of z transform. Understanding it’s region of convergence and inverse z-transform.

ELECTRONIC DEVICES AND CIRCUITS II

Paper Code **ECC-401**

Course Credits 3

Lectures/ Week 3

Tutorials/ Week 0

Course description **UNIT-I** **DIRECT- COUPLED AMPLIFIERS**

Difference amplifier, the emitter-Coupled differential amplifier, Common-mode gain, differential- mode gain, (CMRR), current mirrors, active loads, BJT-input stage, gain stage, level shifter, output stages, complete op-amp cascade with qualitative analysis.

UNIT-II **OP-AMP APPLICATIONS**

Brief review of inverting/non-inverting, Integrators, differentiators, instrumentation amplifier, logarithmic amplifiers, Log/Antilog modules, temperature compensation.

UNIT-III **WAVEFORM GENERATORS AND WAVESHAPING**

Op-amp comparators, regenerative comparators (Schmitt trigger), waveshaping, zero crossing detector, astable and monostable multivibrators, square/triangular wave function generator, saw-toothwave generator, precision rectifiers, peak detector, sample and hold circuit,

UNIT- IV **I C TIMER AND IC PLL**

The IC 555 timer, operational modes, time delay, astable and monostable operations, VCO etc., phase locked loop IC 565 (PLL), principle of operation, three modes of operation, PLL applications, FM demodulaton,

UNIT- V **ANALOG MULTIPLIER AND VOLTAGE REGULATORS**

Analog multiplier using BJTs, IC analog multiplier and its applications, voltage regulators: op-amp based regulators, IC regulators, fixed voltage regulators (78/79XX), 723 IC regulators,

References Books

1. Sedra and Smith, “Microelectronic circuits”, Oxford university press.
2. S. Soclof, “Applications of Analog Integrated circuits”, PHI.
3. Coughlin and Driscoll, “Operational amplifiers and Linear Integrated circuits”, PHI
4. J. Millman and Grabel, “Microelectronics”, McGraw Hill Book Co.
5. K. Laker, “Design of Analog Integrated Circuits and Systems, Tata McGraw Hill.

Course Outcomes

CO1: Ability to describe and analyze the characteristics of differential amplifiers and their DCand small signal characteristics. Ability to realize different gains like common mode and differential mode and the CMRR of the differential amplifier can easily be calculated.

CO2: Ability to design, construct, measure and realize various applications of Op-amp like VCVS, ICVS and VCIS, Integrators, differentiators, instrumentation amplifier, Log/Antilog modules and other different parameters.

CO3: Ability to understand and design various wave generator circuits and shaping circuits like Schmitt trigger, zero crossing detector, astable and monostable multivibrators, square/triangular wave function generator, saw-tooth wave generator, sample and hold circuit, precision rectifiers, peak detector and window detector.

CO4: Ability to design, construct and understand the various application of the op-amp based circuits like VCO, IC 555 timer based circuits and IC 565 PLL based circuits.

CO5: Ability to Design, construct, and take measurement of various analog multiplier, Voltage regulator and Op-amp based circuits to compare experimental/ simulated results in the laboratory with theoretical analysis.

Computer usage/ Software required: PSPICE

COMPUTER ARCHITECTURE

Paper Code: ECC-402

Course Credits: 3

Lectures/ Week: 3

Tutorials/ Week: 0

Course Description

UNIT-I HARDWARE REQUIREMENTS AND MICRO-OPERATIONS

Philosophy of digital systems and computer design, review of digital hardware and MSI/LSI/VLSI devices description and applications. Register transfer and micro-operations: arithmetic, logic and shift micro-operations, simple computer design.

UNIT-II SYSTEM SOFTWARE AND PERIPHERAL DEVICES

Assembly language, the Assembler, important peripheral devices, PC family.

UNIT-III PROCESSOR DESIGN

Processor organization, arithmetic and logic unit (ALU), design of arithmetic and logic unit, design of accumulator, introduction to parallel computing-Pipeline processing.

UNIT-IV LOGIC CONTROL DESIGN

Processor organization, hardware control, microprogram control, control of processor unit, microprogram sequencer.

UNIT-V COMPUTER DESIGN, & MEMORY ORGANIZATION

Design aspects related to: systems configuration, computer instruction set, timing and control, and instruction executions. Review of various memories: bulk magnetic storage, auxiliary memory hierarchy, associative, virtual, and cache memories.

Pre-requisite

Basic Digital Logic

Text Book:

M. Morris Mano, “Computer System Architecture”, 2nd Edition, PHI Ltd. 1982.

Reference Books:

1. M. Morris Mano, “Computer Engineering Hardware”, PHI, 1988.

2. M. Morris Mano, “Digital Logic and Computer Design”, PHI Ltd., 1979.

3. Hayes, “Computer Architecture” McGraw Hill.

4. Hanacher “Computer Organization” Prentice Hall.

Course Outcome:

CO1. Thorough understanding of the basics of computer architecture and organization.

CO2. An ability to create an assembly language program to program a microprocessor system.

CO3. Capability to easily deal with processor design and their modification for high performance and multi-tasking.

CO4. Capability to articulate design issues in the development of control unit or other components that satisfy design requirements and objectives.

CO5. An ability to use the new technologies in memory organization of computers.

Analog Communication

Paper Code	**ECC-403**
Course Credits	3
Lectures/ Week	3
Tutorials/ Week	0

Course Description

UNIT- I AMPLITUDE MODULATION

Amplitude modulation, double side band suppressed carrier modulation, single side band suppressed carrier modulation, effect of frequency and phase errors in synchronous detection, vestigial sideband transmission, comparison of various AM systems, Frequency division multiplexing.

UNIT- II ANGLE MODULATION

Frequency modulation, narrow band FM, multifrequency modulation, square wave modulation, linear and non-linear modulation, some remarks on phase modulation, power content in carrier and sidebands in angle modulated carrier, noise reduction characteristics of angle modulation, generation of FM signals, Demodulation of FM signal

UNIT III PERFORMANCE OF COMMUNICATION SYSTEMS

Bandpass noise representation, noise calculation in communication, noise in AM signals, noise in DSBSC, noise in AM with carrier envelop detection, noise in angle modulated systems, frequency modulation, threshold improvement through pre-emphasis in FM, phase modulation.

UNIT-IV RADIO RECEIVER AND TRANSNITTERS

TRF receiver, disadvantages of TRF receiver, Superhetrodyne receiver, advantages, performance of radio receivers, sensitivity, image frequency and its rejection, double spotting, AGC, AFC, AM and FM receivers, TV transmitter and receiver circuits, introduction to satellite communication.

UNIT-V PULSE MODULATION

Sampling theorem, time division multiplexing, pulse modulation, pulse width modulation (PWM), pulse position modulation (PPM), pulse code modulation (PCM), quantization, encoding, quantization error, companding, delta modulation and adaptive delta modulation, performance of digital signals, eye diagram.

Pre-requisite

Course/Paper Maths III

Text Book J G Proakis & Masoud Salehi, "Communication Systems Engineering", Prentice Hall of India, 2nd Edn., 2006.

Reference Books

1. Simon Haykin, " Communication Systems", Wiley Eastern Ltd., 2000.
2. B P Lathi & Zhi Ding, "Modern Digital & Analog Communication Systems", Oxford University Press, 4th Edn., 2011.
3. Leon W Couch II," Digital & Analog Communication Systems", Prentice Hall of India, 7th Edn. 2008

CO Statements

CO1. To become familiar with the Amplitude Modulation, its various forms, its time-domain and frequency-domain representation, and generation of its various forms.

CO2. To have thorough understanding of Frequency and Phase Modulation, time-domain and frequency-domain representation of FM, Narrowband and Wideband FM, and generation FM signals.

CO3. To study the demodulation techniques of AM and FM signals, AM and FM receivers and performance parameters of radio receivers.

CO4. To study the bandpass and lowpass noise in communication systems and the noise performance of various AM and FM receivers.

CO5. To become familiarize with Pulse Modulation techniques and various Multiplexing schemes and their applications in communication systems.

Computer usage/ Software required: MATLAB

DIGITAL CIRCUITS AND SYSTEMS

Paper Code	**ECE-501**
Course Credits	3
Lectures/ Week	3
Tutorials/ Week	0

Course description **UNIT- I Electronic Devices**

Energy bands in intrinsic and extrinsic silicon; Carrier transport: diffusion current, drift current, mobility and resistivity; Generation and recombination of carriers; Poisson and continuity equations; P-N junction, Zener diode, BJT, LED, photo diode and solar cell.

