NANDHA ENGINEERING COLLEGE

(AUTONOMOUS)

(Approved by AICTE, New Delhi and Affiliated to Anna University, Chennai)

ERODE – 638052 TAMIL NADU

Email: principal@nandhaengg.org Mobile : 73737 12234

1.1.2 Details of Courses where syllabus revision was carried out

B.E.- Electronics and Communication Engineering

R-22 Curriculum

Course Code	Course Name	% of Change
22ECC13	Digital Signal Processing	5
22ECC14	Analog and Digital Communication	5
22ECP06	Analog and Digital Communication Laboratory	10
22ECC13	Microprocessors and Microcontroller Interfacing	30
22ECC14	Data Communication Networks	40
22ECP06	Microprocessors and Microcontrollers Laboratory	5
22ECP07	Data Communication Networks Laboratory	10
22ECC15	VLSI and Chip Design	70
22ECC16	Embedded Systems and IOT Design	100
22ECC05	VLSI Design Laboratory	80
22ECP08	Embedded Systems and IOT Design Laboratory	100
22GED02	Internship/ Industrial Training	100
22ECX01	ASIC Design	100
22ECX02	System on Chip Design	100
22ECX03	System Verilog	100
22ECX04	VLSI Testing and Testability	100
22ECX05	Electronic System Design	100
22ECX06	Electronic Circuit Board Design	100

NANDHA ENGG. COLLEGE DEPT. OF ECE ERODE-52.

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Course Code	Course Name	% of Change
22ECX07	Semiconductor Device Modelling and Simulation	100
22ECX08	Electronic System Packaging	100
22ECX11	Mobile Communication	100
22ECX12	Satellite Communication	70
22ECX14	Information Theory and Coding	100
22ECX15	Radar Communication	70
22ECX16	Digital Communication receivers	100
22ECX17	Software Defined Radio	40
22ECX18	4G / 5G Communication Networks	100
22ECX21	Computer System and Hardware	100
22ECX22	Network Information Security	100
22ECX24	High Performance Communication Networks	40
22ECX25	Wireless Adhoc and Sensor Networks	100
22ECX26	Automotive Electronics and Networking	100
22ECX27	Neural Networks	100
22ECX28	Artificial Intelligence	100
22ECX32	Speech Signal Processing	80
22ECX34	Deep Learning	100
22ECX35	Computer Vision	100
22ECX36	Machine Learning	100
22ECX37	Soft Computing	100
22ECX38	Pattern Recognition	100

NANDHA ENGG. COLLEGE DEPT. OF ECE ERODE-52.

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Course Code	Course Name	% of Change
22ECX41	Control Systems	40
22ECX42	Virtual Instrumentation	100
22ECX43	Wearable Devices	100
22ECX45	Internet Of Things & Its Applications	80
22ECX46	IOT With Single Board Computers	100
22ECX47	Industrial IOT And Industry 4.0	100
22ECX48	Automation for Robotics	100
	Average	**80.32**

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NANDHA ENGG. COLLEGE
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NANDHA ENGINEERING COLLEGE

(An Autonomous Institution affiliated to Anna University Chennai and approved by AICTE, New Delhi)
Erode-638 052, Tamilnadu, India, Phone: 04294 – 225585

Curriculum and Syllabi

for

B.E – Electronics and Communication Engineering [R22]

[CHOICE BASED CREDIT SYSTEM]

(This Curriculum and Syllabi are applicable to Students admitted from the Academic year 2024- 2025 onwards)

July 2024

NANDHA ENGINEERING COLLEGE (AUTONOMOUS), ERODE – 638 052

REGULATIONS – R22 **CHOICE BASED CREDIT SYSTEM**

B.E. ELECTRONICS AND COMMUNICATION ENGINEERING

SEMESTER: I									
S. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PRE-REQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY & EMBEDDED COURSES									
1	22EYA01	Professional Communication - I	HSMC	-	4	2	0	2	3
2	22MYB01	Calculus and Linear Algebra*	BSC	-	4	3	1	0	4
3	22CYB04	Engineering Chemistry	BSC	-	3	3	0	0	3
4	22CSC01	Problem Solving and C Programming	ESC	-	3	3	0	0	3
5	22ECC02	Basics of Electrical and Instrumentation Engineering	ESC	-	3	3	0	0	3
6	22GYA01	தமிழர் மரபு/Heritage of Tamils	HSMC	-	1	1	0	0	1
PRACTICALS									
7	22CSP01	Problem Solving and C Programming Laboratory*	ESC	-	4	0	0	4	2
8	22CYP01	Chemistry Laboratory*	BSC	-	2	0	0	2	1
9	22GEP01	Engineering Practices Laboratory	ESC	-	4	0	0	4	2
MANDATORY NON CREDIT COURSES									
10	22MAN01	Induction Programme	MC	-	0	0	0	0	0
11	22MAN03	Yoga – I *	MC	-	1	0	0	1	0
				TOTAL	**31**	**15**	**1**	**15**	**22**

