SAGI RAMA KRISHNAM RAJU ENGINEERING COLLEGE
(AUTONOMOUS)

(Approved by AICTE, New Delhi, Affiliated to JNTUK, Kakinada)

Accredited by NAAC with 'A+' Grade

Recognised as Scientific and Industrial Research Organisation

SRKR MARG, CHINA AMIRAM, BHIMAVARAM – 534204 W.G.Dt., A.P., INDIA

Regulation: R23	

ELECTRONICS AND COMMUNICATION ENGINEERING (Minors)

(Applicable for AIDS, AIML, CIC, CSBS, CSE, CSG, CSIT, CIVIL, IT&ME)

COURSE STRUCTURE

(With effect from 2023-24 admitted Batch onwards)

Course Code	Course Name	Year/ Sem	Cr	L	T	P	C.I.E	S.E.E	Total Marks
B23ECM101	Basic Electronics	II-II	3	3	1	0	30	70	100
B23ECM201	Signals & Systems	III-I	3	3	1	0	30	70	100
B23ECM301	Principles Of Communications	III-II	3	3	1	0	30	70	100
B23ECM401	Basic VLSI Design	IV-I	3	3	1	0	30	70	100
B23ECM501	*MOOCS-I	II-II to IV-I	3	--	--	--	--	--	100
B23ECM601	*MOOCS-II	II-II to IV-I	3	--	--	--	--	--	100
		TOTAL	**18**	**12**	**4**	**0**	**120**	**280**	**600**

*Two MOOCS courses of any **ELECTRONICS AND COMMUNICATION ENGINEERING** related Program Core Courses from NPTEL/SWAYAM with a minimum duration of 12 weeks (3 Credits) courses other than the courses offered need to be taken by prior information to the concern. These courses should be completed between II Year II Semester to IV Year I Semester.

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
B23ECM101	Minors	3	-	--	3	30	70	3 Hrs

BASIC ELECTRONICS

(Minors Degree Course in ECE)

Course Objectives:

1.	Fundamental operating characteristics of active elements such as BJT and Junction FET.
2.	Basic operation of MOSFET in n-channel and p-channel along with the biasing mechanism.
3.	Analyze the effect of negative feedback on amplifier characteristics and derive the characteristics.
4.	Learn and understand the basic principle of oscillator circuits and perform the analysis of different oscillator circuits.

Course Outcomes: At the end of the course, Students will be able to

S.No	Outcome	Knowledge Level
1.	**Illustrate** the characteristics of BJT in CE, CB configurations along with biasing.	K3
2.	**Interpret** the Operation and the characteristics of JFET.	K3
3.	**Explain** the Operation of a MOSFET along with the basic knowledge of CMOS technology.	K3
4.	**Illustrate** the operation of feedback amplifiers.	K3
5.	**Analyze** the LC and RC oscillators.	K3

SYLLABUS

UNIT-I (8 Hrs)	**Fundamentals of Transistors:** Bipolar Junction Transistor (BJT) construction & Basic operation, Active, Cut-off, Saturation modes of operation, CB, CE configurations, Input and Output characteristics, Transistor as an Amplifier and a Switch, Self and fixed biasing.(without mathematical analysis).
UNIT-II (8 Hrs)	**Field effect transistors (FET's) :** Junction Field Effect Transistor (JFET) Operation, n-channel JFET, p-channel JFET, Pinch-off Voltage, Volt-Ampere characteristics, Advantages of FET over BJT, Applications of FET.
UNIT-III (8 Hrs)	**Metal oxide semiconductor Field effect transistors (MOSFETS) :** Construction and Operation, Classification of MOSFETS: N-channel(NMOS), P-channel(PMOS) Enhancement and Depletion modes. Comparison between BJT, FET and MOSFET. Basics of Complementary Metal oxide semiconductors(CMOS).