UNIT- II MOS Transistor

Metal Oxide Semiconductor (MOS) Structure, MOS System under External Bias, Structure and Operation of MOS Transistor (MOSFET), MOSFET Current-Voltage Characteristics, MOSFET Scaling and Small-Geometry Effects, MOSFET Capacitances.

UNIT-III MOS Inverters: Static and Switching Characteristics

Resistive-Load Inverter, Inverters with n-type MOSFET Load, CMOS Inverter; Delay-Time Definitions, Calculation of Delay Times, Inverter Design with Delay Constraints, Estimation of Interconnect Parasitics, Calculation of Interconnect Delay, Switching Power Dissipation of CMOS Inverters

UNIT–IV MOS Logic Circuits and Semiconductor Memories

MOS Logic Circuits with Depletion nMOS Loads, CMOS Logic Circuits, Complex Logic Circuits, CMOS Transmission Gates (Pass Gates); Latch and Flip-Flop Circuits, Static Random-Access Memory (SRAM) Circuits, Dynamic Random-Access Memory (DRAM) Circuits, Nonvolatile Memories.

	UNIT–V Low-Power CMOS Logic Circuits
	Need of Low power, Sources of Power Dissipation, Low-Power Design through Voltage Scaling, Estimation and Optimization of Switching Activity, Reduction of Switching Capacitance.
Pre-Requisite	None
Text / Reference book	1. Donald A. Neamen, "Semiconductor Physics and Devices: *Basics Principles*", 3rd Edition, Tata McGraw-Hill, 2002.
	2. Sung Mo Kang, Yusuf Leblebici, "CMOS Digital Integrated Circuits: *Analysis and Design*", 3rd Edition, Tata McGraw-Hill, 2003.
Course Outcome	**CO1:** A thorough understanding of carrier transport in the semiconductor devices, and the working principle of basic semiconductor devices, such as diode, Zenor diode, BJT, LED, Photo detector, and Solar Cell etc.
	CO2: An ability to explain the Operation and Scaling/Small-Geometry Effects of MOS Transistor (MOSFET).
	CO3: A thorough understanding of the MOS Inverter Static and Switching Characteristics and to utilize basic understanding of the same to design complex MOS Logic Circuits.
	CO4: An ability to design Complex MOS Logic Circuits and state of the Art Semiconductor Memories.
	CO5: A thorough understanding of sources of power dissipation and their reduction of the same to design low power system.

ACTIVE FILTERS AND SIGNAL PROCESSING

Paper Code	**ECC-501**
Course Credits	3
Lectures/ Week	3
Tutorials/ Week	0
Course description	**UNIT- I ACTIVE ELEMENTS AND THEIR APPLICATIONS**
	Introduction to active elements, primary and secondary building blocks, operational amplifier (op-amp), operational transconductance amplifier (OTA), immittance converter, pathological elements (Nullator, Narator and Nullor) and their use in realizing controlled sources and other active elements, active networks synthesis.

UNIT II ACTIVE FILTER DESIGN

Active filter synthesis, cascade approach, first order networks, simulated inductance approach and FDNR approach to op-amp RC Filters, the biquad (single amplifier and multi-amplifier biquads) filters, negative feedback topology positive feedback topology, some design problems, introduction to active-R filters, Active-C-filters.

UNIT III FILTER APPROMIMATION MODELS

Introduction to analog filter theory, filter approximations, Butterworth approximation, Chebyshev approximation and inverse Chebyshev approximation, frequency transformations, low pass-low pass, low pass-high pass, low pass-band pass and low pass to band reject transformations, some design problems.

UNIT IV SENSITIVITY FUNCTION

Sensitivity study, sensitivity function, magnitude and phas sensitivities, single parameter sensitivity, multiple parameter sensitivity, gain sensitivity, root sensitivity, general relation of network functions sensitivities.

UNIT V SWITCHED CAPACITOR FILTERS

The MOS switch, the switched capacitor/resistor equivalence, analysis of switched capacitor filters using charge conservation equations, switched capacitor biquads, design examples.

Text/

Refrence Books

1. Wai Kai Chen, “Passive and Active Filter Theory and Implementations:, John Wiley and Sons, 1986

2. M.E. Vanvalkenburg,” Analog Filter Design”, Jolt Rinehart & Winston, New Yark, 1982.

3. Y.F. Lam, “Analog and Digital Filters: Design and Realization”, Englewood N.J., 1979

4. GobindDaryanani, “Principles of Active network Synthesis and Design”, John Wiley, New Yark,. 1976.

5. M.E. Van Valkenburg and Kinariwala, “Linear Circuits”, Prenticed Hall of India.

6. R. Schaumann, M.S. Ghausi and K.R. Laker, “Design of Analog Filters: passive, active RC and switched capacitors”, Prentice Hall, Englewood cliffs, NJ, 1990.

CO1.The ability to develop thorough understanding of the different active and pathological elements.

CO2. Capability to develop skills in analysis and design of various analog filters.

CO3. Ability to understand the approximation in the analog filters and analyze their design.

CO4. Ability to develop skill regarding sensitivity functions of various filter transfer functions.

CO5. Capability to understand the principle of operation and design of switched-capacitor filter circuits.

Computer usage/ Software required: PSPICE

DIGITAL COMMUNICATION

Paper Code **ECC-502**

Course Credits 3

Lectures/ Week 3

Tutorials/ Week 0

Course description UNIT I –

ANALOG-TO-DIGITAL CONVERSION (ADC) OF BASEBAND SIGNAL

Pulse Code Modulation (PCM), Sampling, Quantization,Encoding, Quantization Noise and Signal-to-Quantization Noise Ratio (SQNR), Companders, Differential PCM (DPCM), Delta Modulation (DM), Adaptive Delta Modulation (ADM).

UNIT- II DIGITAL BASEBAND SIGNAL TRANSMISSION Basic Building Blocks of Digital Communication systems.**Digital Signaling:** Binary and M-ary Signals, PCM Formats, PAM and Orthogonal symbols, Gram-Schimdt Orthogonolization Procedure (GOP), Constellation Diagram. **PCM Formats/Line Codes:** Unipolar, Polar, Bipolar, Dipolar (OOK and Antipodal), AMI and CMI Line Codes. **Bandwidthand Power of Line Codes:** Power Spectral Density (PSD) of General Line Code, PSD and Bandwidth of various Line Codes. **Baseband Signal Transmission through Bandlimited Channels**: Intersymbol Interference (ISI), Receiver Output in the Presence of ISI, Nyquist’s First Criterion for Zero ISI: Ideal and Practical Solutions, Criterion for controlled ISI: Correlative Coding, Eye Pattern

UNIT III DIGITAL BANDPASS MODULATION

Types of Digital Bandpass Modulation, Mathematical Representation, Constellation Diagrams, Frequency Spectrum, Bandwidth and Generation of the following Digital Bandpass Modulation techniques: **Amplitude Shift Keying (ASK**): Binary ASK (On-Off Keying), M-ary ASK **Phase Shift Keying (PSK):** Binary PSK (BPSK), M-ary PSK (MPSK), Differential PSK (DPSK), Quadrature PSK (QPSK). **Frequency Shift Keying (FSK):** Binary FSK (BFSK), M-ary FSK (MFSK), Continuous Phase FSK (CPFSK), Minimum Shift Keying (MSK), and Gaussian-filtered MSK (GMSK).

UNIT-IV : OPTIMUM RECEIVERS: DEMODULATORS AND DETECTORS OF DIGITAL SIGNALS IN AWGN

Optimum Demodulators: Matched Filter Demodulator, Properties of Matched Filter, Correlation-type Demodulator, Matched Filter and Correlation-type Optimum Demodulators for Binary and M-ary signals. **Optimum Detectors:** Maximum *a posteriori* (MAP) Criterion, Maximum Likelihood (ML) Criterion.

