DEPARTMENT OF

ELECTRONICS AND COMMUNICATION ENGINEERING

B.E. V to VIII SEMESTER

CURRICULUM FOR THE ACADEMIC YEAR

2021-22 to 2024-25

H. K. E. SOCIETY'S

POOJYA DODDAPPA APPA COLLEGE OF ENGINEERING,

KALABURAGI-585102

(An Autonomous Institution, Affiliated to VTU, Belagavi)

About the Institution

The Hyderabad Karnataka Education (HKE) society founded by Late Shri Mahadevappa Rampure, a great visionary and educationist. The HKE Society runs 46 educational institutions. Poojya Doddappa Appa College of Engineering, Gulbarga is the first institution established by the society in 1958.The college is celebrating its golden jubilee year, setting new standards in the field of education and achieving greater heights.

About the department

Department of Electronics & Communication Engineering was established in 1967 & is the pride of Karnataka. With an initial intake of 30 students the department has grown steadily and the present intake is 120 students for the UG programme. The graduates from this Department are playing a vital role in the IT revolution and are instrumental in placing Karnataka on the Global IT Landscape. These professionals have found placement in major industries and multinational corporations. Many of them are successful entrepreneurs.

The department also offers Post Graduate programs in 'Communication Systems' with an intake of 18. Active engagement of faculty in research has led to recognition of department as a Research center by the VTU.

The faculty strength of the department is 28, including 4 Professors, 4 Associate Professors, 20 Assistant Professors. The faculty always strives for imparting better knowledge to the students and works as a team in all departmental activities.

Students graduated from the department are well placed in India and abroad. Quite a few of them have pursued higher studies both in India and abroad. Some of them have qualified for Indian Engineering and Defence Services. Students of the department have bagged university ranks including the First rank on several occasions.

The department has state-of-the-art laboratories in the areas of Communication, DSP, Microwave, Microcontroller, Embedded system, VLSI design etc.

Vision of the Institute

To be an institute of excellence in technical education and research to serve the needs of industry and society at local and global levels.

Mission of the Institute

- To provide a high-quality educational experience for students with values and ethics that enables them to become leaders in their chosen profession.
- To explore, create and develop innovations in engineering and science through research and developmental activities.
- To provide beneficial service to national and multinational industries and communities through educational, technical and professional activities.

Department of Electronics and Communication Engineering

Vision of the Department

To be a premier department in Electronics and Communication Engineering field by providing quality education through teaching, learning, research and innovations to serve the industry and society.

Mission of the Department

M1: Develop an environment for better teaching and learning in collaboration with industry, premier institutes and alumni.

M2: Produce competent engineers to meet the requirements of the industry and the society.

M3: Encourage students to pursue higher education, research work and to take up administrative responsibilities through leadership.

Program Educational Objectives

1. The graduates possess emergent technical skills to perform design and developmental activities in various areas of Electronics and Communication Engineering like Signal Processing, VLSI, Embedded Systems, Communication Systems and other engineering specializations.
2. The graduates indulge into entrepreneurial, higher learning/research activities to be in pace with the continuous developing environment.
3. The graduates exhibit effective communication skills, leadership and team work qualities in industry, research and development organizations maintaining ethical standards.

Program Outcomes

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

2. Problem analysis: Identify, formulate, review research literature, and Analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. Communication: Communicate effectively on complex engineering activities with the Engineering community and with society at large, such as, being able to comprehend and effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. Project management and finance: Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PSO-Program Specific Outcomes

1. Apply the concepts of Electronics & Communication Engineering in various areas like Signal processing, VLSI, Embedded systems, Communication Systems, Digital & Analog Devices and other engineering specializations.

2. Solve complex Electronics and Communication Engineering problems with modern hardware and software tools, along with analytical skills to arrive at cost effective and appropriate solutions.

3. Possess social and environmental awareness along with ethical responsibility to adapt with the emerging technologies in Electronics and Communication Engineering for sustainable real-world applications to have a successful career.

H. K. E. SOCIETY'S

POOJYA DODDAPPA APPA COLLEGE OF ENGINEERING, KALABURAGI

Choice Based Credit System (CBCS)

Scheme of Teaching and Examination 2021-22 to 2024-25

Department of Electronics and Communication Engineering

(Effective from the academic year 2021-22)

V Semester

Sl. No.	Course	Course Code	Course Title	Teaching Department	Teaching Hours/Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Self-Study	Duration in hours	SEE Marks	CIE Marks	Total Marks	
1	PC	21EC51	Linear Control Systems	ECE	3	0	0	-	03	50	50	100	3
2	IPCC	21EC52	Digital Signal Processing	ECE	3	0	2	-	03	50	50	100	4
3	PC	21EC53	Field Theory & Antennas	ECE	3	0	0	-	03	50	50	100	3
4	PC	21EC54	Analog and Digital Communication	ECE	3	0	0	-	03	50	50	100	3
5	PCL	21ECL55	Analog and Digital Communication Lab	ECE	0	0	2	-	03	50	50	100	1
6	AEC	21RMI56	Research Methodology and IPR	ECE	1	2	0	-	03	50	50	100	2
7	HSMS	21CIV57	Environmental Studies	CV/ME	0	2	0	-	03	50	50	100	1
8	AEC	21ECAE582	Introduction to Web Programming	ECE	0	2	0	-	02	50	50	100	1
Total										**450**	**450**	**800**	**18**

Ability Enhancement Courses

SL. No.	Course Code	Course Title	SL. No.	Course Code	Course Title
1	21ECAE581	Communication SIMULINK Tool	2	21ECAE582	Introduction to Web Programming
3	21ECAE583		4	21ECAE584	

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POOJYA DODDAPPA APPA COLLEGE OF ENGINEERING, KALABURAGI

Choice Based Credit System (CBCS)

Scheme of Teaching and Examination 2021-22 to 2024-25

Department of Electronics and Communication Engineering

(Effective from the academic year 2021-22)

VI Semester

Sl. No.	Course	Course Code	Course Title	Teaching Department	Teaching Hours/Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Self-Study	Duration in hours	SEE Marks	CIE Marks	Total Marks	
1	HSMC	21HU61	Entrepreneurship Management and Finance	HSM	3	0	0	-	03	50	50	100	3
2	IPCC	21EC62	Microwave and Radar	ECE	3	0	2	-	03	50	50	100	4
3	PC	21EC63	VLSI Design	ECE	3	0	0	-	03	50	50	100	3
4	PEC	21EC64X	Professional Elective-I	ECE	3	0	0	-	03	50	50	100	3
5	OEC	21EC65OEX	Professional Open Elective - I	ECE	3	0	0	-	03	50	50	100	3
6	PCCL	21ECL66	VLSI Design Lab	ECE	0	0	2	-	03	50	50	100	1
7	MP	21ECMP67	Mini-Project	ECE	0	0	2	-	-	-	50	50	2
8	INT	21INT68	Innovation/ Entrepreneurship /Societal Internship (to be carried out during vacation of IV and V semesters)	ECE	-	-	-	-	-	-	50	50	3
Total										**300**	**400**	**700**	**22**

Professional Elective-I:

1. Information Theory & Coding
2. Adaptive Signal Processing
3. Speech Signal Processing

Professional Open Elective-I:

1. Computer Architecture & Organisation
2. Automotive Electronics
3. Robotics-I

LINEAR CONTROL SYSTEMS			
Course Code	21EC51	Credits	3
Course Type	Theory	CIE Marks	50
Lecture Hours(L:T:P)	3:0:0	SEE Marks	50
Total Hours	42	SEE Hours	3

Course objectives: This course will enable students to:

- To teach the fundamental concepts of Control systems and mathematical modeling of thesystem
- To study the concept of time response and frequency response of the system
- To teach the basics of stability analysis of the system

Module-1	**Teaching Hours**
Basic concepts: Open-loop and Closed-loop control systems. Mathematical Models of Physical Systems: Differential equations of physical systems, transfer functions, Block diagram algebra, Signal flow graphs.	9
Module-2	
Time Response Analysis: Standard test signals, Time response of first and second order systems, Effect of adding a zero to a system, Time response specifications, Steady state errors and error constants. Performance indices.	8
Module-3	
Concept of stability and algebraic criteria: The concept of stability, Necessary conditions for stability, Routh & Hurwitz stability criterions, Relative stability analysis. The Root Locus Technique: The Root Locus concept, Construction of Root Loci.	9
Module-4	
Frequency response analysis: Correlation between time and frequency response, Bode plots – General procedure for constructing Bode plots. Polar plots, Stability in frequency domain –Nyquist stability criteria, Assessment of relative stability using Nyquist criteria.	8
Module-5	
State Variable Analysis and Design: Concept of state, state variables and state models, State model for Linear continuous time systems, State variables and linear discrete-time systems, Diagonalization, Solution of state equations, Controllability and Observability.	8

Question paper pattern:

- The question paper shall have five Module for 100 marks;
- Each full question carries 20 marks.
- Two questions to be set in each module (total ten questions).
- The candidate will have to answer one full question from each module.

Note: There can be a maximum of 4 subsections in each Question.

Text Books:

1. I J Nagrath and M Gopal, Control systems and Engineering, New Age Publishers 6th Edition-2017.
2 . K Ogata, Modern Control Engineering, PHI 3rd Edition-2001

Reference Books:

1. Kuo B C, Control Engineering

E books and online course materials: NPTEL

Course outcomes:
On completion of the course, the student will have the ability to:

Course Code	CO #	Course Outcome (CO)
21EC51	CO1	Analyze physical systems using differential equations, block diagrams and signal flow graphs.
	CO2	Analyze time response of first and second ordersystems.
	CO3	Construct the root locus and analyze the stability of the system in time domain.
	CO4	Construct Bode plot, Polar plot and analyze the stability in the frequency domain.
	CO5	Obtain state models for linear systems and determine for observability and controllability.