UNIT-IV (8 Hrs)	**Feedback Amplifiers:** Feedback principle and concept, types of feedback, classification of amplifiers, feedback topologies, Characteristics of negative feedback amplifiers, Generalized analysis of feedback amplifiers (without mathematical analysis).
UNIT-V (8 Hrs)	**Oscillators:** Oscillator principle, condition for oscillations, types of oscillators, RC- phase shift and Wien bridge oscillators, Generalized analysis of LC Oscillators, Hartley and Colpitt's oscillators using BJT(without mathematical analysis).
Textbooks:	
1.	Electronic Devices and Circuit Theory – Robert L.Boylestad and Lowis Nashelsky, Pearson Edition, 2021.
2.	Electronic devices and circuits by S.Salivahanan and N.Sureshkumar, Tata MCGrawHilledition.
Reference Books:	
1.	Integrated Electronics: Analog and Digital circuits and systems by Jacob Millman and Christos C.Halkias, Tata MCGraw Hill edition.
2.	Electronic Devices and Circuits by Sanjeev Guptha, DhanapatRai publications.
e-Resources	
1.	https://books.google.co.in/books?id=Qta8v9hJBMAC&printsec=copyright#v=onepage&q&f=false

				Course Code: B23ECM101	
		SAGI RAMA KRISHNAM RAJU ENGINEERING COLLEGE (A)			**R23**
		II B.Tech. II Semester MODEL QUESTION PAPER			
		BASIC ELECTRONICS			
		(Minors Degree Course in ECE)			
Time: 3 Hrs.				**Max. Marks: 70 M**	
		Answer Question No.1 compulsorily			
		Answer **ONE Question** from **EACH UNIT**			
		Assume suitable data if necessary			
				10 x 2 = 20 Marks	
			CO	**KL**	**M**
1.	**a).**	When does a transistor act as a switch?	**1**	**2**	**2**
	b).	What is meant by biasing a transistor?	**2**	**1**	**2**
	c).	Why FET is called as voltage operated device?	**2**	**2**	**2**
	d).	Comparison between JFET and MOSFET.	**3**	**1**	**2**
	e).	Explain the depletion node of operation in MOSFET?	**3**	**2**	**2**
	f).	Explain PMOSFET	**4**	**1**	**2**
	g).	List out the various types of feedback topologies.	**4**	**1**	**2**
	h).	Discuss the merits and demerits of negative feedback amplifiers.	**5**	**1**	**2**
	i).	Write down the general applications of oscillators.	**5**	**2**	**2**
	j).	State the Barkhausen criterion for an oscillator	**5**	**2**	**2**
				5 x 10 = 50 Marks	
		UNIT-1			
2.	**a).**	Plot the input and output characteristics of transistor in CEconfiguration?	**1**	**2**	**5**
	b).	Explain different modes of operation of a BJT.	**1**	**3**	**5**
		OR			
3.		Explain the operation of a BJT in self-bias.	**1**	**4**	**10**
		UNIT-2			
4.	**a).**	List out the advantages of FET over BJT.	**2**	**3**	**5**
	b).	Write a brief note on the characteristics of a Junction FET.	**2**	**2**	**5**
		OR			
5.		Explain the construction and working of a n-channel JFET.	**2**	**3**	**10**
		UNIT-3			
6.	**a).**	Write a brief note on construction and operation of a N-MOSFET.	**3**	**4**	**5**
	b).	List out the comparisons between BJT, FET and MOSFET.	3	4	5
		OR			
7.		Explain the operation of complementary metal oxide semiconductors.	**3**	**3**	**10**
		UNIT-4			
8.	**a).**	Explain the classification of amplifiers?	**4**	**3**	**5**
	b).	Explain voltage series feedback amplifier.	**4**	**3**	**5**
		OR			

9.		Explain current shunt and voltage shunt feedback amplifiers?	**4**	**3**	**10**
		UNIT-5			
10.		Explain the working of Hartley oscillator using BJT	**5**	**3**	**10**
		OR			
11.		Explain the working of RC phase shift oscillator.	**5**	**3**	**10**