UNIT-V SYNCHRONIZATION, DEMODULATION AND DETECTION OF DIGITAL BANDPASS MODULATED SIGNALS

Carrier Synchronization: M^{th} Power PLL, **Symbol Synchronization:** Early-Late Gate Synchronization. **Demodulation and Detection:** Coherent &Non-Coherent Techniques **ASK:** Coherent BASK, MASK **PSK:** Coherent BPSK, MPSK, QPSK &Non-Coherent DPSK **FSK:** Coherent & Non-Coherent MFSK, Optimum Detection of BFSK

Pre-requisite

Course/Paper: Communication Systems, Maths III

Text Book: 1. J G Proakis& Masoud Salehi, "Digital Communications", Mc Graw Hill Education, 5th Edn., 2014.

2. Simon Haykin, "Digital Communications", Wiley India Edition, 2006.

Reference Books: 1. B P Lathi & Zhi Ding, "Modern Digital & Analog Communication Systems", Oxford University Press, 4th Edn., 2011.

2.. Leon W Couch II," Digital & Analog Communication Systems", Prentice Hall of India, 7th Edn., 2008

Course Outcomes:

CO1: To become familiar with Analog-to-Digital converters for baseband signal such as PCM, DPCM, DM and ADM.

CO2: A thorough understanding of digital signalling for the baseband signal transmission , line codes and applying various pulse-shaping techniques to combat the ISI present in the received signal.

CO3: To familiarize with different types of digital modulation schemes such as ASK, PSK, FSK and their different forms.

CO4: An ability to design demodulators and detectors for digital signal in the presence of AWGN.

CO5: A thorough understanding of synchronization demodulation and detection of digital bandpass modulated signals.

Computer usage/

Software required:	MATLAB

Microprocessors and Applications

Paper Code	**ECC-503**
Course Credits	3
Lectures/ Week	3
Tutorials/ Week	0
Course description	**UNIT- I INTRODUCTION AND ORGANIZATION**

UNIT- I INTRODUCTION AND ORGANIZATION

Evaluation of microprocessors, basic block of micro computer, typical micro computer architecture, single chip microprocessor, functional representation of simple and typical microprocessor, general purpose and dedicated registers, INTEL 8085 pin and functional block diagram, tristate concept, INTEL 8085 externally initiated signals, basic concepts of timing and control unit.

UNIT-II PROGRAMMING OF MICROPROCESSORS

Data representation, instruction and data flow, addressing modes, instruction set of INTEL 8085 machine cycle, T-state and timing diagram, introduction to programming, use of mnemonics and assembly language, flowchart, assembler pseudo-instruction, flowchart and program writing techniques.

UNIT-III INTERFACING MEMORY AND I/O DEVICES

Necessity of interfacing, address space partitioning, memory mapped I/O and I/O mapped I/O, hardware scheme of data transfer, various interrupt schemes and associated instructions of INTEL 8085, direct memory access data transfer. Review of semiconductor memories, timing operation, memory interfacing, programmable peripheral interfaces, 8255, 8253 programmable interrupt controller, enabling and disabling and masking of interrupts, particularly in 8085.

UNIT-IV 16-BIT MICROPROCESSOR AND ITS ARCHITECTURE

Intel 8086/8088 architecture, addressing modes, instructions set, assembler dependent instructions, 8086 I/O, I/O processor (IOP), Interrupts and DMA .

UNIT-V PENTIUM AND PENTIUM PRO MICROPROCESSOR

Serial I/O, Introduction to Pentium and Pentium pro microprocessor, special pentium registers.

Pre-requisite Course/Paper:	Computer Architecture
Text Book:	1. R. Goankar, "Microprocessor architecture", Penram International Publication, Fifth edition, 1989 2. Rafiquzzaman, "Microprocessor and Microcomputer based System Design", CRC press, 1995
Reference Books:	B. B. Bray, "8086/8088/Intel Microprocessor", 8^{th} Edition
Course Outcomes	**CO1:** Familiarity with the basic architecture of a well-known microprocessor 8085, awareness of the instruction set and instruction execution mechanism in 8085 microprocessor. **CO2:** An ability to learn the programming of 8085 microprocessor and its applications. **CO3:** Achieving the thorough knowledge of data transfer between the microprocessor and the peripherals, challenges in data transfer and the limitations of basic architecture regarding the data transfer. **CO4:** Learning how and why the microprocessor needs to be interrupted, how the software and hardware governs the interrupt process. The students will be introduced to high end processors. **CO5:** To know the challenges and architectural limitations of 8085, 8086/8088 microprocessors. To know how these challenges have been overcome in high end processors like Pentium processors.
Computer usage/ Software required:	1. Assembly Language Programming 2. Microprogramming

ELECTROMAGNETIC FIELD THEORY

Paper Code	**ECC-504**
Course Credits	3
Lectures/ Week	3
Tutorials/ Week	0
Course Description	**UNIT-1 VECTOR ANALYSIS, COULOMB'S LAW AND ELECTRIC FIELD INTENSITY**.

Review of scalars and vectors, vector algebra, cartesian co-ordinate system, vector components and unit vectors, vector field, dot product, cylindrical and spherical coordinate systems, experimental law of Coulomb, electric field intensity, field due to a continuous volume charge distribution, field of a line charge, field of a sheet of charge.

UNIT-II ELECTRIC FLUX DENSITY, GAUSS'S LAW, DIVERGENCE, ENERGY AND POTENTIAL.

Electric flux density, Gauss's Law, application of Gauss's Law, some symmetrical charge distributions, differential volume element, divergence, vector operator ∇ and divergence theorem, Energy expended in moving a point charge in an electric field, Line integral, Definition of potential difference and potential, Potential field of a point charge, Potential field of system of charges-conservative property, Potential gradient, Dipole, Energy density in electrostatic field.

UNIT-III CONDUCTORS, DIELECTRICS, CAPACITANCE, POISSON'S AND LAPLACE'S EQUATIONS.

Current and current density, continuity of current, semiconductors, Poisson's and Laplace's equations, product solution of Laplace equation.

UNIT-IV STEADY MAGNETIC FIELD AND AMPERE'S CIRCUITAL LAW.

Biot-Savart's Law, Ampere's circuital Law, Curl, Stoke's theorem, magnetic flux and magnetic flux density.

UNIT-V MAXWELL'S EQUATIONS.

Faraday's Laws, displacement current, Maxwell's equations in point from, Maxwell's equations in integral form

Pre-requisite Course/ Paper: Vector concept

Text Book: W H Hayt, J A Buck and M Jaleel Akhtar, "Engineering Electromagnetics", McGraw Hill Education, 8th edition.

Reference Books

1. Joseph A Edminister, "*Electromagnetics*". Schaum's Outline Series in Engineering. M.c.Graw Hill Book, Co, new Delhi-1986.
2. K E Lonngren, S V Savov and R J Jost, "Fundamentals of electromagnetic with MATLAB", PHI, 2nd edition.
3. A Pramanik, "Electromagnetism , Volume 1-(Theory)", PHI, 2014.
4. D K Cheng, "Field and wave electromagnetics", Pearson, 2nd edition.
5. M N O Sadiku, "Principles of electromagnetism", Oxford, 4th edition.
6. S Bhooshan, "Fundamentals of engineering electromagnetics", Oxford, 2013.

Course Outcome

CO1. A thorough understanding of transformations between cartesian, cylindrical and spherical coordinate systems and application of Coulomb's law to compute electric field intensity due to various charge distributions.

CO2. An ability to apply Gauss's law to symmetrical charge distributions, understanding of divergence theorem and potential field computation due to system of charges.

CO3. A thorough understanding of continuity of current and application of Poisson's and Laplace's equations to determine parameters like potential and capacitance.

CO4. A thorough understanding of laws and theorems related to magnetostatics such as Biot-Savart's law, Ampere's circuital law, Stoke's Theorem etc.

CO5. An ability to interpret and identify various EM fields as Maxwellian on the basis of Maxwell's equations.

INSTRUMENTATION AND CONTROL SYSTEM

Paper Code	**ECC-505**
Course Credits	3
Lectures/ Week	3
Tutorials/ Week	0
Course Description	**UNIT – I**

Sensor fundamentals, transducer characteristics, selection of sensors, signal sources, Sensor circuits for signal conditioning (Wheatstone Bridge, Constant Current Sources, Amplifier Circuits, Current to Voltage Converter), Data Acquisition system (DAS) requirements, Design methodology of computer based DAS (Operating Voltage, Interfacing Circuits, Signal Cables and Connectors, Data Acquisition Cards, Analog to Digital Converters, Digital to Analog Converters, Digital Input/Output Boards, Interfacing, Data Acquisition Software), Error Classification, sources of error.