21EC51: Linear Control Systems

CO#	Course Outcome (CO)	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Analyze physical systems using differential equations, block diagrams and signal flow graphs.	3	3	2					1		1		1	3	2	2
CO2	Analyze time response of first and second ordersystems.	3	3	2					1		1		1	3	2	2
CO3	Construct the root locus and analyze the stability of thesystem in time domain.	3	3	2		2			1		1		1	3	2	2
CO4	Construct Bode plot, Polar plot and analyze the stability in the frequency domain.	3	3	2		2			1		1		1	3	2	2
CO5	Obtain state models for linear systems and determine for observability and controllability.	3	3	2					1		1		1	3	2	3
Average		3	3	2		2			1		1		1	3	2	2.2

DIGITAL SIGNAL PROCESSING			
Course Code	21EC52	Credits	4
Course Type	Integrated	CIE Marks	50
Lecture Hours(L:T:P)	3:0:2	SEE Marks	50
Total Hours	42 (Theory)+14 Lab Slots	SEE Hours	3

Course objectives: This course will enable students to study:

- Basic concepts of digital signal processing.
- Analysis and processing of signals for different kind of applications and retrieval of information from signals.
- Design of digital filters and its realization.
- Analysis of signals using the discrete Fourier transforms (DFT) and Z-Transform.

Module	Teaching Hours
Module -1	
Discrete Fourier Transform: Representation of periodic sequences – The Discrete Fourier Series, Properties of DFS, Sampling the Z-transform, Fourier Representation of finite duration sequences – The Discrete Fourier Transform, Properties of DFT, Examples on DFT properties.	9
Module -2	
DFT Continued: Linear filtering using DFT, Filtering of long data sequences, and Frequency analysis of signals using DFT. **Computation of the Discrete Fourier Transform:** Goertzel algorithm, Decimation in Time algorithms, Decimation in Frequency algorithms, FFT algorithms for N a composite number. Chirp Z-Transform algorithm.	8
Module -3	
IIR Filters: Design of IIR digital filters from Analog filters – Impulse Invariance, Design based on numerical solution of the differential equation, Bilinear transformation, Characteristics of commonly used Analog filters, Design examples – Analog to digital Transformation. Frequency transformations. Comparison of Digital IIR and FIR filters	9
Module -4	
FIR Filters: Properties of FIR digital filters, Design of Linear phase FIR filters using windows and frequency sampling method, Design of FIR differentiators, Design of Hilbert Transforms.	8
Module -5	
Digital Filter Structures: Basic Network structures for IIR filters – Direct forms, Cascade form, Parallel form, transposed form, Lattice structures, Basic network structures for FIR Systems – Direct forms Cascade form, Networks for Linear phase FIR systems, Frequency sampling structure, Lattice structure.	8

Question paper pattern:

- The question paper shall have five Module for 100 marks;
- Each full question carries 20 marks.
- Two questions to be set in each module (total ten questions).
- The candidate will have to answer one full question from each module.

Note: There can be a maximum of 4 subsections in each Question.

Text book:

1. A.V.Oppenheim and R.W.Schafer, Digital Signal Processing, PHI.

Reference Books:

1. J.G.Proakis and D.G.Manolakis, Digital Signal Processing- Principals, Algorithms and Applications, PHI.
2. Rabiner and Gold, Theory and Applications of Digital Signal Processing, PHI
3. SanjitK.Mitra, Digital Signal- A computer- Based Approach, TMH.

List of Experiments

1. Introduction to MATLAB
2. Verification of sampling theorem
3. Generation of signals (Sinusoidal signals, Exponential signals etc.)
4. Operations on signals (Time shifting, time scaling and amplitude scaling)
5. Solution of difference equations.
6. Linear convolution, circular convolution.
7. Fourier representation of Discrete-time signals (DTFT, DFS), Properties of DTFT and DFS.
8. Discrete Fourier Transform(DFT), Properties of DFT
9. Linear filtering using DFT
10. DFT and IDFT using radix-2 FFT algorithm.
1. Design and implement digital IIR filters
12. Design and implement digital FIR filters

Course outcomes:
On completion of the course, the student will have the ability to:

Course Code	CO #	Course Outcome (CO)
21EC52	CO1	Compute the Discrete Fourier Transform (DFT) of a sequence.
	CO2	Analyze the efficient computation of DFT using Fast Fourier Transform.
	CO3	Design FIR filters using Windows and frequency sampling Techniques.
	CO4	Design digital IIR filters from Analog filters.
	CO5	Realize digital filters using Network structures.

21EC52: Digital Signal Processing

CO#	Course Outcome (CO)	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1																
CO2																
CO3																
CO4																
CO5																

FIELD THEORY AND ANTENNAS			
Course Code	21EC53	Credits	3
Course Type	Theory	CIE Marks	50
Lecture Hours(L:T:P)	3:0:0	SEE Marks	50
Total Hours	42	SEE Hours	3

Course Objectives: The objectives of the course is to enable students:

- To understand the theory of vector analysis
- To understand the concepts of electrostatics, electrical potential, energy density and their applications.
- To analyze the concepts of magneto statics, magnetic flux density, scalar and vector potential and its applications
- To explore Biot Savart's Law, Ampere's Law, Faraday's Laws, and Maxwell'sequations

Module	Teaching Hours
Module-1	
Electric field intensity: Electric field due to continuous volume charge, line charge, sheet charge. Electric flux density, Gauss law and Divergence: electric flux density, Gauss law and its applications, divergence theorem. **Energy and potential:** Energy and potential in a moving point charge in an electric field, line integral, potential difference and potential, potential field of a point charge, The potential field of a system of charges- conservative property, potential gradient, the dipole, Laplace and Poisson's equations.	9
Module-2	
Magnetic Fields: Steady Magnetic fields: Biot savart's law, Ampere's circuital law, Curl. Stokes theorem, magnetic flux and flux density, magnetic force between differential current elements , magnetic boundary conditions **Time varying fields and Maxwell's equations**: Faraday's law, displacement current, Maxwell's equations in point form and integral form, the retarded potentials.	8
Module-3	
Introduction to Antenna: Principle of radiation, isotropic radiator, radiation resistance, radiation pattern, beam width, bandwidth, directivity, gain, effective length of an antenna, relationship between gain and radiating efficiency, power gain, Frii's transmission formula.	8
Module-4	
Antenna arrays: Point sources, two element arrays of equal amplitude and same phase, equal amplitude and opposite phase and unequal amplitude and any phase, broad side and end fire arrays, multiplication of patterns, Binomial arrays, Effectof earth on vertical pattern	8
Module-5	
Antenna Measurement: Methods of measuring impedance, field pattern, gain and directivity. **Antenna Types**: Yagi-Uda antenna, folded dipole antenna, parabolic reflectors, loop antenna, Helical antenna, horn antenna, patch antenna,slot antenna	9

Question paper pattern:

- The question paper shall have five Module for 100 marks;
- Each full question carries 20 marks.
- Two questions to be set in each module (total ten questions).
- The candidate will have to answer one full question from each module.

Note: There can be a maximum of 4 subsections in each Question.

Text Books:

1. William H Hayt Jr and John A Buck., Engineering electromagnetic, TMH 7th ed.
2. K D Prasad, Antenna and Wave propagation, Satyaprakashan Publishers,2012

Reference Books:

1. John D Kraus, Antennas, Third Edition, McGrawHill
2. Jordan and Balmain, Electromagnetic waves and radiating systems, Second Edition, PHI
3. C A Balanis, Antenna theory analysis and design, Third Edition, Wiley
4. E C Jordon & K G . Balmain., electromagnetic waves and radiation system., PHI2nd ed
5. Kraus J D and Carver K R., electromagnetic., (TMH)
6. P V Gupta., An Introduction Course in electromagnetic.
7. P. N. O Sadiku, "Elements of electromagnetic" 4th ed. Oxford University press.

E books and online course materials:

Course outcomes:
On completion of the course, the student will have the ability to:

Course Code	CO #	Course Outcome (CO)
21EC53	CO1	Analyze the Electric fields due to different sources of electric fields
	CO2	Analyze Steady and time varying magnetic fields
	CO3	Determine the characteristic parameters of antennas
	CO4	Analyze antenna arrays.
	CO5	Illustrate the construction and working of different types of antennas.