CO-COURSE OUTCOME **KL-KNOWLEDGE LEVEL** **M-MARKS**

NOTE : Questions can be given as A,B splits or as a single Question for 10 marks

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
B23ECM201	**Minors**	**3**	**--**	**--**	**3**	**30**	**70**	**3 Hrs.**

SIGNALS AND SYSTEMS

(Minors Degree Course in ECE)

Course Objectives:

1.	To introduce the fundamental concepts and techniques associated with the understanding of signals and systems.
2.	To familiarize with techniques suitable for analyzing continuous-time LTI systems using transforms.
3.	To familiarize with development of mathematical skills to solve problems involving convolution and sampling.

Course Outcomes: At the end of the course, Students will be able to

S.No	Outcome	Knowledge Level
1.	**Apply** the basic concepts of signals and systems.	K3
2.	**Analyze** the spectral characteristics of Continuous Time aperiodic signals using Fourier analysis.	K4
3.	**Apply** Laplace transforms for analyzing continuous time signals and systems	K3
4.	**Apply** Z- transforms for analyzing discrete-time signals and systems.	K3
5.	**Outline** the process of sampling and the effects of under sampling.	K2

SYLLABUS

UNIT-I (8 Hrs)	**Introduction to Continuous –Time and Discrete –Time Signals** Continuous–Time & Discrete–Time signals, Signal Energy and Power, Periodic Signals, Even & odd Signals, Continuous-Time complex Exponential and Sinusoidal Signals, Discrete–Time complex Exponential and Sinusoidal Signals and their Periodicity, The Continuous–Time and Discrete–Time Unit Impulse and Unit step Functions.
UNIT-II (8 Hrs)	**Introduction to Continuous –Time and Discrete –Time Systems** Continuous–Time and Discrete–Time Systems, Operations on signals, Interconnections of Systems, Basic System Properties, Continuous–Time and Discrete Time LTI Systems: The Graphical interpretation of Convolution Integral and The Convolution Sum, Causal LTI Systems Described by Differential and Difference Equations, Singularity Functions.
UNIT-III (8 Hrs)	**Continuous time Fourier Transform** Introduction, Representation of Aperiodic signals, Continuous time Fourier Transform, Properties of the continuous time Fourier Transform, Systems characterized by linear constant coefficient differential equations.

UNIT-IV (8 Hrs)	**Laplace Transform** Introduction, The Laplace Transform, Region of convergence for Laplace Transforms, The Inverse Laplace Transform, Properties of Laplace Transforms, The initial and Final value theorems.
UNIT-V (10 Hrs)	**Sampling Theorem and Z-Transform** Introduction to Sampling Theorem, Statement of Sampling Theorem for Low pass signals (Theorem Proof for Low Pass signals only), Discussion on Critical sampling, Oversampling and Under sampling (aliasing), The Z-Transform, The Inverse ZTransform, Properties of Z-Transform, Initial and Final Value theorems, Some common Z-transform pairs.

Textbooks:	
1.	Signals Systems and Communication-B. P. Lathi, BS Publication.
2.	Signals and Systems- Alan V. Oppenheim, Alan S. Willsky and Ian T. Young, PHI, 2ndEdn.
Reference Books:	
1.	Signals and Systems – P.RamakrishnaRao, TMH.
2.	Signals and Systems- A.AnandKumar,PHI
e-Resources	
1.	https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/videolectures/
2.	https://swayam.gov.in/nd1_noc20_ee06/preview