UNIT – II

Basic Control System Components, Classification of Systems, Block Diagrammatic description, Reduction of Block diagrams. Signal Flow Graphs and their use in determining function of systems

UNIT – III

Properties of systems: Linearity, Time Invariance, Stability, Causality. Transfer Function, Impulse Response, Poles, zeroes and their significance, Stability analysis of systems, Routh –Hurwitz criterion. Transient and steady state analysis of LTI systems

UNIT - IV

	Frequency Response Analysis Tools and Techniques of LTI Control Systems-Root Locus, Bode Plot, Nyquist Plot.
	UNIT - V
	Control Systems compensators: Elements of lead and lag compensation, Elements of proportional-Integral-Derivative (PID) control. Introduction to State Variable representation, controllability and observability of system Introduction to Digital and Microprocessor based control Systems
Pre –Requisite Course/ Paper	Signals and Systems
Text Book	1. M.Gopal, "Control System – Principles and Design", Tata McGraw Hill, 3rd Edition. 2. Mainuddin Gaurav Singhal A. L. Dawar, "Sensors and Measurement Techniques for Chemical Gas Lasers", IFSA Publishing, S. L.
Reference Books	1. I.J. Nagrath and M.Gopal, "Control System Engineering", Wiley Eastern, Second edition, 1982. 2. K.Ogata, "Modern control Engineering", Prentice Hall of India, 1989. 3. William A. Wolovich, "Automatic Control Systems-Basic Analysis and design", Oxford, 2011. 4. Kuo, "Digital Control Systems", Oxford, Reprint 2013.
Course Outcome	**CO1.** Understanding of signal conditioning circuits and data acquisition system and ability to classify error and identify its sources. **CO2.** Thorough understanding of Control system and its classification, Ability to determine transfer function of system using Block Diagram Reduction technique and derive mathematical models of mechanical control system, Ability to determine transfer function of system using Signal Flow Graph technique, **CO3.** Capability to define stability conditions of system using Routh Hurwitz Criteria and ability to perform time response analysis of first order and second order LTI systems for various inputs **CO4.** Ability to perform frequency response analysis of LTI system using Root Locus, Bode Plot and Nyquist Plot. **CO5.** Understanding of various types of Compensation techniques in control system, Ability to compute Controllability and Observability of LTI system and Understanding of Digital and Microprocessor based control systems

ANTENNA AND WAVE PROPAGATION

Paper Code **ECE-601**

Course Credits 3

Lectures/ Week 3

Tutorials/ Week 0

Course description **UNIT-I** **ELECTROMAGNETIC WAVES**

Review of Maxwell's equations and boundary conditions. Wave equations and their solutions. Uniform plane waves, sinusoidal time variation, wave-propagation in lossless and conducting media, propagation in good dielectrics and conductors, depth of penetration, polarization, reflection and reflection co-efficient, reflection and refraction of planes waves by conductors and dielectrics, surface impedance.

UNIT-II **GUIDED WAVES AND WAVEGUIDES**

Guided wave propagation between parallel conducting planes, TE, TM and TEM modes of propagation, velocity of propagation, attenuation in parallel plane guides, rectangular plane guides: TE, TM and TEM modes of propagation, excitation of modes in waveguides. Introduction to cavity resonator. Introduction to cylindrical (metallic and dielectric) waveguides.

UNIT-III **ANTENNA THEORY**

Vector magnetic potential and retarded potentials. The alternating current element and its induction and radiation fields, power radiated by a current element, application to short and long antennae. Radiation resistance, directional properties of antennae, radiation patterns, Reciprocity theorem, equivalence of the receiving and transmitting patterns of an antenna. Directivity and gain, receiving cross-section, linear antenna arrays, broadcast arrays, effect of earth.

UNIT-IV **ANTENNA SYSTEMS**

Non-resonant antennae, Yagi-Uda and Rhombic antennae, UHF and microwave antenna: antenna with parabolic reflectors, horn and lens antenna, Turnstile and Clover leaf antenna, wideband and special purpose antennae: Helical discone, log-periodic and loop antennae.

UNIT-V RADIO WAVE PROPAGATION

Different ways of radio wave propagation, effects of environment on radio wave propagation. Ground (surface) waves and their characteristics, sky-wave propagation: the ionosphere and its effects, reflection mechanism, virtual height, critical frequency, maximum usable frequency, skip distance transmission path and fading, diversity techniques, Ionosphere variation, space waves: microwave spacewave propagation, troposphere scatter propagation.

Pre-requisite Electromagnetic Field Theory

Course/Paper:

Text Book: Jordan E C & K G Balmain, "Electromagnetic Waves and Radiating Systems", PHI Pvt. Ltd, New Delhi, 1987

Reference Books: J.D. Kraus, "Antenna and wave propagation", Mc-Graw Hill, 4th edition.

Course Outcomes

CO1: Knowledge of the concept of electromagnetic waves and its propagation in different mediums.

CO2: Analysis of bounded propagation of electromagnetic waves through waveguides & derive their characteristics.

CO3: Evaluation of infinitesimal current element as a dipole antenna and work-out its fields, power radiated and radiation pattern.

CO4: Knowledge of various types of antennas such Horn, Loop, Rhombic etc. And derive its various parameters for optimisation.

CO5: Analysing different types of radio wave propagation and atmospheric effects on radio wave propagation.

VLSI Design

Paper Code **ECC-601**

Course Credits 3

Lectures/ Week 3

Tutorials/ Week 0

Course description **UNIT-I** **MOSFET MODELS**

Introduction, MOSFET modeling: accumulation, flat-band, depletion and inversion mode of operation, subthreshold conduction, depletion mode and enhancement mode MOSFET, Inverters,

UNIT-II **CURRENT TRENDS IN VLSI DESIGN**

Bulk Technology, Advantages and limitations, short channel effects: threshold voltage roll-off, channel length modulation, velocity saturation, DIBL, hot carrier effects, SOI Technology, Partially and fully depleted SOI, layout designing.

UNIT-III **DIGITAL VLSI DESIGN**

NMOS device sizing, Device sizing in NOR and NAND gates, CMOS device sizing. Symmetric devices: Advantages and limitations, Transmission gates, delay modeling**.**

UNIT-IV **PROGRAMMABLE DEVICES**

Introduction to VHDL, design methodology, styles of modeling, designing basic building blocks and functional units as adder, multiplexer and decoder; programming the FPGA and CPLD.

UNIT-V **CMOS PROCESSING TECHNOLOGY**

Device fabrication, crystal growth, CZ technique, FZ technique, Oxidation, dry and wet oxidation, Lithography, Etching, Diffusion, Ion Implantation and Metallization.

Pre-requisite Course/Paper: Analog electronics –I & II, Digital circuits and Systems

Text Book:

1. Allen Strader, "VLSI Design technologies", McGraw Hill International Edition, 1990.
2. May and Sze, "Semiconductor fabrication", John Wiley, 2004.
3. Boris and Backer, "CMOS VLSI designing", John Wiley, 3rd edition, 2001

Reference Books:

1. Neil H. E. Waste, "CMOS VLSI Design", Pearson, 3rd edition, 2006.
2. R.J. Baker, H.W. Li and D.E. Boyce, "CMOS: Circuit Design, Layout and Simulation", IEEE Press, PHI, Pvt. Ltd. New Delhi – 2000
3. R.L. Geiger, P.A. Allen and N.R. Strader, "VLSI: Design Techniques for analog Digital Circuits", McGraw Hill International Edition, Electronic Engineering Series, 1990
4. S.M. Szee, "VLSI", McGraw Hill International Editions, 2000
5. Malcolm R. Haskard, "ASIC Designing", Printice Hall, New York, Edition, 1990
6. Donald L. Schilling and Charles Belove, "Electronic Circuits: Discrete and Integrated", McGraw Hill Book Company, New Delhi

Course Outcomes

CO1: Understanding of basics of MOSFET modelling.

CO2: Understanding of impact of device sizing on the performance of Nano-scaled NMOS and CMOS circuitry.

CO3: Understanding of how to keep Moore's law valid in future using bulk technology and SOI technology and the trade-off thereof.