21EC53: Field Theory and Antennas

CO#	Course Outcome (CO)	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Analyze the Electric fields due to different sources of electric fields	3	3	2					1		1		1	3	2	2
CO2	Analyze Steady and time varying magnetic fields	3	3	2					1		1		1	3	2	2
CO3	Determine the characteristic parameters of antennas	3	2						1		1		1	3	2	2
CO4	Analyze antenna arrays.	3	3	2	2				1		1		1	3	2	2
CO5	Illustrate the construction and working of different types of antennas.	3	2	2	2				1		1			3	2	3
	AVERAGE	3	2.6	2	2				1		1		1	3	2	2.2

ANALOG AND DIGITAL COMMUNICATION			
Course Code	21EC54	Credits	3
Course Type	Theory	CIE Marks	50
Lecture Hours(L:T:P)	3:0:0	SEE Marks	50
Total Hours	42	SEE Hours	3

Course Objectives: The objectives of the course is to enable students:

1. To introduce the concepts of analogue communication systems.
2. To equip students with various issues related to analogue communication such as modulation, demodulation.
3. To understand different PCM techniques and its analysis in terms of SNR.
4. To understand different carrier modulation techniques and its BER performance.
5. To study and understand properties of orthogonal codes and its use in spread spectrum communication

Modules	Teaching Hours
Module-1	
Amplitude Modulation: Amplitude modulation, double sideband, double sideband suppressed carrier modulation, SSB modulation, vestigial sideband modulation, costas receiver, quardrature-amplitude modulation.	**8**
Module-2	
Angle Modulation: Basic definitions, properties of angle-modulated waves, relationship between PM and FM waves, narrow-band frequency modulation, wide-band Frequency Modulation, transmission bandwidth of FM waves, generation of FM waves, demodulation of FM signals **Radio Receivers**: Tuned radio frequency receiver, super heterodyne receiver- RF section, frequency mixers, tracking, intermediate frequency, AGC.	**9**
Module-3	
Pulse Modulation systems: Pulse amplitude modulation (PAM), Pulse width modulation (PWM) and Pulse position modulation (PPM). Bandwidth requirements, generation and reconstruction methods, Analog to digital conversion, quantization and encoding techniques, quantization noise in PCM, Companding in PCM systems, Time division multiplexing (TDM), The delta modulator and its operation, quantization noise and slope overload in delta modulators. Comparison of delta modulation and PCM.	**9**
Module-4	
Digital Modulation: PSK, DPSK and FSK. M-array data communication systems, QAM systems, four phase PSK effects of noise in modulated digital communication Systems, Probability of error expression for binary communications, probability of error in QAM systems, comparison of digital modulation systems.	**8**
Module-5	
Spread Spectrum Systems: PN sequence, PN sequence generation, Properties of PN sequence, Direct sequence Spread spectrum, Slow and fast Frequency hopping, Time hopping, Signal space dimensionality and processing gain, antijam characteristics, CDMA Applications, comparison of spread spectrum communication.	**8**

Question paper pattern:

- The question paper shall have five Module for 100 marks;
- Each full question carries 20 marks.

- Two questions to be set in each module (total ten questions).
- The candidate will have to answer one full question from each module.

Note: There can be a maximum of 4 subsections in each Question.

Text Books:

1. Simon Haykin, 'Introduction to Analog and Digital Communications', Second Edition.
2. Herbert Taub, Donald L.Schiling, 'Principles of Communication Systems', Second Edition.

Reference Books:

1. Simon Haykin, Digital Communications, John Wiley and Sons.
2. H.P.Hsu , Analog and Digital Communications, Schuam's outline series.
3. J G Proakis, Digital communications, MH.
4. B P Lathi, Modern Digital and Analog Communication, 3rd Edition.

E books and online course materials: NPTEL

Course outcomes:
On completion of the course, the student will have the ability to:

Course Code	CO #	Course Outcome (CO)
21EC54	**CO1**	Analyze different amplitude modulation and demodulation techniques.
	CO2	Analyze different angle modulation and demodulation techniques.
	CO3	Analyze different PCM techniques and its analysis in terms of SNR
	CO4	Analyze different carrier modulation techniques and its BER performance
	CO5	Analyze properties of orthogonal codes and its use in spread spectrum communication.

21EC54: Analog and Digital Communication

CO#	Course Outcome (CO)	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Analyze different amplitude modulation and demodulation techniques.	3	2	2	2				1		1		1	3	2	2
CO2	Analyze different angle modulation and demodulation techniques.	3	3	2	2				1		1		1	3	2	2
CO3	Analyze different PCM techniques and its analysis in terms of SNR	3	3	2	2				1		1		1	3	2	2
CO4	Analyze different carrier modulation techniques and its BER performance	3	3	2	2				1		1		1	3	2	2
CO5	Analyze properties of orthogonal codes and its use in spread spectrum communication.	3	2	2	2				1		1		1	3	2	2
Average		3	2.6	2	2				1		1		1	3	2	2

ANALOG & DIGITAL COMMUNICATION LAB			
Course Code	21ECL55	Credits	1
Course Type	Practical	CIE Marks	50
Lecture Hours(L:T:P)	0:0:2	SEE Marks	50
Total Hours	28	SEE Hours	3

Course Objectives: The objectives of the course is to enable students:

- To design and demonstrate second order active low pass, high pass, band pass filters
- To design and demonstrate analog and angle modulation.
- To design and demonstrate pulse modulation and demodulation.
- To design and demonstrate digital modulation and demodulation such ASK, PSK, DPSK and FSK.
- To verify and demonstrate PN sequence generation.

List of Experiments

1. Second order active low pass and high pass filter
2. Second order active band pass and band elimination filter
3. Amplitude modulation and demodulation using envelop detector
4. Frequency modulation and demodulation using PLL
5. Pre-emphasis and De-emphasis circuits.
6. PAM modulation and demodulation
7. PPM Modulation and demodulation
8. PWM Modulation and demodulation
9. Signal sampling and its reconstruction
10. Time division multiplexing of signals
11. Amplitude shift keying
12. Frequency shift keying
13. Phase shift keying
14. Differential phase shift keying
15. PN sequence generator

Conduct of Practical Examination:

- All laboratory experiments are to be included for practical examination
- Students are allowed to pick one experiment from the lot.
- Strictly follow the instructions as printed on the cover page of answer Script for breakup of marks.
- Change of experiment is allowed only once and will be evaluated for 85% of the total Marks.

Course outcomes:
On completion of the course, the student will have the ability to:

Course Code	CO #	Course Outcome (CO)
21ECL55	CO1	Design various second order active filters.
	CO2	Design AM, FM and its demodulation.
	CO3	Design pre-emphasis and de-emphasis.
	CO4	Design and implement ASK, FSK and PSK modulation and demodulation.
	CO5	Design and implement PN sequence generator.

21ECL55: Analog and Digital Communication Lab

CO#	Course Outcome (CO)	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Design various second order active filters.	3	2	2	2	2	1	1	2	3	2		1	3	3	2
CO2	Design AM, FM and its demodulation.	3	2	2	2	2	1	1	2	3	2		1	3	3	2
CO3	Design pre-emphasis and de-emphasis.	3	2	2	2	2	1	1	2	3	2		1	3	3	2
CO4	Design and implement ASK, FSK and PSK modulation and demodulation.	3	2	2	2	2	1	1	2	3	2		1	3	3	2
CO5	Design and implement PN sequence generator.	3	2	2	2	2	1	1	2	3	2		1	3	3	2
Average		3	2	2	2	2	1	1	2	3	2		1	3	3	2

RESEARCH METHODOLOGY & INTELLECTUAL PROPERTY RIGHTS			
Course Code	21RMI56	Credits	2
Course Type	Theory	CIE Marks	50
Lecture Hours(L:T:P)	1:2:0	SEE Marks	50
Total Hours	28	SEE Hours	3

Course Objectives: The objectives of the course is to enable students:

- To Understand the knowledge on basics of research and its types.
- To Learn the concept of defining research problem and Literature Review, Technical Reading.
- To learn the concept of attributions and citation and research design.
- Concepts, classification, need for protection, International regime of IPRs - WIPO, TRIPS, Patent - Meaning, Types, surrender, revocation, restoration, Infringement, Procedure for obtaining Patent and Patent Agents.
- Meaning, essential requirements, procedure for registration and Infringement of Industrial Designs, Copyright.

Modules	Teaching Hours
Module-1	
Introduction: Meaning of Research, Objectives of Engineering Research, and Motivation in Engineering Research, Types of Engineering Research, Finding and Solving a Worthwhile Problem. Ethics in Engineering Research, Ethics in Engineering Research Practice, Types of Research Misconduct, Ethical Issues Related to Authorship	**6**
Module-2	
Defining the research problem - Selecting the problem. Necessity of defining the problem Techniques involved in defining the problem- Importance of literature review in defining a problem Literature Review and Technical Reading, New and Existing Knowledge, Analysis and Synthesis of Prior Art Bibliographic Databases, Web of Science, Google and Google Scholar, Effective Search: The Way Forward Introduction to Technical Reading Conceptualizing Research, Critical and Creative Reading, Taking Notes While Reading, Reading Mathematics and Algorithms, Reading a Datasheet.	**6**
Module-3	
Research design and methods - Research design - Basic principles. Need of research design Features of good design- Important concepts relating to research design - Observation and Facts Attributions and Citations: Giving Credit Wherever Due, Citations: Functions and Attributes, Impact of Title and Keywords on Citations, Knowledge Flow through Citation, Citing Datasets, Styles for Citations, Acknowledgments and Attributions, What Should Be Acknowledged, Acknowledgments in, Books Dissertations, Dedication or Acknowledgments.	**6**
Module-4	
Basic Concepts of Intellectual Property (IP), Classification of IP, Need for Protection of IP, International regime of IPRs - WIPO , TRIPS. Patents: Meaning of a Patent – Characteristics/ Features. Patentable and Non-Patentable Invention. Procedure for obtaining Patent. Surrender of Patent, revocation &restoration of Patents, Infringement of Patents and related remedies (penalties) . Different prescribed forms used in Patent Act. Patent agentsqualifications and disqualifications Case studies on patents - Case study of Neem petent, Curcuma(Turmeric)patent and Basmati rice patent, Apple inc.v Samsung electronics co.Ltd	**5**

Module-5	
Industrial Design: Introduction to Industrial Designs. Essential requirements of Registration. Designs which are not registrable, who is entitled to seek Registration, Procedure for Registration of Designs Copy Right Meaning of Copy Right. Characteristics of Copyright. Who is Author, various rights of owner of Copyright. Procedure for registration. Term of copyright, Infringement of Copyright and Its remedies. Software Copyright.	**5**

Question paper pattern:

- The question paper shall have five Module for 100 marks;
- Each full question carries 20 marks.
- Two questions to be set in each module (total ten questions).
- The candidate will have to answer one full question from each module.