				Course Code: B23ECM201	
		SAGI RAMA KRISHNAM RAJU ENGINEERING COLLEGE (A)			**R23**
		III B. Tech I Semester MODEL QUESTION PAPER			
		SIGNALS AND SYSTEMS			
		(Minors Degree Course in ECE)			
Time: 3 Hrs.				**Max. Marks: 70 M**	
		Answer Question No.1 compulsorily			
		Answer **ONE Question** from **EACH UNIT**			
		Assume suitable data if necessary			
				10 x 2 = 20 Marks	
			CO	**KL**	**M**
1.	**a).**	Explain how a power signal is different from an energy signal with an example	**1**	**2**	**2**
	b).	What are the properties to be satisfied by the LTI system?	**1**	**2**	**2**
	c).	Give expressions for convolution integral and convolution sum?	**2**	**2**	**2**
	d).	Evaluate even and odd components of $x(t) = \sin(t)\cos(t) - sin(t)$	**2**	**2**	**2**
	e).	State the differentiation in time domain property of the continuous-time Fourier Transform.	**3**	**2**	**2**
	f).	Let x(t)=j/πt, Evaluate it's Fourier Transform	**3**	**3**	**2**
	g).	What is the relation between Laplace transform and Fourier transform?	**4**	**2**	**2**
	h).	An LTI system h(t) is stable, Discuss ROC of system function H(s).	**4**	**2**	**2**
	i).	State the Nyquist criterion for sampling continuous-time signals.	**5**	**2**	**2**
	j).	What is the time shifting property of Z transform?	**5**	**2**	**2**
				5 x 10 = 50 Marks	
		UNIT-1			
2.	**a).**	Explain all classification of signals with examples for each category.	**1**	**3**	**5**
	b).	Determine the power of the following signals. 1)$x(t) = 5\cos(50t)$ 2)$y(t) = e^{j20t}$	**1**	**3**	**5**
		OR			
3.	**a).**	Prove the energy of the power signal is infinite over infinite time.	**1**	**3**	**5**
	b).	Find weather the below signals are periodic or not, if periodic find periodicity also. 1) $x(t) = \cos(0.1\pi\, n)$ 2) $y(t) = \cos(20t)$	**1**	**3**	**5**
		UNIT-2			
4.	**a).**	Determine whether the following systems are time in variant or not. 1)$y(t) = x(t^2)$	**2**	**2**	**5**

		2)$y(t) = x(2n)$			
	b).	Find the convolution of the following two discrete time sequences x(n)={1, 2, 5, 4} and y(n)={6, 2, 4, 3}.	**2**	**2**	**5**
		OR			
	a).	Find the convolution of the following two signals. $x(t) = e^{at}u(t)$& $h(t) = u(t)$	**2**	**3**	**5**
5.	**b).**	Explain all classification of systems with examples for each category.	**2**	**3**	**5**
		UNIT-3			
6.	**a).**	State and derive time shifting and time scaling Properties of Fourier Transform.	**3**	**3**	**5**
	b).	Find the Fourier transform of the following 1. $e^{at}u(t)$ 2. $\cos(3t)\,u(t)$	**3**	**3**	**5**
		OR			
7.	**a).**	Find the inverse Fourier transform of X(jw) =1/(1+jw)^2	**3**	**3**	**5**
	b).	State and prove the differentiation in the frequency domain property of CTFT	**3**	**3**	**5**
		UNIT-4			
8.	**a).**	Find the Laplace Transform of $x(t) = te^{-at}u(t)$	**4**	**3**	**5**
	b).	State and prove any two properties of the Laplace Transform.	**4**	**3**	**5**
		OR			
9.	**a).**	Compute the initial and final values for $X(s) = \frac{2s+5}{s(s+3)(s+4)}$	**4**	**3**	**5**
	b).	Find the inverse Laplace Transform of $X(s) = \frac{2s}{(s-1)(s+4)}$, if ROC is Re{s}>1 & Re{s}<-4	**4**	**3**	**5**
		UNIT-5			
10.	**a).**	Find the inverse Z – Transform of $X(z) = \frac{z(z-1)}{(z+1)(z+2)}$ with ROC$\|z\| > 2$	**5**	**3**	**5**
	b).	State the Nyquist sampling theorem and discuss effects of under sampling,	**5**	**3**	**5**
		OR			
11.	**a).**	List out the properties of ROC of Z – Transform.	**5**	**3**	**5**
	b).	Find the Z – Transform of the signal $\left(\frac{1}{2}\right)^n u(n)$	**5**	**3**	**5**