CO4: Comprehensive knowledge of device fabrication, steps involved in integrated circuit fabrication, various challenges and the current solutions in IC fabrication

CO5: To implement combinational & sequential circuits using Hardware Descriptive Language (VHDL). To understand concept of Programmable Devices, PLA, PAL, CPLD and FPGA.

Computer usage/ VHDL & Logic synthesis

DIGITAL SIGNAL PROCESSING

Paper Code	**ECC-602**
Course Credits	3
Lectures/ Week	3
Tutorials/ Week	0

Course description

UNIT- I DISCRETE TIME SIGNALS AND SYSTEMS

Review of Discrete Time Fourier Transform, Z-transform, Properties of Z-transform, Discrete Time convolution, Difference equations, Direct Form I and II structures and stability analysis using Z-Transform.

UNIT- II DISCRETE FOURIER TRANSFORM

Introduction, The DFT: Fourier representation of periodic signals, properties of DFT: Linearity, Periodicity, Circular shift of a sequence, circular convolution and multiplication of two DFTs, Fast Fourier Transform (FFT) Algorithms: Decimation in Time and Decimation in Frequency domain.

UNIT- III INFINITE IMPULSE RESPONSE DIGITAL FILTER DESIGN

Introduction to III filters, Design of IIIR filters, Bilinear Transformation, Impulse Invariant Response method and Step-Invariant Response method. Digital filter transformation, Design examples.

UNIT-IV FINITE IMPULSE RESPONSE DIGITAL FILTER DESIGN

Introduction to FIRDF, Characteristics of FIR filters, Design of FIR filters: Fourier series and Window function method, Design examples

UNIT-V APPLICATIONS OF DSP

Introduction, Application to Image Processing: Image formation and recording, Image sampling and quantization, Image compression, Image restoration, Image enhancement. Application in RADAR. Application to Speech Processing: Model of Speech Production, Short time Fourier Transform and Synthesis of Speech, Speech Synthesis, Channel Vocoders, Subband coding of Speech and Audio signals: Transmitter, Receiver.

Pre-requisite Signals and Systems

Course/Paper:

Text Book:	1. J G Proakis and D G Manolakis, “Introduction to Digital Signal Processing”, PHI,1989.
.**Reference Books:**	1. Andreas Antonio, “*Digital Filter Analysis, Design and Application*”, McGraw Hill (International Edition), 1993
	2. A V Oppenheim and R W Shafer, “*Digital Signal Processing*”, PHI, 1985
	3. L R Rabiner and B Gold, “*Theory and Application of Signal Processing*”, PHI, 1985.
	4. Roman Kuc, “*Introduction to Digital Signal Processing*”, McGraw Hill Book Co, 1988.
Course Outcomes	**CO1:** An ability to represent discrete time signals and their analysis using Z-transform
	CO2: A thorough understanding of properties of DFT and algorithms of FFT
	CO3: An understanding of the basic concept of IIR filters
	CO4: An understanding of the basic concept of FIR filters and window functions
	CO5: A familiarity with various applications of DSP
Computer usage/ Software required:	MATLAB

MICROWAVE ENGINEERING

PaperCode: **ECC – 603**

Course Credits 3

Lectures/ Week 3

Tutorials/ Week 0

Course description UNIT I ELECTROMAGNETIC WAVES

Microwave frequencies, system and unit of measure, review of Maxwell's equations and formation of electric and magnetic waves, equation in rectangular and cylindrical co-ordinates plane, uniform plane and non-uniform waves, reflections, boundary conditions plane wave propagation in free space, lossless, lossy media, good conductors, poor conductors, linear and circular polarization of electromagnetic waves.

UNIT II MICROWAVE TRANSMISSION LINES

Transmission line equation and their solutions, characteristic impedance, propagation constant standing waves and reflections. Measurement of standing waves ration and their interpretations. Quarter and half wave-length lines, circuit properties of transmission lines. Single stub and double stub for matching. Smith chart and application.

UNIT III WAVE GUIDES, CAVITY RESONATORS AND COMPONENTS

Introduction to wave guides, solution of wave equations for rectangular and circular wave guides, TE and TM modes in rectangular guides and their field configuration, Methods of excitation of wave guides, wave guide joints and their basic accessories. Rectangular and cavity resonators, field configuration and resonant frequency. Wave guides tees, magnetic tees, hybrid rings, directional coupler, circulation and isolators.

UNIT IV MICROWAVE TUBE AND CIRCUITS

Working principle of Klystron, reflex Klystron, Magnetron, traveling wave tubes. (TWTO). Formulation of expressions for velocity modulations, transit time of electron, beam coupling co-efficient, bunching parameters of Klystron and reflex Klystron, application process in magnetron and traveling wave tube (TWT). Formulation of expression of cut-off voltage and fluxing cylindrical magnetron.

UNIT V SOLID STATE MICROWAVE DEVICES AND CIRCUITS

Stripline and micro strip circuits, microwave transistors and integrated circuits and their high frequency limitations. Circuit properties and principle of working of Varactor, Laser, Laser parametric amplifier, tunnel diodes, gun devices. IMPATT, TRAPATS, BARITT and PIN diodes and their practical applications.

Pre-requisite Course/Paper	ELECTROMAGNETIC FIELD AND THEORY
Text Books	Samuel Y. Lio, "Microwave Devices and circuits", PHI Ltd.,
Reference Books	1. Electronics Comm. System by George Kennedy, McGraw Hill International Publication,2006. 2. M.Kulkarni,"Microwave And Radar Engineering",Umesh Publications,2003. 3. K.D.Prasad, "Antenna and Wave Propagation", Satya Prakashan New Delhi,2008.
Course Outcomes:	**CO1:** To understand and analyze various principles involving propagation of microwaves in different media. **CO2.** To analyze how transmission lines can be utilized as circuit elements and to study different impedance matching techniques. **CO3:** Ability to identify and study the performance of wave guides and resonators and to study the performance of various microwave components. **CO4:** To study the comparative performance and analysis of microwave tubes and circuits. **CO5:** To understand the significance, types and characteristics of various microwave solid state devices and circuits.

DATA COMMUNICATION AND COMPUTER NETWORKING

Paper Code	**ECC-604**
Course Credits	3
Lectures/ Week	3
Tutorials/ Week	0

Course description

UNIT- I DATA COMMUNICATION AND NETWORKING

Data communication and networking; Communication model, Internet, OSI reference model, Concept and terminology: Analog and Digital data transmission, Transmission impairments, Channel capacity, Guided/Unguided transmission Media, Line Coding; Digital Modulation, Types of errors; Error Detection

UNIT- II DATA LINK CONTROL PROTOCOLS

Flow control, Stop and Wait Automatic Repeat Request (ARQ) Protocol, Go-Back-N ARQ Protocol, Selective Reject ARQ Protocol, Piggybacking, HDLC Protocol, HDLC frame format, Bit Stuffing

UNIT- III SWITCHING PRINCIPLES AND ROUTING PROTCOLS

Switched Communication networks, Circuit switching, Message switching and Packet switching principles, Datagram and virtual circuit switching, Routing in packet switched networks; Least cost Algorithms: Bellmann Ford Algorithm, Dijkstra Algorithm

UNIT-IV MEDIUM ACCESS CONTROL AND LOCAL AREA NETWORKS

Background; Topologies and Transmission Media; Random Access medium access control (MAC), LAN Protocol Architecture; Aloha and Slotted Aloha, Carrier Sensing Multiple Access/Collision Detection (CSMA/CD), Ethernet frame format, Bridges

UNIT-V INTERNET PROTOCOLS

TCP/IP protocol architecture, Internet protocols, IP addressing, IPv-4 and IPv-6, Address mapping, TCP and UDP, Electronic mail, SMTP, MIME and DNS

Pre-requisite Course/Paper: Basic knowledge of computer and internet

Text Book:	B.A. Forouzan , “Data Communication and Networking”, Tata McGraw Hill, India.
Reference Books:	1. William Stallings, Data and Computer Communications, Eighth Edition (2007), Pearson Education Low Price edition 2.D.E. Comer, “Computer Networks and Internets”, Pearson Education India.
Course Outcomes:	**CO1:** An understanding of the basic concept of data communication and computer networking. **CO2:** A thorough understanding of the flow and error control protocols used in data transmission. **CO3:** A understanding of the concept of switching and routing in switched network. **CO4:** A thorough understanding of MAC layer and protocols related to it. **CO5:** A familiarity with the concept of internet protocols and IP addressing.
Computer usage/ Software required:	Basic computer

EMBEDDED SYSTEM DESIGN

Paper Code ECE-701 Course Credits 3 Lectures/ Week 3 Tutorials/ Week 0

Course Description

UNIT- 1 Definition and characteristics of embedded systems, Von Neumann and Harvard architectures, CISC and RISC architectures, Microcontroller vs. General-purpose microprocessor, Design challenges in optimizing design metrics, and performance metrics in embedded system design, Applications of Embedded systems.