Note: There can be a maximum of 4 subsections in each Question.

Text Books:

1. Research Methodology: Methods and Techniques C.R.Kothari, Gaurav Garg New Age International 4th Edition,2018
2. Dipankar Deb•RajeebDey,ValentinaE.Balas "EngineeringResearchMethodology",ISSN1868- 4394 ISSN 1868-4408 (electronic), Intelligent Systems Reference Library, ISBN 978-981-13- 2946-3 ISBN 978-981-13-2947-0 (eBook), https://doi.org/10.1007/978-981-13-2947-0.3
3. Dr. M.K. Bhandari"Law relating to Intellectual property" January 2017 (Publisher By Central Law Publications). Dr. R Radha Krishna and Dr. S Balasubramanain "Text book of Intellectual Property Right". First edition, New Delhi 2008. Excel books.
4. P Narayan "Text book of Intellectual Property Right". 2017 ,Publisher: Eastern Law House

Reference Books:

1. David V.Thiel"ResearchMethodsforEngineers"CambridgeUniversityPress,978-1-107-03488- 4-
2. Nishith Desai Associates - Intellectual property law in India – Legal, Regulatory & Tax

E books and online course materials:

- NPTEL: INTELLECTUAL PROPERTY by PROF.FEROZ ALI , Department of Humanities and Social Sciences IIT Madras https://nptel.ac.in/content/syllabus_pdf/109106137.pdf
- www.wipo.int
- www.ipindia.nic.in

Course outcomes:

On completion of the course, the student will have the ability to:

Course Code	CO #	Course Outcome (CO)
21RMI56	**CO1**	To know them leaning of engineering research.
	CO2	To know the defining of research problem and procedure of Literature Review.
	CO3	To know the Attributions and Citations and research design.
	CO4	Highlights the basic Concepts and types of IPRs and Patents
	CO5	Analyse and verify the procedure for Registration of Industrial Designs & Copyrights

INTRODUCTION TO WEB PROGRAMMING			
Course Code	21ECAE582	Credits	1
Course Type	Practical	CIE Marks	50
Lecture Hours(L:T:P)	0:0:2	SEE Marks	50
Total Hours	28	SEE Hours	2

Course Objectives: The objectives of the course is to enable students to:

- To use the syntax and semantics of HTML and XHTML.
- To develop different parts of a web page.
- To understand how CSS can enhance the design of a webpage.
- To create and apply CSS styling to a webpage.
- To get familiarity with the JavaScript language and understand Document Object Model handling of Java Script.

Modules	Teaching Hours
Module-1	
Traditional HTML and XHTML: First Look at HTML and XHTML, Hello HTML and XHTML World, HTML and XHTML: Version History, HTML and XHTML DTDs: The Specifications Up Close, (X)HTML Document Structure, Browsers and (X)HTML, The Rules of (X)HTML, Major Themes of (X)HTML, The Future of Markup—Two Paths?	5
Module-2	
HTML5: Hello HTML5, Loose Syntax Returns, XHTML5, HTML5: Embracing the Reality of Web Markup, Presentational Markup Removed and Redefined, HTML5 Document Structure Changes, Adding Semantics, HTML5's Open Media Effort, Client-Side Graphics with <canvas>, HTML5 Form Changes, Emerging Elements and Attributes to Support Web Applications	5
Module-3	
Cascading Style Sheets (CSS): Introduction, CSS Overview , CSS Rules, Example with Type Selectors and the Universal Selector, CSS Syntax and Style, Class Selectors, ID Selectors, span and div Elements, Cascading, style Attribute, style Container, External CSS Files, CSS Properties, Color Properties, RGB Values for Color, Opacity Values for Color, HSL and HSLA Values for Color, Font Properties, line-height Property, Text Properties, Border Properties, Element Box, padding Property, margin Property , Case Study: Description of a Small City's Core Area.	6
Module-4	
Tables and CSS, Links and Images: Table Elements, Formatting a Data Table: Borders, Alignment, and Padding, CSS Structural Pseudo- Class Selectors, thread and tbody Elements, Cell Spanning, Web Accessibility, CSS display Property with Table Values, a Element, Relative URLs, Navigation Within a Web Page, CSS for Links, Bitmap Image Formats: GIF, JPEG, PNG, img Element, Responsive Images, Positioning Images, Shortcut Icon, iframe Element.	6
Module-5	
Introduction to JavaScript: Functions, DOM, Forms, and Event Handlers: History of JavaScript, Hello World Web Page, Buttons, Functions, Variables, Identifiers, Assignment Statements and Objects, Document Object Model, Forms and How They're Processed: Client-Side Versus Server-Side, form Element, Controls, Text Control, Accessing a Form's Control Values, reset and focus Methods	6

Question paper pattern:

- The question paper shall have five Module for 100 marks;
- Each full question carries 20 marks.
- Two questions to be set in each module (total ten questions).
- The candidate will have to answer one full question from each module.

Note: There can be a maximum of 4 subsections in each Question.

Text Books:

1. HTML & CSS: The Complete Reference Thomas A. Powell, , Fifth Edition, Tata McGraw Hill.
2. Web Programming with HTML5, CSS and JavaScript, John Dean, Jones & Bartlett Learning, First Edition

Reference Books:

1. M Deitel, P.J. Deitel, A.B Goldberg, "Internet & World Wide Web How to H Program"-3rd Edition, Pearson Education/PHI, 2004.
2. Chris Bates, "Web Programming Building Internet Applications"- 3rd Edition, Wiley India, 2006.

E books and online course materials:

https://onlinecourses.swayam2.ac.in/aic20_sp11/preview

Course outcomes:
On completion of the course, the student will have the ability to:

Course Code	CO #	Course Outcome (CO)
21ECAE582	CO1	Explain the historical context and justification for HTML over XHTML
	CO2	Develop HTML5 documents and adding various semantic markup tags
	CO3	Analyse various attributes, values and types of CSS
	CO4	Develop the ability to create own website for given assignment and also perform dynamic designing using CSS.
	CO5	Implement core constructs and event handling mechanisms of JavaScript.

21ECAE582: Introduction to Web Programming

CO#	Course Outcome (CO)	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Explain the historical context and justification for HTML over XHTML	2	2	2	2				2		2		2			3
CO2	Develop HTML5 documents and adding various semantic markup tags	2	2	2	3				2		2		2			3
CO3	Analyse various attributes, values and types of CSS	2	2	3	3				2		2		2			3
CO4	Develop the ability to create own website for given assignment and also perform dynamic designing using CSS	2	2	3	3				2		2		2			3
CO5	Implement core constructs and event handling mechanisms of JavaScript.	2	2	2	3				2		2		2			3
Average		2	2	2.4	2.8				2		2		2			3

ENTREPRENEURSHIP, MANAGEMENT AND FINANCE			
Course Code	21HU61	Credits	3
Course Type	Theory	CIE Marks	50
Lecture Hours(L:T:P)	3:0:0	SEE Marks	50
Total Hours	42	SEE Hours	3

Course Learning Objectives: The objectives of the course is to enable students to:

- The Meaning, Functions, Characteristics, Types, Role and Barriers of Entrepreneurship, Government Support for Entrepreneurship
- Management – Meaning, nature, characteristics, scope , functions, role etc and Engineers social responsibility and ethics
- Preparation of Project and Source of Finance
- Fundamentals of Financial Accounting
- Personnel and Material Management, Inventory Control

Modules	Teaching Hours
Module-1	
Entrepreneur: Meaning of Entrepreneur; Functions of an Entrepreneur; Characteristics of an entrepreneur , Types of Entrepreneur; Intrapreneurs – an emerging class ; Role of Entrepreneurs in economic development; Barriers to entrepreneurship, Government Support for Innovation and Entrepreneurship in India - Startup-India, Make-in-India, PMMY, AIM , STEP, BIRAC, Stand-up India, TREAD.	9
Module-2	
Management: Introduction – Meaning – nature and characteristics of Management, Scope and functional areas of management, Levels of Management, Henry Fayol - 14 Principles to Management , McKinsey's 7-S Model, Management by objective(MBO) – Meaning, process of MBO, benefits and drawbacks of MBO.	9
Module-3	
Preparation of Project: Meaning of project; Project Identification; Project Selection; Project Report; Need and Significance of Report; Contents; **Source of Finance:** Long Term Sources(Equity, Preference, Debt Capital, Debentures, loan from Financial Institutions etc) and Short Term Source(Loan from commercial banks, Trade Credit, Customer Advances etc)	8
Module-4	
Fundamentals of Financial Accounting: Definition, Scope and Functions of Accounting , Accounting Concepts and Conventions: Golden rules of Accounting, Final Accounts - Trading and Profit and Loss Account, Balance sheet	8
Module-5	
Personnel Management: Functions of Personnel Management, Recruitment, Selection and Training, Wages, Salary and Incentives **Material Management and Inventory Control:** Meaning, Scope and Objects of Material Management. Inventory Control- Meaning and Functions of Inventory control ; Economic Order Quantity(EOQ) and various stock level (Re-order level, Minimum level, Maximum level, Average level and Danger level)	8

Question paper pattern:

- The question paper shall have five Module for 100 marks;
- Each full question carries 20 marks.
- Two questions to be set in each module (total ten questions).
- The candidate will have to answer one full question from each module.

Note: There can be a maximum of 4 subsections in each Question.