CO-COURSE OUTCOME KL-KNOWLEDGE LEVEL M-MARKS

NOTE : Questions can be given as A,B splits or as a single Question for 10 marks

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
B23ECM301	**Minors**	**3**	**--**	**--**	**3**	**30**	**70**	**3 Hrs.**

PRINCIPLES OF COMMUNICATIONS

(Minors Degree Course in ECE)

Course Objectives: Students are expected to

1.	Familiarize with the fundamental concepts of communication systems and various techniques of analog modulation and demodulation of signals.
2.	Introduce the elementary concepts of digital communication systems and familiarize with basic techniques of generating and demodulating pulse modulated signals.
3.	Introduce the elementary concepts of digital representation of analog signals.

Course Outcomes: At the end of the course, Students will be able to

S.No	Outcome	Knowledge Level
1.	**Differentiate** various amplitude modulation and demodulation schemes and compare the performance of various amplitude modulation techniques.	K4
2.	**Differentiate** various frequency modulation and demodulation schemes and analyse the performance of frequency modulation techniques.	K4
3.	**Familiarize** the sampling and differentiate various Pulse modulation and demodulation techniques.	K2
4.	**Aware** of basic concepts of digital representation of analog signals.	K2
5.	**Familiarize** the concepts of digital modulation techniques.	K2

SYLLABUS

UNIT-I (10Hrs)	**AMPLITUDE MODULATION:** Introduction, Frequency Translation, Amplitude Modulation, Switching Modulator, Envelope Detector, Double Side Band-Suppressed Carrier Modulation, Ring Modulator, Coherent Detection, Quadrature Amplitude Modulation, SSB Modulation, VSB Modulation, Frequency-Division Multiplexing.
UNIT-II (08 Hrs)	**ANGLE MODULATION:** Basic Definitions, Frequency Modulation: Narrow Band FM, Wide Band FM, Transmission Bandwidth of FM Signals, Generation of FM Signals, Demodulation of FM Signals, Phase-Locked Loop FM demodulator. FM Threshold Effect, Pre-Emphasis and De-Emphasis in FM.
UNIT-III (08 Hrs)	**PULSE MODULATION:** Introduction, why digitize analog sources? The Low Pass Sampling Process, Pulse Amplitude Modulation. Time Division Multiplexing, Pulse width Modulation, Pulse-Position Modulation, Generation and Detection of PWM and PPM waves.

UNIT-IV (08 Hrs)	**DIGITAL REPRESENTATION OF ANALOG SIGNAL:** Quantization of signals, Quantization error, Pulse Code Modulation, Companding, T1 Digital system, Differential Pulse Code Modulation, Delta Modulation.
UNIT-V (08 Hrs)	**DIGITAL MODULATION AND TRANSMISSION:** Binary Phase-Shift Keying, Differential Phase-Shift Keying, Differentially Encoded PSK (DEPSK), Quadrature Phase Shift Keying (QPSK), M-ary PSK, Binary Frequency Shift-Keying**.**
Textbooks:	
1.	**Principles of Communication Systems,** H.Taub&D.L.Schilling, TMH, 2011
2.	**Communication Systems**, Simon Haykins& Moher, 5th Edition, John Willey, India Pvt. Ltd, 2010, ISBN 978 – 81 – 265 – 2151 – 7.
Reference Books:	
1.	Modern Digital and Analog Communication Systems, B. P. Lathi, Oxford University Press., 4th edition.
2.	An Introduction to Analog and Digital Communication, Simon Haykins, John Wiley India Pvt. Ltd., 2008, ISBN 978–81–265–3653–5.
3.	Communication Systems, Harold P.E, Stern Samy and A.Mahmond, Pearson Edition, 2004.
4.	Communication Systems: Analog and Digital, R.P.Singh and S.Sapre: TMH 2nd edition, 2007.
e-Resources	
1.	https://nptel.ac.in/courses/117/105/117105143/
2.	https://nptel.ac.in/courses/117/101/117101051/
3.	https://www.tutorialspoint.com/analog_communication/index.htm
4.	https://www.tutorialspoint.com/digital_communication/index.htm