UNIT- II 8051 Architecture, Programming model of 8051, Pin diagram of 8051,Program counter and data pointer flags and Program status word (PSW), Internal memory, Internal RAM, Special function registers.

UNIT- III 8051 Assembly language Programming, Assembling and Running 8051 program, Machine code in program, 8051 Flag bits and PSW, 8051 registers banks and stack, jump, loops, Logic and call instructions, Design from various 8051 chips, Delay Calculations.

UNIT-IV I/O ports and programming, I/O bit manipulation program, 8051 programming in C, I/O programming in C, Addressing SFR, Logic operations in C

UNIT-V Connecting 8051 to 8255 motor control, Motor control: Stepper Motor interfacing, Controlling Stepper Motor via opt isolator

Pre-requisite of Course/Paper: Basic knowledge of digital logic required but not mandatory.

Text Book: Mohd. Ali Mazidi, JC Mazidi and Mc Kinlay, "The 8051 microcontroller and Embedded system- using Assembling and C", Pearson 2008.

Reference Books:

- Frank Vahid and Tony Givaris, "Embedded System", Willy India 2002.
- Rajkamal,"Embedded systems: architecture, programming and design", Tata McGraw-hill 2008.

Course outcomes:

CO1: Thorough understanding of Embedded System and its characteristics, differences between Microprocessor and Microcontroller and optimization of Design Metrics for an Embedded System.

CO2: Understanding of architecture, Internal memory, Special function registers, Programming model and pin structure of 8051 microcontroller.

CO3: Thorough understanding of loop, jump, call instructions, various Addressing Modes, arithmetic and logic instructions in 8051, Ability to program 8051 in Assembly Language.

CO4: Ability to program 8051 microcontroller using Embedded C.

CO5: Capability to program 8051 timers to generate time delays and counter operations, understanding of 8051 interfacing with LCD, stepper motor and 8255 chip.

Computer usage: Assembly & C programming.

Software required:

SDCC (Small Device C Compiler) – A free, open-source C compiler for 8051 and other microcontrollers.

Website: https://sdcc.sourceforge.net

MCU 8051 IDE – An open-source IDE that supports Assembly and C programming.
Website: https://sourceforge.net/projects/mcu8051ide

ECE-704 Information Theory & Coding Techniques

LTP 3-0-0 Credits: 3

Sources-memory less and Markov; Information; Entropy; Extended sources; Shanon's noiseless coding theorem; Source coding; Mutual information; Channel capacity; BSC and other channels; Shanon's channel capacity theorem; Continuous channels; Comparison of communication systems based on information Theory; Channel Coding; Block and convolutional codes; majority logic decoding; Viterbi decoding algorithm; Coding gains and performance

Reference book

Element of information theory

T.M. Cover. Joy A. Thomas

6 Reviews

John Wiley and Sons, 18-Jul0-2006

OPTICAL FIBER COMMUNICATION

Paper Code: **ECE-707**

Course Credits: 3

Lectures/ Week: 3

Tutorials/ Week: 0

Course description: **UNIT I: INTRODUCTION**

Introduction, Elements of Optical fiber link, Ray theory transmission; Total internal reflection, Acceptance angle, Numerical aperture, Skew rays, Mode theory of optical propagation; Electromagnetic waves, Maxwell equations, Modes in Planar guide, Fiber types; Single mode fibers, Multimode fibers, Step index fibers, Graded index fibers.

UNIT II: TRANSMISSION CHARACTERISTICS OF OPTICAL FIBERS

Attenuation; Absorption losses, intrinsic absorption, extrinsic absorption, Linear and Non linear Scattering losses, Rayleigh scattering, Mie Scattering, Dispersion; Intra and inter Modal Dispersion, Multipath dispersion, Chromatic dispersion, waveguide dispersion, Over all Fiber Dispersion.

UNIT III: SOURCES AND DETECTORS

Optical sources: Light Emitting Diodes (LED), Laser diode(LD); Absorption and Emission of radiation, Spontaneous emission and stimulated emission, Population inversion, Comparison of LED and LD, Optical Detectors; Photo diode, PIN photodiode, Avalanche photodiode(APD), Responsively, Quantum efficiency , Photo detector noise –Noise sources , Signal to Noise ratio , Detector response time, Optical modulators.

UNIT IV: FIBER LINK DESIGNAND OPTICAL MODULATORS

Fiber Link : System design considerations, Link Design, Link Loss Budget - Power Budget and Time Budget, Loss limits, Dispersion limits, Bandwidth distance product, Modulation of LED and LD, Mach- Zehnder Modulator(MZM), Electro-Absorption Modulator(EAM)

UNIT V: COHERENT LIGHT WAVE SYSTEMS AND OPTICAL NETWORKS
Basic concepts; Local oscillator, Homodyne and Heterodyne detection/demodulation, Signal to noise ratio, Modulation formats; ASK Format, PSK Format, FSK Format, Bit Error Rate, Networks – SONET / SDH, WDM Networks ; Conventional WDM, Course WDM, Dense WDM, EDFA system

Text Book:

1. Optical Fiber Communications Principles and Practice – John M. Senior, Pearson Education – Third Edition. 2009.

2. Optical Fiber Communications – Gerd Keiser – Mc Graw Hill – Fifth Edition. 2013

3. Fiber-optic communication systems - Govind P. Agrawal, Third edition, John Wiley & sons, 2002.

Course Outcomes:

CO1. An ability to understand the general system of optical fiber communication, ray & mode theory and fiber configuration.

CO2. An ability to explain the attenuation, scattering, & bending loss and dispersion of fiber.

CO3. An ability to describe optical sources like LEDs, Laser diodes and Optical detectors like photodiode, PIN photodiode, Avalanche photodiode (APD).

CO4. An ability to analyze and apply link design and understand Mach-Zehnder Modulator (MZM), Electro-Absorption Modulator (EAM) and EDFA system.

CO5. An ability to describe fundamental receiver operation, SONET/SDH and WDM concept.

Mobile Communication (ECE-710)

UNIT I INTRODUCTION TO WIRELESS MOBILE COMMUNICATION 9 HOURS

History and evolution of mobile radio systems, Types of mobile wireless services/systems – Cellular, WLL, Paging, Satellite systems, Standard, Future trends in personal wireless systems.

UNIT II CELLULAR CONCEPT AND SYSTEM DESIGN FUNDAMENTALS 9 HOURS

Cellular concept and frequency reuse, Multiple Access Schemes, Channel assignment and handoff, Interface and system capacity, Trunking and Erlang capacity calculations

UNIT III MOBILE RADIO PROPAGATION 9 HOURS

Radio wave propagation issues in personal wireless systems, Propagation models, Multipath fading and based and impulse models, Parameters of mobile multipath channels, Antenna systems in mobile radio.

UNIT IV MODULATION AND SIGNAL PROCESSING 9 HOURS

Analog and digital modulation techniques, Performance of various modulation techniques – Spectral efficiency, Error rate, Power Amplification, Equalization/Rake receiver concepts, Diversity and Space-time processing, Speech coding and channel coding.

UNIT V SYSTEM EXAMPLES AND DESIGN ISSUES 9 HOURS

Multiple Access Techniques – FDMA, TDMA and CDMA systems, Operational systems, Wireless networking, design issues in personal wireless systems.

References:

1. T.S. Rappaport, Wireless Communication; Principles and Practice, Prentice Hall, NJ, 1996.

2. W.C.Y. Lee, Mobile Communication Engineering; Theory and Application, Second Edition, McGraw-Hill International, 1998.

CO1. Identify various propagation effects

CO2. To have knowledge of the mobile system specifications.

CO3. Classify multiple access techniques in mobile communication.