Text books:

1. Financial Accounting -B S Raman- United Publishers Manglore, Maheswar S N & Maheswari S K-Vikas Publishing House. January 2018.
2. Management & Entrepreneurship- K R Phaneesh- Sudha Publications January 2018, Prof Manjunatha & Amit kumar G – laxmi Publication, January 2011. Veerbhadrappa Havina - Published by New Age International (P) Ltd., 2009.
3. Principles of Management First Edition (English, G. Murugesan), Laxmi Publications – New Delhi.
4. Management by Objectives (Mbo) in Enterprises: 21 December 2018 by Dr Wazir Ali Khan

Reference Books:

1. Industrial Organization & Engineering Economics-T R Banga & S C Sharma- Khanna Publishers, Dehli.

E books and online course materials:

1. https://nptel.ac.in/courses/110/106/110106141/
2. https://www.businessmanagementideas.com/notes/management-notes/notes-on-management-in-an-organisation/4669
3. https://vskub.ac.in/wp-content/uploads/2020/04/Unit-5-ppmb.pdf

Course outcomes:

On completion of the course, the student will have the ability to:

Course Code	CO #	Course Outcome (CO)
21HU61	CO1	Develop Entrepreneurship skills
	CO2	Apply the concepts of management and Management By Objective(MBO)
	CO3	Prepare project report & choose different Source of Finance.
	CO4	Apply Fundamentals of Financial Accounting and interpret the final accounts
	CO5	Apply personnel management skills, Material and inventory control techniques

21HU61: Entrepreneurship, Management and Finance

CO#	Course Outcome (CO)	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Develop Entrepreneurship skills	2					2	2	3	3	2	3	3	2		
CO2	Apply the concepts of management and Management By Objective(MBO)	2	1				1	2	3	3	3	3	2	2	1	
CO3	Prepare project report & choose different Source of Finance.	2					1	1	2	3	3	3	2	2		
CO4	Apply Fundamentals of Financial Accounting and interpret the final accounts	2					1	1	2	3	3	3	2	2		
CO5	Apply personnel management skills, Material and inventory control techniques	2					1	1	2	2	2	2	3	2		
Average		2	1				1.2	1.4	2.4	2.8	2.6	2.8	2.4	2	1	

MICROWAVES AND RADAR			
Course Code	21EC62	Credits	4
Course Type	Integrated	CIE Marks	50
Lecture Hours(L:T:P)	3:0:2	SEE Marks	50
Total Hours	42 (Theory) + 14 Lab Slots	SEE Hours	3

Course Learning Objectives: The objectives of the course is to enable students to:

- Understand the basic concepts of Active& Passive Devices.
- Learn & analyze the Detection of RADAR.
- Analyze the functional aspects of moving target indicator & pulse Doppler RADAR.
- Introduce different types of RADAR Antenna & Tracking Techniques.

Modules	Teaching Hours
Module-1	
Microwave Waveguides And Components: Introduction, hybrid circuits, directional couplers, circulators, magic tee and isolators, phase shifters, attenuators, s-matrix representation of multiport networks.	9
Module-2	
Microwave Diodes: Transfer electron devices: Introduction: Avalanche transit time devices: READ diode, IMPATT diode, BARITT diode, parametric amplifiers and other diodes: PIN diodes, Schottky diodes. GUNN effect diodes – GaAs diodes, RWH theory, Modes of operation.	9
Module-3	
Radar: Principle, RADAR Range equation, applications, detection of signals in noise, receiver noise & signal – to- noise ratio, probabilities of detection of false alarm, probability of detection, radar cross section of targets, simple & complex targets, transmitter power, pulse repetition frequency & range ambiguities, system losses.	8
Module-4	
MTI & Pulse Doppler Radar: Introduction, simple CW Doppler radar, pulse radar that extracts Doppler frequency shifted echo signal, sweep to sweep subtraction & delay line canceller, MTI Radar block diagram, frequency response of single delay line canceller, blind speeds, clutter attenuation, MTI improvement factor, digital MTI processing, blind phases, I & Q channel, moving target detector.	8
Module-5	
Tracking With Radar: Types of Tracking radar, mono pulse tracking, conical scan & sequential lobing, tracking in range. **Radar Antennas**: Reflector antennas, electronically steered phased array antennas, phase shifters, frequency scan arrays, radiators for phased arrays.	8

Question paper pattern:

- The question paper shall have five Module for 100 marks;
- Each full question carries 20 marks.
- Two questions to be set in each module (total ten questions).
- The candidate will have to answer one full question from each module.

Note: There can be a maximum of 4 subsections in each Question.

Text books:

1. Microwave Devices and Circuits – Liao / Pearson Education
2. Microwave Engineering – Annapurna Das, Sisir K Das TMHPublication, 2001.

Reference Books:

1. Introduction to Radar Systems – Merrill I Skolnik, 3rd Ed,TMH, 2001.
2. Microwave Engineering – David M Pozar, John Wiley, 2E, 2004.

E books and online course materials:

1. https://www.nap.edu/read/2266/chapter/4
2. https://www.radartutorial.eu/01.basics/Radar%20Principle.en.html

List of Experiments:

1. V-I Characteristics of Gun diode
2. Repeller mode characteristics of reflex klystron.
3. Measurement of guide wavelength and frequency.
4. Measurement of VSWR.
5. Calibration of attenuator
6. Measurement of attenuation.
7. Characteristics of directional coupler
8. Characteristics of Isolator.
9. Characteristics of Circulator.
10. Characteristics of magic tree.
11. Measurement of unknown impedance.
12. Radiation pattern of horn antenna.
13. Micro strip experiments.

Course outcomes:
On completion of the course, the student will have the ability to:

Course Code	CO #	Course Outcome (CO)
21EC62	CO1	Understand the basic concepts & functional characteristics of passive devices
	CO2	Understand the basic concepts & functional characteristics of Active devices
	CO3	Analyze the functional aspects of RADAR
	CO4	Analyze the functional aspects of MTI and Pulse Doppler Radar
	CO5	Understand constructional aspects of different Radar Antennas and their functioning.

21EC62: Microwaves and Radar

CO#	Course Outcome (CO)	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Understand the basic concepts & functional characteristics of passive devices	2	1	1	1				1				2	3	1	1
CO2	Understand the basic concepts & functional characteristics of Active devices	2	1	1	1				1				2	3	1	1
CO3	Analyze the functional aspects of RADAR	2	2	1					1				2	2	1	1
CO4	Analyze the functional aspects of MTI and Pulse Doppler Radar	2	2	2	1				1				2	3	1	1
CO5	Understand constructional aspects of different Radar Antennas and their functioning.	1			1				1				2	3	2	1
Average		1.8	1.2	1	1				1				2	2.8	1.2	1

VLSI DESIGN			
Course Code	21EC63	Credits	3
Course Type	Theory	CIE Marks	50
Lecture Hours(L:T:P)	3:0:0	SEE Marks	50
Total Hours	42	SEE Hours	3

Course Objectives: The objectives of the course is to enable students to:

- Impart knowledge of MOS transistor theory and CMOS technologies
- Impart knowledge on architectural choices and performance tradeoffs involved in designing and realizing the circuits in CMOS technology
- Cultivate the concepts of subsystem design processes.
- Demonstrate the concepts of CMOS testing

Modules	Teaching Hours
Module-1	
Introduction: A Brief History, MOS Transistors, MOS Transistor Theory, Ideal I-V Characteristics, Non-ideal I-V Effects, DC Transfer Characteristics. MOS Device Design Equations. **Fabrication:** nMOS Fabrication, CMOS Fabrication [P-well process, N-well process, Twin tub process, BiCMOS Technology.	**9**
Module-2	
Circuit Design Processes: MOS layers. Stick Diagrams. Design rules and layout – lambda-based design and other rules. **Logic Design with MOSFET:** Basic logic gates and complex logic gates in CMOS, Transmission gates circuits, CMOS Design rules and NMOS Design rules.	**9**
Module-3	
Basic Circuit Concepts: Sheet resistance. Area capacitances. Capacitance calculations. The delay unit, Inverter delays. Driving capacitive loads. Propagation delays. Wiring capacitances. **Scaling of MOS circuits:** Scaling models and scaling factors. Limits on scaling.	**8**
Module-4	
Subsystem Designs: Some Architectural Issues, Switch Logic, Gate(restoring) Logic, Parity Generators, Multiplexers, The Programmable Logic Array (PLA) **Subsystem Design Processes:** Some General considerations, An illustration of Design Processes.	**8**
Module-5	
Memory, Registers and Aspects of system Timing- System Timing Considerations, Some commonly used Storage/Memory elements. (Self study)**Testing and Verification:** Introduction, Logic Verification, Logic Verification Principles, Manufacturing Test Principles, Design for testability.	**8**

Question paper pattern:

- The question paper shall have five Module for 100 marks;
- Each full question carries 20 marks.
- Two questions to be set in each module (total ten questions).
- The candidate will have to answer one full question from each module.