				Course Code: B23ECM301	
SAGI RAMA KRISHNAM RAJU ENGINEERING COLLEGE (A)					**R23**
III B.Tech II Semester MODEL QUESTION PAPER					
PRINCIPLES OF COMMUNICATIONS					
(Minors Degree Course in ECE)					
Time: 3 Hrs.				**Max. Marks: 70 M**	
Answer Question No.1 compulsorily					
Answer **ONE Question** from **EACH UNIT**					
Assume suitable data if necessary					
				10 x 2 = 20 Marks	
			CO	**KL**	**M**
1.	**a).**	What is frequency translation, and why is it used in communication systems?	**1**	**2**	**2**
	b).	Explain the purpose of an envelope detector in amplitude modulation.	**1**	**3**	**2**
	c).	Differentiate between Narrowband FM and Wideband FM.	**2**	**2**	**2**
	d).	What is the function of pre-emphasis in FM systems?	**2**	**3**	**2**
	e).	What is pulse amplitude modulation (PAM)?	**3**	**2**	**2**
	f).	How does pulse-width modulation (PWM) differ from pulse-position modulation (PPM)?	**3**	**3**	**2**
	g).	What is quantization error in digital communication?	**4**	**2**	**2**
	h).	Define differential pulse code modulation (DPCM).	**4**	**2**	**2**
	i).	What is binary phase-shift keying (BPSK)?	**5**	**2**	**2**
	j).	What is the role of frequency-shift keying (FSK) in digital communication?	**5**	**2**	**2**
				5 x 10 = 50 Marks	
		UNIT-1			
2.	**a).**	Explain the working principles of amplitude modulation (AM) with suitable diagrams?	**1**	**3**	**5**
	b).	Explain generation of DSB-SC Signal	**1**	**3**	**5**
3.	**a).**	Explain about envelope detection, and its applications	**1**	**3**	**4**
	b).	Compare and contrast double sideband (DSB), single sideband (SSB), and vestigial sideband (VSB) modulation techniques.	**1**	**3**	**6**
		UNIT-2			
4.	**a).**	Describe the generation and demodulation of FM signals	**2**	**3**	**5**
	b).	Discuss narrowband and wideband FM	**2**	**3**	**5**
		OR			
5.	**a).**	Explain the FM threshold effect.	**2**	**3**	**4**
	b).	Discuss the importance of PLL in FM demodulator	**2**	**3**	**6**
		UNIT-3			
6.	**a).**	Why is digitization of analog sources necessary? Explain pulse amplitude modulation (PAM).	**3**	**3**	**5**
	b).	Discuss time-division multiplexing (TDM) and its significance in pulse	**3**	**3**	**5**

		modulation systems.			
		OR			
7.		Explain how pulse width modulation (PWM) and pulse position modulation (PPM) signals are generated and detected.	**3**	**3**	**10**
		UNIT-4			
8.	**a).**	Explain pulse code modulation (PCM).	**4**	**3**	**6**
	b).	Explain delta modulation and highlight its advantages and limitations compared to PCM.	**4**	**3**	**4**
		OR			
9.	**a).**	Explain the quantization process, including the concept of quantization error.	**4**	**3**	**5**
	b).	Describe differential pulse code modulation (DPCM).	**4**	**3**	**5**
		UNIT-5			
10.	**a).**	Discuss M-arysignaling techniques, their significance in improving data transmission rates, and the comparison between M-ary PSK and M-ary FSK.	**5**	**3**	**5**
	b).	Discuss frequency-shift keying (FSK). Discuss their applications and performance in communication systems.	**5**	**3**	**5**
		OR			
11.	**a).**	Compare and contrast different digital modulation techniques, such as binary phase-shift keying (BPSK), quadrature phase-shift keying (QPSK)	**5**	**3**	**6**
	b).	Explain and quadrature phase-shift keying (QPSK) in detail. Discuss their signal representation and error performance.	**5**	**3**	**4**

CO-COURSE OUTCOME KL-KNOWLEDGE LEVEL M-MARKS

NOTE : Questions can be given as A,B splits or as a single Question for 10 marks

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
B23ECM401	Minors	3	--	--	3	30	70	3 Hrs.