CO4. Outline cellular mobile communication standards

CO5. Analyze various methodologies to improve the cellular capacity

RF Circuit Design (ECO-703)

Unit 1 Introduction: Importance of Radio frequency Design, RF Behavior of Passive Components, Chip, Components and Circuit Board Considerations, General Transmission Line Equation, Microstrip Transmission Lines

Unit 2 Single-and Multiport Networks: Interconnecting Networks, Network Properties and Applications, Scattering Parameters.

Unit 3 Active RF Components and Modeling: Semiconductor Basics, RF Diodes, Bipolar-Junction Transistor, RF Field Effect Transistors, High Electron Mobility Transistors, Diode Models, Transistor Models, Matching and Biasing Networks: Impedance Matching Using Discrete Components, Microstrip Line Matching Networks, Amplifier Classes of Operation and Biasing Networks.

Unit 4 RF Transistor Amplifier: Characteristics of Amplifiers, Amplifier Power Relations, Stability Considerations, Constant Gain, Noise Figure Circles, Constant VSWR Circles, Broadband, High Power, and Multistage Amplifiers.

Unit 5 Oscillators and Mixers: Basic Oscillator Model, High Frequency Oscillator Configuration, Basic Characteristics of Mixers.

References

1. Reinhold Ludwig, Pavel Bretchko, “RF Circuit Design” 1st Indian Reprint, Pearson Education Asia, 2001.

2. B Razavi, “Design of Analog CMOS Integrated Circuits” Mc Graw Hill, 2000.

3. Behzad Razavi, “RF Microelectronics”, Pearson Education, 2nd edition, 1997.

4. Reinhold Ludwig,Gene Bdgdanov,“RF Circuit Design: Theory & Applications ” 2nd edtion, 2008.

5. Peter b. Kenington, “High Linearity RF Amplifier Design”, Artech House Microwave Library,Kindle Edition, 2000.

6. Jeremy Everard, “Fundamentals of RF Circuit Design With Low Noise Oscillators”, John Wiley & Sons Ltd, 2001.

Device Modeling and Circuit Simulation (ECO-803)

Unit 1 Physics and Properties of Semiconductors: P-N Junction,

Unit 2 Bipolar transistor, State-of-the-Art, Bipolar Transistor Technology, E-M Model, Gummel Poon model

Unit 3 Metal-Semiconductor Contacts, Metal-Oxide-Silicon capacitance, MOS Field-Effect Transistor, State-of-the-Art MOS Technology.

Unit 4 UDSM Transistor Design Issues: Short channel and ultra shot channel effects; Effect tox, effect of high k and low k dielectrics on the gate leakage and Source- drain leakage; tunneling effects; different gate structures in UDSM-impact and reliability challenges in UDSM.

Unit 5 Compact models for MOSFET Level 1, 2 and 3, MOS model parameters

References

1. R.S. Muller and T.I. Kamins, "Device Electronics for Integrated Circuits" Wiley,

2. R. F. Pierret, Addison, "Semiconductor Device Fundamentals" Wesley, 1996.

3. S M Sze, "Physics of Semiconductor Devices", Wiley, 2nd edition.

4. S M sze,G S May, "Fundamentals of semiconductor fabrication" Wiley.

5. Y.P. Tsividis, "The MOS transistor", McGraw-Hill, International edition, 1988.

WIRELESS COMMUNICATION

Paper Code **ECO-804**

Course Credits 3

Lectures/ Week 3

Tutorials/ Week 0

Course description

UNIT- I WIRELESS PERSONAL AREA NETWORK (W PAN)

Introduction to Wireless Communication, radio frequency spectrum and unregulated bands, advantages and disadvantages of wireless communications; What is a WPAN, current standards – IEEE project 802; Infrared WPANs (IrDA) – overview, IrDA Overview, salient features and considerations; Bluetooth – introduction, Blue tooth SIG and IEEE 802.15.1 standards, Bluetooth protocol stack, Bluetooth radio module, Bluetooth power classes, Technology piconets and scatternets, Link management Protocol (LMP) Layer, Bluetooth security, Bluetooth issues.

UNIT- II WIRELESS LOCAL AREA NETWORKS (WLAN)

Introduction ; WLAN components – wireless NIC, Access points; WLAN Modes – Ad Hoc Mode, Infrastructure Mode; IEEE -802. standards; IEEE 802.11 Infrared WLAN; IEEE – 802.11b standards, Wi-Fi, Physical Layer, Medium Access Control Layer – put coordination function, association and re-association, power management, MAC frame-formats.

UNIT- III WIRELESS WIDE AREA NETWORKS (PART-I)

Introduction to mobile telephony, the conventional mobile telephone service – basis limitations; The concept of cellular telephony – how cellular telephony works; AMPS, digital cellular telephony; capacity augmentation techniques – frequency re-use, cell sectoring, cell splitting.

UNIT-IV WIRELESS WIDE AREA NETWORKS (PART-II)

Global System for Mobile – general GSM system structure, HLR, VIR, BSC, BTS, MSC; various generations of mobile networks (1a , 2G , 2.5G , 3G); Digital cellular wireless migration path; Satellite Communication – introduction and basics , satellite system configuration , payload and platform , satellite frequency bands , modulation techniques – ASK , PSK , FSK , QAM ; frequency reuse : various types of satellites – LEO , MEO (HED), GEO (geosynchronous and geostationary)

UNIT-V FIXED WIRELESS

Introduction – What is fixed wireless? last mile wireless connection, baseband and broadband transmission, backhaul connections; Baseband systems – Remote Wireless Bridge; Broadband transmission – Free Space optics (FCD) salient features, advantages and disadvantages ; Local Multipoint distribution Service (LMDS), main features, LMDS infrastructures, advantage and disadvantages; Multichannel Multipoint Distribution Service (MMDS), main features, advantages, disadvantages.

Pre-requisite

Course/Paper: Communication Systems

Text Book/ - Mark Ciampa, "Guide to Wireless Communications",

Reference books: Vikas Publishing House, Reprint 2003

- Theodore S. Rappaport, "Wireless Communications: Principles and Practices", Pearson Education, 2nd edition.

Course outcomes:

CO1: Ability to understand the fundamentals of wireless communication, Bluetooth and IrDA standards, their working and their comparison.

CO2: Ability to understand the IEEE 802.11 standards, their protocol description, power management and other issues, and the comparison of these standards.- Compare various wireless technologies

CO3: Ability to understand design of Wireless Wide Area Networks which includes the concept of cellular telephony, improving system capacity, handling interference, Radio Resource Management and handoff.

CO4: Ability to trace the evolution of various generations of mobile networks, including the evolution in technology (modulation type, etc) and transmission elements such as satellites.

CO5: Ability to understand the concept of fixed wireless in the backdrop of mobile networks, baseband and broadband technologies (FCD, LMDS, MMDS) and their comparison.

Honors Degree in Nanoelectronics and VLSI Design

VLSI Technology ECH-411

Unit 1 Environment for VLSI Technology: Clean room and safety requirements, Wafer cleaning process and wet chemical etching techniques. Impurity incorporation: Solid state diffusion modelling and technology, Ion implantation modelling, technology and damage annealing, Characterization of impurity profiles.

Unit 2 Oxidation: Kinetics of Silicon dioxide growth both for thick, thin and ultrathin films, Oxidation technology in VLSI, characterization of oxide films, high K and low k dielectrics for ULSI.

Unit 3 Lithography: Photolithography, E-beam lithography and newer lithography techniques for VLSI, Mask generation.

Unit 4 Chemical vapour deposition techniques: CVD techniques for deposition of polysilicon Silicon dioxide, Silicon nitride and metal films, epitaxial growth of Silicon, modelling and techniques. Metal film deposition: Evaporation, sputtering techniques, Failure mechanisms in metal interconnects, multi level and metallization schemes. Bonding, encapsulation, isolation techniques; junction, oxide, V groove, trench, SOI, SOS, Modern processing techniques.

Unit 5 Plasma and Rapid thermal processing: Plasma etching and RIE techniques, RIBE, LPCVD, PECVD, laser enhanced CVD, EB, IB and X-ray lithography, Pattern generation techniques, Bipolar IC processing, MOS/CMOS processing; Modern trends in IC processing, Process modelling of unit processes, Introduction to process simulators.