Note: There can be a maximum of 4 subsections in each Question

Text books:

1. Basic VLSI Design – Douglas A Pucknell & Kamran Eshraghian,PHI 3rd Edition (original Edition – 1994), 2005.
2. Principles of CMOS VLSI Design: A Systems Perspective, Neil H. E. Westeand K. Eshragian,

2nd edition, Pearson Education (Asia Pvt. Ltd., 2000.) McGraw-Hill Publishing Co.Ltd.
3. Introduction to VLSI circuits & systems, John P.Uymeura

Reference Books:

1. CMOS Digital 4Integrated Circuits: Analysis and Design, Sung-Mo Kang & Yusuf Leblebici, 3rd Edition, Tata McGraw Hill, New Delhi, 2007.
2. Analysis and Design of Digital Integrated Circuits – D.A Hodges,H.G Jackson and R.A Saleh 3rd Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2007

E books and online course materials: NPTEL

Course outcomes:
On completion of the course, the student will have the ability to:

Course Code	CO #	Course Outcome (CO)
21EC63	CO1	Analyze MOS transistor theory and fabrication process.
	CO2	Design MOS circuits using stick and layout diagrams.
	CO3	Analyze CMOS fabrication flow and technology scaling
	CO4	Analyze CMOS subsystems and architectural issue with the design constraints
	CO5	Analyze Memory elements and testability issues in VLSI Design

21EC63: VLSI Design

CO#	Course Outcome (CO)	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Analyze MOS transistor theory and fabrication process.	3	2	2									1	3		3
CO2	Design MOS circuits using stick and layout diagrams.	2	3	3		3							1	3	2	3
CO3	Analyze CMOS fabrication flow and technology scaling	2	3	2		3							1	3	2	3
CO4	Analyze CMOS subsystems and architectural issue with the design constraints	3	3	2									1	3	2	3
CO5	Analyze Memory elements and testability issues in VLSI Design	3	2	2									1	3	2	3
Average		2.6	2.6	2.2		3							1	3	2	3

INFORMATION THEORY AND CODING			
Course Code	21EC641	Credits	3
Course Type	Theory	CIE Marks	50
Lecture Hours(L:T:P)	3:0:0	SEE Marks	50
Total Hours	42	SEE Hours	3

Course Objectives: The objectives of the course is to enable students to:

- Introduce the basic concepts of information theory.
- Analyze the channel capacity of discrete channels.
- Analyze the error control strategies.
- Analyze different coding and decoding techniques.

Modules	Teaching Hours
Module-1	
Source Coding: Introduction to information theory, information measure, entropy, Discrete memoryless source, Source information rate and source coding theorem, Huffman coding and its extension, Entropy and information rate of Markoff sources, Shannon's algorithm for source encoding	8
Module-2	
Channel Capacity and Coding: Channel models, Channel capacity, Channel coding, Information capacity Theorem, The Shannon's limit, Mutual Information and their properties, estimation of channel capacity using Muroga's method,	9
Module-3	
Linear Block Codes: Introduction to Linear Block Codes, Syndrome and Error Detection, Minimum Distance of Block Codes, Error Detecting and Error Correcting Capabilities of Block Codes, Standard Array and Syndrome Decoding, Single Parity Check Codes, Hamming Codes, A class of single-error correcting and double-error detecting codes, Reed- Muller Code	9
Module-4	
Cyclic codes: Description of Cyclic codes, generator and parity Check Matrices of Cyclic codes, Encoding of cyclic codes, Syndrome computation and Error Detection, Decoding of Cyclic Codes, Bose-Chaudhuri Hocquenghem code.	8
Module-5	
Convolution codes: Encoding of convolution codes, Time and frequency transform domain methods, Matrix description, Graphical approaches, State transition table, State diagram, Code tree, Trellis diagram, Viterbi decoding.	8

Question paper pattern:

- The question paper shall have five Module for 100 marks;
- Each full question carries 20 marks.
- Two questions to be set in each module (total ten questions).
- The candidate will have to answer one full question from each module.

Note: There can be a maximum of 4 subsections in each Question.

Text Books:

1. Shu Lin, Daniel J. Costello, Jr, Error Control Coding Fundamentals and Applications, 2nd Edition, Pearson, 2011.
2. Information Theory Coding and Cryptography, Ranjan Bose, Tata Mc Graw-Hill, 2008.

Reference Books:

1. K. Sam Shanmugam, Digital and Analog Communication systems, John wiley, 2006.
2. Simon Haykin, Digital Communications, Johan Wiley, 2006.
3. A. Bruce Carlson, Paul B. Crilly, Jannet C. Rutledge, Communication Systems, Fourth Edition, Mc Graw-Hill International edition, 2002

E books and online course materials: NPTEL

Course outcomes:
On completion of the course, the student will have the ability to:

Course Code	CO #	Course Outcome (CO)
21EC641	**CO1**	Understand the basic notion of information theory
	CO2	Determine the channel capacity
	CO3	Analyze the error control strategies
	CO4	Analyze various coding techniques.
	CO5	Analyze decoding techniques

21EC641: Information Theory and Coding

CO#	Course Outcome (CO)	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Understand the basic notion of information theory	3	2										1	3		
CO2	Determine the channel capacity	3	2										1	3		
CO3	Analyze the error control strategies	3	3	3		2							1	3	2	2
CO4	Analyze various coding techniques.	3	3	3		2							1	3	2	2
CO5	Analyze decoding techniques	3	3	3		2							1	3	2	2
Average		3	2.6	3		2							1	3	2	2

ADAPTIVE SIGNAL PROCESSING			
Course Code	21EC642	Credits	3
Course Type	Theory	CIE Marks	50
Lecture Hours(L:T:P)	3:0:0	SEE Marks	50
Total Hours	42	SEE Hours	3

Course objectives: This course will enable students to:

- To study the fundamental concepts of adaptive filtering theory
- To study the stochastic process
- To study the linear optimum filter
- To study the least square and recursive least square algorithm.

Modules	Teaching Hours
Module -1	
Introduction adaptive signal processing: filtering problem, linear optimum filter, adaptive filters, linear filter structures approaches to LAF, adaptive beam forming, four classes of application Stochastic process and models: Discrete time stochastic process, mean ergodic theorem, correlation matrix, stochastic models, word decomposition, autoregressive process, Yule –walker	9
Module -2	
Weiner filter: linear optimum filtering, principle of orthogonality, minimum mean square error, Weiner –Hopf equation, error performance surface, linear constrained minimum varience, improving coverage and capacity in cellular systems.	8
Module -3	
Linear prediction: Forward linear prediction, backward linear prediction, Levinson Durbin algorithm, properties of prediction error filters, Auto regressive model of stationary stochastic. Method of steepest descent:Basic idea, steepest descent algorithm to the weiner filter, stability of steepest descent algorithm	8
Module -4	
Least mean square adaptive: structure and operation of LMS algorithm, LMS adaptive algorithm, applications (adaptive noise cancellation, adaptive beam forming) Method of least squares:linear least square estimation problem, data windowing principle of orthogonality, minimum sum of errors squares, normal equations and linear least squares, time average correlation matrix	9
Module -5	
Recurssive least squares adaptive filters: preliminaries, matrix inversion lemma, exponentially weighted RLS Kalman filters: Recursive min mean square estimation for random variables, statement of kalman filtering problem, innovation process, estimation using innovation, filtering, initial conditions, summary of kalman filter	**8**

Question paper pattern:

- The question paper shall have five Module for 100 marks;
- Each full question carries 20 marks.

- Two questions to be set in each module (total ten questions).
- The candidate will have to answer one full question from each module.

Note: There can be a maximum of 4 subsections in each Question.

Text Books:

1. Simon Haykin, Adaptive filter theory, Pearson education 4th Edition-2002.

Reference Books:

1. Adaptive signal processing, Bernard Widro and Samuel strearns, Pearson education 2001

Course outcomes:
On completion of the course, the student will have the ability to:

Course outcomes	CO #	Course Outcome (CO)
21EC642	CO1	Understand the different filter structure.
	CO2	Analyze and design Weiner filter for practical applications.
	CO3	Analyze and design linear prediction filter.
	CO4	Design LMS error reduction technique.
	CO5	Understand recursive filters

21EC642: Adaptive Signal Processing

CO#	Course Outcome (CO)	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Understand the different filter structure.	1	3	1									2	2	1	
CO2	Analyze and design Weiner filter for practical applications.	3	3	1	1	2							2	3	3	2
CO3	Analyze and design linear prediction filter.	3	3	2	1	2							2	3	3	2
CO4	Design LMS error reduction technique.	2	3	1	1	2							2	3	3	2
CO5	Understand recursive filters	1	2	1									2	1	1	
Average		1.8	2.8	1.2	1	2							2	2.4	2.2	2

SPEECH SIGNAL PROCESSING			
Course Code	21EC643	Credits	3
Course Type	Theory	CIE Marks	50
Lecture Hours(L:T:P)	3:0:0	SEE Marks	50
Total Hours	42	SEE Hours	3

Course objectives: This course will enable students:

- To provide students with the knowledge of basic characteristics of speech signal in relation to production and hearing of speech by humans.
- To describe basic algorithms of speech analysis common to many applications.
- To give an overview of applications (recognition, synthesis, coding) and to inform about practical aspects of speech algorithms implementation.

Modules	Teaching Hours
Module -1	
Speech Production – human speech production mechanism, acoustic theory of speech production, digital models for speech production. Speech perception – human hearing, auditory psychophysics, JND, pitch perception, auditory masking, models for speech perception.	9
Module -2	
Speech Analysis – Time and frequency domain analysis of speech, speech parameter estimation, Linear prediction.	8
Module -3	
Speech compression – quality measures, waveform coding, source coders, Speech compression standards for personal communication systems	8
Module -4	
Audio processing – characteristics of audio signals, sampling, Audio compression techniques, Standards for audio compression in multimedia applications, MPEG audio encoding and decoding, audio databases and applications.	8
Module -5	
Speech synthesis – text to speech synthesis, letter to sound rules, syntactic analysis, timing and pitch segmental analysis. Speech recognition – Segmental feature extraction, DTW, HMMs, approaches for speaker, speech and language recognition and verification.	9

Question paper pattern:

- The question paper shall have five Module for 100 marks;
- Each full question carries 20 marks.
- Two questions to be set in each module (total ten questions).
- The candidate will have to answer one full question from each module.