BASIC VLSI DESIGN

(Minors Degree Course in ECE)

Course Objectives:

1.	To introduce various fabrication steps of MOS transistors and their electrical properties.
2.	To implement the stick diagrams and layouts using CMOS/Bi-CMOS design rules.
3.	To explain MOS technology interconnection such as circuits, scaling models, static and dynamic designs.
4.	To introduce Basic FPGA Architecture and testing methods of digital circuits.

Course Outcomes: At the end of the course, Students will be able to

S.No	Outcome	Knowledge Level
1.	**Understand** CMOS fabrication and MOS transistor characteristics.	K2
2.	**Draw** layout diagrams using stick diagrams and design rules.	K3
3.	**Analyze** delay and scaling in MOS circuits.	K4
4.	**Apply** testability techniques and understand FPGA architecture.	K3
5.	**Design** static and dynamic CMOS logic circuits.	K4

SYLLABUS

UNIT-I (10Hrs)	**Introduction:** Introduction to IC Technology, Fabrication process: CMOS (NMOS, PMOS), Ids versus Vds Relationships, Aspects of MOS transistor Threshold Voltage, MOS transistor Transconductance, Output Conductance and Figure of Merit. NMOS Inverter, Pull-up to Pull down Ratio for NMOS inverter driven by another NMOS Inverter, and through one or more pass transistors, The CMOS Inverter, Latch-up in CMOS circuits.
UNIT-II (10 Hrs)	**MOS and Bi-CMOS Circuit Design Processes:** MOS Layers, Stick Diagrams, Design Rules and Layout, General observations on the Design rules, 2µm Double Metal, Double Poly, CMOS/BiCMOS rules, Layout Diagrams of NAND and NOR gates and CMOS inverter.
UNIT-III (10 Hrs)	**Basic Circuit Concepts:** Sheet Resistance, Sheet Resistance concept applied to MOS transistors and Inverters, Area Capacitance of Layers, Standard unit of capacitance, The Delay Unit, Inverter Delays, Propagation Delays. Scaling of MOS Circuits: Scaling models, Scaling factors for device parameters, Limitations of Scaling on substrate doping.
UNIT-IV (10 Hrs)	**Test and Testability:** Design for Testability, Scan Design Techniques and Built-In-Self Test. FPGA Based Systems: Introduction, Basic concepts, FPGA architecture.

UNIT-V (10 Hrs)	**Static CMOS Design:** Complementary CMOS and its static properties, Ratioed logic, Pass Transistor logic- Design of logic gates. Dynamic CMOS Design: Basic principles, speed and power dissipation of dynamic logic, Issues in dynamic logic- charge leakage, charge sharing, Static latches and registers- Latches versus registers, The bistability principle.
Textbooks:	
1.	Essentials of VLSI Circuits and Systems By Kamran Eshraghian, Douglas and A. Pucknell and Sholeh Eshraghian, Prentice-Hall of India Private Limited,2005 Edition. 2. Digital Integrated Circuits, Jan M. Rabaey, Anantha Chandrakasan and Borivoje Nikolic,2nd edition, 2016
2.	Digital Integrated Circuits, Jan M. Rabaey, Anantha Chandrakasan and Borivoje Nikolic,2nd edition, 2016.
Reference Books:	
1.	FPGA Based System Design‖- Wayne Wolf, Pearson Education, 2004, Technology and Engineering 2. CMOS Digital Integrated Circuits Analysis and Design, Sung-Mo Kang, Yusuf Leblebici, Tata McGraw Hill Education,2003.
2.	CMOS Digital Integrated Circuits Analysis and Design, Sung-Mo Kang, Yusuf Leblebici, Tata McGraw Hill Education,2003.
e-Resources	
1.	https://www.engineersgarage.com/vlsi-technology-an-overview/
2.	https://www.tutorialspoint.com/vlsi_design/vlsi_design_digital_system.html