References

1. S K Gandhi, “VLSI Fabrication Principles: Silicon and Gallium Arsenide”, 2nd edition, Wiley, 1994.

2. G S May, S M Sze, “Fundamental of Semiconductor fabrication” Wiley, 2003.

3. Stephen A. Campbell “The Science and Engineering of Microelectronic Fabrication” 2nd Edtion, Oxford University Press, 2001.

4. Benjamin Eynon, Banqiu Wu, “Photomask Fabrication Technology” 1st edtion,Mcgraw-Hill, 2005.

CMOS Digital VLSI Design

Paper Code	**ECH-511/ECD-511**
Course Credits	**3**
Lectures /week	**3**
Tutorials/Week	**0**

Course Description

UNIT-I Introduction to MOS TRANSISTOR

The PN Junction, MOSFET device physics: Structure and operation of NMOS/PMOS transistors, MOSFET Current-Voltage Characteristics, Threshold voltage analysis, Channel Length Modulation, MOSFET Scaling & small geometry effects, subthreshold conduction, MOSFET capacitances.

UNIT-II CMOS INVERTER

Ideal Inverter, Various Inverter topologies, Voltage transfer curve (VTC) of the CMOS inverter, Noise margins, β-ratio sizing for balanced rise/fall times, Supply Voltage Scaling in CMOS Inverters, Power considerations in a CMOS Inverter, Delay time definitions, CMOS Ring Oscillator Circuit.

UNIT-III Advanced CMOS Logic Families

Ratioed and pseudo-CMOS logic, transmission-gate logic, Pass-transistor logic, Use of nMOS pass-transistors and CMOS transmission gates in multiplexers, Dynamic logic families

UNIT-IV Combinational MOS Logic Circuits

Introduction, MOS Logic Circuits with Depletion nMOS Loads, CMOS Logic Circuits, Complex Logic Circuits, AOI and OAI Gates, Pseudo-nMOS Gates

UNIT-V Sequential Circuits and CMOS Memory

Sequential logic circuits: Design of basic CMOS latches and flip-flops, CMOS memory fundamentals: Static RAM (6T SRAM cell) and dynamic RAM (1T–1C DRAM cell) design principles; basic read/write operation, setup and hold time for flip-flops

Pre-Requisite Semiconductor Physics

Text/Reference Book

1. D. A. Neamen, *Semiconductor Physics and Devices: Basic Principles*, 4th ed. New York, NY, USA: McGraw-Hill, 2012.
2. S. M. Kang and Y. Leblebici, *CMOS Digital Integrated Circuits: Analysis and Design*, 3rd ed. New York, NY, USA: McGraw-Hill, 2003.
3. N. H. E. Weste and D. Harris, *CMOS VLSI Design: A Circuits and Systems Perspective*, 4th ed. Boston, MA, USA: Addison-Wesley, 2011.
4. J. M. Rabaey, A. Chandrakasan, and B. Nikolić, *Digital Integrated Circuits: A Design Perspective*, 2nd ed. Upper Saddle River, NJ, USA: Prentice Hall, 2003.

Course Outcome:

CO1. Understand MOSFET device Physics, CMOS fundamentals, and Scaling Effects

CO2. Analyse CMOS inverters along with other topologies, static and dynamic characteristics

CO3. Analyze and design advanced CMOS logic circuits for efficient digital system implementation.

CO4. Design and analyze combinational MOS logic circuits for optimized digital logic implementation.

CO5. Design and evaluate sequential CMOS circuits and memory elements, with focus on timing constraints and read/write operations.

CMOS Analog VLSI Design (ECH-611)

Unit 1 Introduction: Analog MOS circuits, single stage amplifiers, differential amplifiers, passive and active current mirrors, frequency and transient responses, noise, feedback, operational amplifiers, stability and frequency compensation, analog switches, switched-capacitor circuits.

Unit 2 Active filter synthesis, cascade approach, first order networks, simulated inductance approach and FDNR approach to op-amp RC Filters, the biquad (single amplifier and multi-amplifier biquads) filters, negative feedback topology positive feedback topology, some design problems, introduction to active-R filters, Active-C-filters.

Unit 3 A/D Converters: Over Sampled A/D Converters, Nyquist rate A/D Converters-Modulators for Over sampled A/D Conversion

Unit 4 Operational Amplifier: Differential and Common mode circuits, Op Amp CMRR requirements, Need for single and multistage amplifiers, Effect of loading in differential stage. Performance Analysis: dc gain, frequency response, noise, mismatch, slew rate of cascade and two stage OP Amps, Fully Differential Op Amps-common-mode feedback, loop stability

Unit 5 Phase Locked Loops: Problem of lock acquisition, phase Detector. Basic PLL and its dynamics, Charge-pump PLL, Non-ideal effects in PLL: PFD/CL non idealities, Jitter, Delay Locked Loop, Amplifications.

Reference

1. Neil H. E. Weste & Kamran Eshraghian, “Principles of CMOS VLSI Design” 2nd edition, Pearson education Asia, 2000.
2. Wayne Wolf, “Modern VLSI Design” Pearson Education, 4th Indian Reprint 2005.
3. R.S. Muller and T.I. Kamins, “Device Electronics for Integrated Circuits” Wiley, 1986.
4. DA. and Eshrachian K, “Basic VLSI design-systems & circuits”, PHI, 1988.
5. B Razavi, “Design of Analog CMOS Integrated Circuits”, Mc Graw Hill, 2000

CMOS Mixed Signal VLSI Design (ECH-711)

Unit 1 Fundamentals of Mixed-Signal Design, Mixed-Signal Concepts: Introduction to mixed-signal integrated circuits and their importance. MOSFET Theory: Review of MOS transistor theory, switches, and CMOS logic. Design Methodology**:** Understanding the design process, using concepts like gm/Id, and exploring design flows for mixed-signal ICs. Performance Metrics: Concepts of noise, linearity, offset, and other performance measures in mixed-signal systems.

Unit 2 Introduction to data conversion systems, sampling, and sample-and-hold circuits. DAC Architectures: Design and analysis of different DAC (Digital-to-Analog Converter) architectures. ADC Architectures: Understanding the basics and performance measures of ADCs (Analog-to-Digital Converters). Non-Idealities: Analysis of non-ideal effects in ADCs and DACs and compensation techniques

Unit 3 Comparators**:** Design, performance, and characterization of comparators. Operational Amplifiers (Op-Amps): Analysis and design of op-amps, including preamplifier design and deriving op-amp specifications. Current Mirrors: Design of current mirrors and their role in mixed-signal circuits.

Unit 4 Switched-Capacitor Circuits: Design of switched-capacitor circuits and their applications in filtering and data conversion. Tunable Filters: Design of frequency and Q-tunable continuous-time filters. CMOS Layout: Layout considerations for mixed-signal ICs, including parasitic components and layout-dependent effects on performance.

Unit 5 Integrating analog and digital blocks, floor planning, and design verification tools. Signal Integrity: Strategies for designing mixed-signal systems, such as separating analog and digital components, proper routing, and filtering to prevent interference.

References

CMOS Mixed-Signal Circuit Design by R. Jacob Baker.
Analog Integrated Circuit Design by David A. Johns and Ken Martin.
Design of Analog CMOS Integrated Circuits by Behzad Razavi

Semiconductor Device Modeling (ECH-811)

Unit 1 Basic semiconductor physics, E-B diagram, fermi dirac function, effective mass. generation and recombination, drift and diffusion,

Unit 2 PN junction, R-B junction, Zener breakdown, avalanche breakdown, schottky junction, heterojunction

Unit 3 Bipolar junction transistor, E-M model, Gummel poon model, HBT

Unit 4 Field Effect Transistors (MOSFET, HEMT), Special purpose MOS devices including memories and imagers. Other semiconductor devices.

Unit 5 BSIM level 1, level 2 and Level 3 SPICE model

References

1. R.S. Muller and T.I. Kamins, “Device Electronics for Integrated Circuits” Wiley,

2. R. F. Pierret, Addison, “Semiconductor Device Fundamentals” Wesley, 1996.

3. S M Sze, “Physics of Semiconductor Devices”, Wiley, 2nd edition.

4. S M sze,G S May, “Fundamentals of semiconductor fabrication” Wiley.

5. Y.P. Tsividis, “The MOS transistor”, McGraw-Hill, International edition, 1988.