Note: There can be a maximum of 4 subsections in each Question.

Text Books:

1. Lawrence Rabiner and Biing-Hwang Juang, “Fundamentals of Speech Recognition”, Pearson Education, 2003.

Reference Books:

1. Daniel Jurafsky and James H Martin, "Speech and Language Processing – An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition", Pearson Education.
2. Steven W. Smith, "The Scientist and Engineer's Guide to Digital Signal Processing", California Technical Publishing.
3. Thomas F Quatieri, "Discrete-Time Speech Signal Processing – Principles and Practice", Pearson Education

Course outcomes:
On completion of the course, the student will have the ability to:

Course Code	CO #	**Course Outcome (CO)**
21EC643	CO1	Analyze mechanisms of human speech production and how the articulation mode of different classes of speech sounds determines their acoustic characteristics
	CO2	Analyze and design algorithms for extracting parameters from the speech signal.
	CO3	Analyze speech compression standards for personal communication.
	CO4	Design systems for efficient quantization and coding of speech signals.
	CO5	Analyze and Design algorithms for speech synthesis and recognition.

21EC643: Speech Signal Processing

CO#	Course Outcome (CO)	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Analyze mechanisms of human speech production and how the articulation mode of different classes of speech sounds determines their acoustic characteristics	2	3		3								2	3	3	2
CO2	Analyze and design algorithms for extracting parameters from the speech signal.	3	2		3	3							2	3	2	1
CO3	Analyze speech compression standards for personal communication.	3	3		2	2							2	3	2	1
CO4	Design systems for efficient quantization and coding of speech signals.	3	3	2	3	3							2	3	2	2
CO5	Analyze and Design algorithms for speech synthesis and recognition.	3	3	3	3	3							2	3	2	1
Average		2.8	2.8	2.5	2.8	2.75							2	3	2.2	1.4

COMPUTER ARCHITECTURE AND ORGANIZATION			
Course Code	21EC65OE1	Credits	3
Course Type	Theory	CIE Marks	50
Lecture Hours(L:T:P)	3:0:0	SEE Marks	50
Total Hours	42	SEE Hours	3

Course objectives: This course will enable students:

- To introduce design concepts of processor and control unit design.
- To introduce the concepts of memory organization.
- To introduce the concept of parallel computing.

Modules	Teaching Hours
Module -1	
Processor Design: Processor organization, Information representation, number formats, Instruction sets – Instruction formats, Instruction types, assembly language programming, Fixed point arithmetic – addition, subtraction, multiplication and division, ALU Design – basic ALU organization, floating point arithmetic, arithmetic processors.	9
Module -2	
Control Design: Instruction sequencing, Instruction interpretation, Hardwired Control – Design methods, multiplier control unit, CPU control unit, Microprogrammed control – basic concepts, control memory organization multiplier control unit.	8
Module -3	
Memory organization: Memory Technology – memory device characteristics, random access memories, serial access memories, Virtual memories – memory hierarchies, main memory allocation, segments, pages and files.	9
Module -4	
System organization: Communication – Bus control, computer networks, I/O systems – programmed IO, DMA and interrupts, IO processors.	8
Module -5	
Parallel Processing: Basic concepts – Types of parallel processors, performance considerations, Pipeline processors – pipeline structures, vector super computers, Multiprocessor architectures.	8

Question paper pattern:

- The question paper shall have five Module for 100 marks;
- Each full question carries 20 marks.
- Two questions to be set in each module (total ten questions).
- The candidate will have to answer one full question from each module.
- Note: There can be a maximum of 4 subsections in each Question.

Text Books:

1. John P Hayes, Computer architecture and Organization, Mcgraw-Hill ,2nd Edition-1988.
2. William Stallings, Computer organization and architecture, Pearson, 7th Edition, 2006.

Reference Books:

1. Kai Hwang, Faye a.Briggs, Computer architecture and parallel processing, MacGraw-Hill 1985.

Course outcomes:

On completion of the course, the student will have the ability to:

Course Code	CO #	Course Outcome (CO)
21EC65OE1	CO1	Analyze and Design ALU Circuits and processors. Represent numbers in different formats.
	CO2	Design control units to interface with Multiplexers and other input and output devices.
	CO3	Estimate memory requirements and interface with different memories.
	CO4	Interface interrupts, I/O devices and design computer networks.
	CO5	Analyze pipelined, parallel and multi processors and their processing.

21EC65OE1: Computer Architecture And Organization

CO#	Course Outcome (CO)	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Analyze and Design ALU Circuits and processors. Represent numbers in different formats.	2	3		3								2	3	3	2
CO2	Design control units to interface with Multiplexers and other input and output devices.	3	2		3	3							2	3	2	1
CO3	Estimate memory requirements and interface with different memories.	3	3		2	2							2	3	2	1
CO4	Interface interrupts, I/O devices and design computer networks.	3	3	2	3	3							2	3	2	2
CO5	Analyze pipelined, parallel and multi processors and their processing.	3	3	3	3	3							2	3	2	1
Average		2.8	2.8	2.5	2.8	2.75							2	3	2.2	1.4

AUTOMOTIVE ELECTRONICS			
Course Code	21EC65OE2	Credits	3
Course Type	Theory	CIE Marks	50
Lecture Hours(L:T:P)	3:0:0	SEE Marks	50
Total Hours	42	SEE Hours	3

Course objectives: This course will enable students:

- To analyse the functioning of different automotive components.
- To understand the operation of different automotive networks.
- To understand the add-on features of current automotive systems.

Modules	Teaching Hours
Module -1	
Automotive Fundamentals Overview-Evolution of Automotive Electronics, Automobile Physical Configuration, Survey of Major Automotive Systems, The Engine - Engine Block, Cylinder Head, Four Stroke Cycle, Engine Control, Ignition System- Spark plug, High voltage circuit and distribution, Spark pulse generation, Ignition Timing, Diesel Engine, Drive Train - Transmission, Drive Shaft, Differential, Suspension, Brakes, Steering System, Starter Battery --Operating principle: **The Basics of Electronic Engine Control-**Motivation for Electronic Engine Control- Exhaust Emissions, Fuel Economy, Concept of an Electronic Engine control system, Definition of General terms, Definition of Engine performance terms, Engine mapping, Effect of Air/Fuel ratio, spark timing and EGR on performance, Control Strategy, Electronic Fuel control system, Analysis of intake manifold pressure, Electronic Ignition.	9
Module -2	
Automotive Sensors -Automotive Control System applications of Sensors and Actuators - Variables to be measured, Airflow rate sensor, Strain Gauge MAP sensor, Engine Crankshaft Angular Position Sensor, Magnetic Reluctance Position Sensor, Hall effect Position Sensor, Shielded Field Sensor, Optical Crankshaft Position Sensor, Throttle Angle Sensor (TAS), Engine Coolant Temperature (ECT) Sensor, Exhaust Gas Oxygen (02/EGO) Lambda Sensors, Piezoelectric Knock Sensor. **Automotive Engine Control Actuators-**Solenoid, Fuel Injector, EGR Actuator, Ignition System	8
Module -3	
Digital Engine Control Systems - Digital Engine control features, Control modes for fuel Control (Seven Modes), EGR Control, Electronic Ignition Control -Closed loop Ignition timing, Spark Advance Correction Scheme, Integrated Engine Control System- Secondary Air Management, Evaporative Emissions Canister Purge, Automatic System Adjustment, System Diagnostics. **Control Units-** Operating conditions, Design, Data processing, Programming, Digital modules in the Control unit, Control unit software.	8
Module -4	
Automotive Networking - Bus Systems- Classification, Applications in the vehicle, Coupling of networks, Examples of networked vehicles, Buses - CAN Bus, UN Bus, MOST Bus, Bluetooth, Flex Ray, Diagnostic Interfaces **Vehicle Motion Control** - Typical Cruise Control System, Digital Cruise Control	8

System, Digital Speed Sensor, Throttle Actuator, Digital Cruise Control configuration, Cruise Control Electronics (Digital only), Antilock Brake System (ABS)	
Module -5	
Automotive Diagnostics - Timing Light, Engine Analyzer, On-board diagnostics, Off-board diagnostics, Expert Systems, Occupant Protection Systems -Accelerometer based Air Bag systems. **Future Automotive Electronic Systems-**Alternative Fuel Engines, Electric and Hybrid vehicles, Fuel cell powered cars, Collision Avoidance Radar warning Systems, Low tyre pressure warning system, Heads Up display, Speech Synthesis, Navigation - Navigation Sensors - Radio Navigation, Signpost navigation, dead reckoning navigation, Voice Recognition Cell Phone dialing, Advanced Cruise Control, Stability Augmentation, Automatic driving Control	9

Question paper pattern:

- The question paper shall have five Module for 100 marks;
- Each full question carries 20 marks.
- Two questions to be set in each module (total ten questions).
- The candidate will have to answer one full question from each module.

Note: There can be a maximum of 4 subsections in each Question.

Text Books:

1. William B. Ribbens, "Understanding Automotive Electronics", 6th Edition, Elsevier Publishing.
2. Robert Bosch GmbH (Ed.) Bosch Automotive Electrics and Automotive Electronics Systems and Components, Networking and Hybrid Drive, 5th edition, John Wiley & Sons Inc., 2007.