					Course Code: B23ECM401
		SAGI RAMA KRISHNAM RAJU ENGINEERING COLLEGE (A)			**R23**
		IV B.Tech I Semester MODEL QUESTION PAPER			
		BASIC VLSI DESIGN			
		(Minors Degree Course in ECE)			
Time: 3 Hrs.					**Max. Marks: 70 M**
		Answer Question No.1 compulsorily			
		Answer **ONE Question** from **EACH UNIT**			
		Assume suitable data if necessary			
					10 x 2 = 20 Marks
			CO	**KL**	**M**
1.	**a).**	Give the basic process for IC fabrication	**1**	**2**	**2**
	b).	What is Enhancement mode transistor?	**1**	**3**	**2**
	c).	Give the different types of CMOS process?	**2**	**2**	**2**
	d).	Give the various color coding used in stick diagram?	**2**	**1**	**2**
	e).	What do you mean by inverter delay?	**3**	**1**	**2**
	f).	What are the limitations of scaling	**3**	**2**	**2**
	g).	Give some examples of fault models?	**4**	**2**	**2**
	h).	What are the different methods of programming of PALs?	**4**	**1**	**2**
	i).	Discuss ratoned logic?	**5**	**2**	**2**
	j).	compare Static CMOS and Dynamic CMOS logic?	**5**	**1**	**2**
					5 x 10 = 50 Marks
		UNIT-1			
2.	**a).**	Explain the NMOS fabrication steps with neat diagrams.	**1**	**3**	**6**
	b).	Derive the relation between pull –up tp pull-down ratio for nMOS inverter.	**1**	**3**	**4**
3.	**a).**	With neat diagrams explain the process of P-well CMOS Inverter.	**1**	**3**	**6**
	b).	Explain in detail about latch-up in CMOS	**1**	**3**	**4**
		UNIT-2			
4.		Draw the stick diagrams and layouts for (a) CMOS inverter (b) 3 Input NAND and NOR gates using NMOS Technology	**2**	**4**	**10**
		OR			
5.		Sketch λ-based design rules for wires, transistors and contacts.	**2**	**4**	**10**
		UNIT-3			
6.	**a).**	What is meant by Delay unit? Estimate NMOS inverter pair delays with relevant example.	**3**	**2**	**5**
	b).	Write a short note on scaling models.	**3**	**2**	**5**
		OR			
7.	**a).**	Draw scaled NMOS transistor and derive all scaling factors for device parameters. Consider Combined V and D scaling model .	**3**	**3**	**5**
	b).	Calculate total on resistance of CMOS inverter where ZPU/ZPD=8/1	**3**	**2**	**5**

		UNIT-4			
8.	**a).**	Explain about various Scan design techniques.	**4**	**2**	**5**
	b).	Explain about controllability and observability?	**4**	**2**	**5**
		OR			
9.	**a).**	Explain the Basic FPGA Architecture.	**4**	**3**	**5**
	b).	Write various steps to be followed for test mode in Scan Design Techniques?	**4**	**2**	**5**
		UNIT-5			
10.	**a).**	Write a short note on complementary CMOS and its properties	**5**	**3**	**6**
	b).	Explain Bi-stability principle.	**5**	**2**	**4**
		OR			
11.		Explain charge leakage and charge sharing in dynamic logics.	**5**	**3**	**10**

CO-COURSE OUTCOME **KL-KNOWLEDGE LEVEL** **M-MARKS**

NOTE : Questions can be given as A,B splits or as a single Question for 10 marks