Reference Books:

1. "Design Methods of Safety-Critical Electronic Automotive Systems" by FulepTimea
2. "Automotive Electronic Diagnostics" by Mandy Concepcion

Course outcomes:
On completion of the course, the student will have the ability to:

Course Code	CO #	Course Outcome (CO)
21EC65OE2	CO1	Describe the basics of automobile dynamics and design electronics.
	CO2	Acquire an overview of automotive components, subsystems, and basics of Electronic Engine Control in today's automotive industry.
	CO3	Use available automotive sensors and actuators while interfacing with microcontrollers/ microprocessors during automotive system design.
	CO4	Understand the networking of various modules in automotive systems, communication protocols and diagnostics of the sub systems
	CO5	Design and implement the electronics that attribute the reliability, safety, and smartness to the automobiles, providing add-on comforts and get fair idea on future Automotive Electronic Systems.

21EC65OE2: Automotive Electronics

CO#	Course Outcome (CO)	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1																
CO2																
CO3																
CO4																
CO5																
Average																

ROBOTICS-I			
Course Code	21EC65OE3	Credits	3
Course Type	Theory	CIE Marks	50
Lecture Hours(L:T:P)	3:0:0	SEE Marks	50
Total Hours	42	SEE Hours	3

Course objectives: This course will enable students to:

- Identify basic components of robot system and its functionality
- Identify the representation of robot and homogenous transformation of various arm configurations.
- Analyze the functions of sensors in the robot.
- Evaluate and compare the use of robots in different applications.
- Recognize material handling applications, processing operations, assembly and inspection operations to increase product quality and uniformity in minimize cycle times and effort.

Modules	Teaching Hours
Module -1	
Overview On Robotics & SCADA: Introduction to robotics, history of robotics, robotic configuration, Different types, Various generations, Degrees of freedom, Anatomy of a robot. Classification of robots. **SCADA**: Introduction and brief history of SCADA, SCADA systems software, considerations and benefits of SCADA system.	9
Module -2	
Control Systems and Components: Basic control systems concepts and models, controllers, robot actuation and feedback components. **Robot end effectors:** Types of end effectors, mechanical grippers, other types of grippers, tools as end effectors, robot/end effectors interface, consideration in gripper selection and design. **Sensor in Robotics:** Transducer and sensors, sensors in robotics tactile sensor, proximity and range sensors.	8
Module -3	
Machine vision: Introduction to machine vision. The sensing and digitizing function of machine vision, image processing and analysis: image data reduction, segmentation, feature extraction, object recognition, robotic application. **Artificial Intelligence**: Goals of AI in research, AI techniques: knowledge representation, problem representation and problem solving and search techniques in problem solving.	8
Module -4	
Robot cell design and control: Robot cell layouts, multiple robots and machine interference. Other consideration in work cell design, work cell control, interlocks, error detection and recovery, work-cell controller. **Material transfer, machine loading/unloading:** General considerations in robot material handling material transfer application, machine loading and unloading.	8
Module -5	

Processing operations, Assembly & Inspection: Spot welding, continuous arc welding, spray coating, other processing operations using robots, Assembly and robotic assembly automation, parts presentation methods, assembly operations, compliance and remote center compliance (RCC) device, assembly system configurations, designing for robotic assembly, inspection automation.	9

Question paper pattern:

- The question paper shall have five Module for 100 marks;
- Each full question carries 20 marks.
- Two questions to be set in each module (total ten questions).
- The candidate will have to answer one full question from each module.

Note: There can be a maximum of 4 subsections in each Question.

Text Books:

1. Mikell P. Groover, Mitchel Weiss, Roger N. Nagel, Nicholas G. Odrey and AshishDutta, "Industrial Robotics: Technology, Programming and Applications", 2nd Edition, Tata McGraw Hill, 2012.
2. Srinivas Medida, Pocket Guide on Industrial Automation: For Engineers and Technicians, 1st Edition, IDC Technologies, 2007. (http://www.pacontrol.com/download/Industri alAutomation-Pocket-Guide.pdf)
3. Roland Siegwart, Illah R. Nourbakhsh, and Davide Scaramuzza, "Introduction to Autonomous Mobile Robots", 2ndEdition, PHI, 2011.

Reference Books:

1. Ghosh, Control in Robotics and Automation: Sensor Based Integration, Allied Publishers, Chennai, 1998.
2. Asfahl C.R., Robots and manufacturing Automation, John Wiley, USA 1992

Course outcomes:
On completion of the course, the student will have the ability to:

Course Code	CO #	Course Outcome (CO)
21EC65OE3	CO1	Identify basic components of robot system and its functionality.
	CO2	Study various Control systems, end effectors and sensors of robot system.
	CO3	Analyze the Machine Vision and artificial intelligence techniques.
	CO4	Study robot cell design with controlling.
	CO5	Recognize the processing operations, assembly and inspection for robot system.

21EC65OE3: Robotics-I

CO#	Course Outcome (CO)	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Identify basic components of robot system and its functionality.	1						2					2	2	2	2
CO2	Study various Control systems, end effectors and sensors of robot system.	1	2	2				2					2	2	2	2
CO3	Analyze the Machine Vision and artificial intelligence techniques.	1	2	2				2				2	2	2	2	2
CO4	Study robot cell design with controlling.	1	2	2	2			2				2	2	2	2	2
CO5	Recognize the processing operations, assembly and inspection for robot system.	1	2	2	2			2				2	2	2	3	2
Average		**1**	**2**	**2**	**2**			**2**				**2**	**2**	**2**	**2.2**	**2**

VLSI LAB			
Course Code	21ECL66	Credits	1
Course Type	Practical	CIE Marks	50
Lecture Hours(L:T:P)	0:0:2	SEE Marks	50
Total Hours	28	SEE Hours	3

Course Objectives: The objectives of the course is to enable students to:

- Study & understand the schematic & layout of basic gates.
- Study & Analyze the schematic& layout of combinational circuits.
- Learn &understand schematic& layout of Sequential circuits.

List of Experiments

1. Design and develop Schematic to simulate the following
2. Inverter
3. 2-input NAND and NOR gate
4. 3-input NAND and NOR gate
5. Transmission Gate
6. AND gate
7. OR gate
8. MUX/DEMUX
9. Design circuit for given expressions.
10. Draw the layout and simulate the following, also plot the transient response
    a. CMOS Inverter
    b. NAND
    c. AND
    d. OR
    e. XOR
    f. XNOR
    g. Buffer
11. Flip-flops
    a. R-S
    b. D-T
    c. J-K

Conduct of Practical Examination:

- All laboratory experiments are to be included for practical examination
- Students are allowed to pick one experiment from the lot.
- Strictly follow the instructions as printed on the cover page of answer script for breakup of marks.
- Change of experiment is allowed only once and will be evaluated for 85% of the total mark s.

Course outcomes:

On completion of the course, the student will have the ability to:

Course Code	CO #	Course Outcome (CO)
21ECL66	CO1	Develop stick diagrams to simulate combinational and sequential logic circuits.
	CO2	Develop layouts to simulate combinational Logic circuits.
	CO3	Develop layouts to simulate combinational circuits using transmission gates.
	CO4	Develop layouts to simulate combinational circuits using MOS transistor
	CO5	Develop layouts to simulate sequential circuits using MOS transistor.

21ECL66: VLSI Design Lab

CO#	Course Outcome (CO)	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Develop stick diagrams to simulate combinational and sequential logic circuits.	3	1	1	1	3				2			1	3	2	3
CO2	Develop layouts to simulate combinational Logic circuits.	3	1	1	1	3				2			1	3	2	3
CO3	Develop layouts to simulate combinational circuits using transmission gates.	3	1	1	1	3				2			1	3	2	3
CO4	Develop layouts to simulate combinational circuits using MOS transistor	3	1	1	1	3				2			1	3	2	3
CO5	Develop layouts to simulate sequential circuits using MOS transistor.	3	1	1	1	3				2			1	3	2	3
Average		3	1	1	1	3				2			1	3	2	3

MINI-PROJECT			
Course Code	21ECMP67	Credits	2
Course Type	Practical	CIE Marks	50
Lecture Hours(L:T:P)	0:0:2	SEE Marks	50
Total Hours	28	SEE Hours	3

Course objectives: This course will enable students:

- Improve the practical skills
- Collect the information of project
- Analyze and select appropriate method
- Plan and implement project
- Document and present the project

Each batch comprising of two to four students shall identify mini project related to the curriculum of study. Students are supposed to carry out the following during the semester

1. Selecting the project which is having some functionality.
2. Collect the information about project
3. Develop, test and implement project
4. Document the work.

Each group shall submit a project report at the end of sixth semester. The project report should contain Literature survey, Design, Engineering documentation and Test results. Innovative design concepts, Reliability considerations, Its usefulness in practice taken care of in the project shall be given due weightage.

Guidelines for Evaluation:

1. Attendance and regularity,
2. Understanding and involvement.
3. Level of completion, Originality and Functionality.
4. Project report.

Conduct of Practical Examination:

- All laboratory experiments are to be included for practical examination.
- Students are allowed to pick one experiment from the lot

Course outcomes:
On completion of the course, the student will have the ability to:

Course Code	CO #	Course Outcome (CO)
21ECMP67	CO1	Implement the layout/schematic (Design) .
	CO2	Testing of the individual modules.
	CO3	Record the results and analyze.
	CO4	Perform the review
	CO5	Demonstration of the work done (Viva Voce)

21ECMP67: Mini-Project

CO#	Course Outcome (CO)	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Implement the layout/ schematic (Design)	3	3	2	1	3				3		3	1	2	2	
CO2	Testing of the individual modules.	2	2			2				3			1	2	2	
CO3	Record the results and analyze.	2	3			2		2		3			1	2	2	
CO4	Perform the review									3	3					
CO5	Demonstration of the work done (Viva Voce)	1	1		1	2	3	3	3	3	3	3	1	2	2	2
Average		2	2.2	2	1	2.2	3	2.5	3	3	3	3	1	2	2	2