*** Ratified by Eleventh Academic Council**

SEMESTER: II									
S. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PRE REQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY & EMBEDDED COURSES									
1	22EYA02	Professional Communication- II	HSMC	22EYA01	4	2	0	2	3
2	22MYB04	Transforms and Partial Differential Equations*	BSC	-	4	3	1	0	4
3	22PYB03	Solid State Physics	BSC	-	3	3	0	0	3
4	22CSC02	Data Structures using C*	ESC		3	3	0	0	3
5	22ECC04	Electronic Devices and Circuits (Theory + Lab)	PCC	-	5	3	0	2	4
6	22GYA02	தமிழரும் தொழில்நுட்பமும்/ Tamils and Technology	HSMC	-	1	1	0	0	1
PRACTICALS									
7	22PYP01	Physics Laboratory*	BSC	-	2	0	0	2	1
8	22CSP02	Data Structures Laboratory*	ESC	-	4	0	0	4	2
9	22MEP01	Engineering Graphics Laboratory	ESC	-	4	0	0	4	2
MANDATORY NON CREDIT COURSES									
10	22MAN02R	Soft /Analytical Skills - I	MC	-	3	1	0	2	0
11	22MAN05	Yoga - II*	MC	-	1	0	0	1	0
				TOTAL	**33**	**16**	**1**	**1**	**23**

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SEMESTER: III									
S. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PRE-REQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY & EMBEDDED COURSES									
1	22MYB06	Probability and Random Processes	BSC	-	4	3	1	0	4
2	22ECC05	Digital Logic Design	PCC	-	3	3	0	0	3
3	22ECC06	Signals and Systems	PCC	22MYB01, 22MYB04	3	3	0	0	3
4	22ECC07	Analog Electronics	PCC	22ECC04	3	3	0	0	3
5	22ECC08	Electromagnetic Waves	PCC	-	3	3	0	0	3
6	22ITC04	Algorithms	ESC	-	3	3	0	0	3

PRACTICALS									
7	22ECP02	Digital Logic Design Laboratory	PCC	-	4	0	0	4	2
8	22ECP03	Analog Electronics Laboratory	PCC	22ECC04	4	0	0	4	2
MANDATORY NON CREDIT COURSES									
9	22MAN04R	Soft / Analytical Skills - II	MC	-	3	1	0	2	0
10	22MAN09	Indian Constitution	MC	-	1	1	0	0	0
				TOTAL	**31**	**20**	**1**	**10**	**23**

SEMESTER: IV									
S. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PRE-REQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY & EMBEDDED COURSES									
1	22ITC06	Java Programming	ESC	-	3	3	0	0	3
2	22ECC09	Analog Circuit Design	PCC	22ECC04	3	3	0	0	3
3	22ECC10	Transmission Lines and RF Systems	PCC	22ECC08	3	3	0	0	3
4	22ECC11	Digital Signal Processing*	PCC	22ECC06	5	3	0	2	4
5	22ECC12	Analog and Digital Communication*	PCC	22ECC06	3	3	0	0	3
PRACTICALS									
6	22ITP04	Java Programming Laboratory	ESC	-	4	0	0	4	2
7	22ECP04	Analog Circuit Design Laboratory	PCC	22ECC04	4	0	0	4	2
8	22ECP05	Analog and Digital Communication Laboratory*	PCC	22ECC06	4	0	0	4	2
MANDATORY NON CREDIT COURSES									
9	22MAN07R	Soft/Analytical Skills - III	MC	-	5	3	0	2	0
10	22GED01	Personality and Character Development	MC	-	1	0	0	1	0
				TOTAL	**35**	**20**	**0**	**15**	**22**

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SEMESTER: V									
S. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PRE-REQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY & EMBEDDED COURSES									
1	22ECC13	Microprocessors and Microcontroller Interfacing	PCC	-	3	3	0	0	3
2	22ECC14	Data Communication Networks	PCC	-	3	3	0	0	3
3	22CYB06	Environmental Science and Sustainability	BSC	-	3	3	0	0	3
4	E1	Elective(PEC)	PEC	-	3	3	0	0	3
5	E2	Elective(PEC)	PEC	-	3	3	0	0	3
6	E3	Elective(PEC)	PEC	-	3	3	0	0	3
PRACTICALS									
7	22ECP06	Microprocessors and Microcontrollers Laboratory	PCC	-	4	0	0	4	2
8	22ECP07	Data Communication Networks Laboratory	PCC	-	4	0	0	2	2
MANDATORY NON CREDIT COURSES									
9	22MAN08R	Soft/Analytical Skills - IV	MC	-	3	1	0	2	0
				TOTAL	**29**	**19**	**0**	**11**	**22**

SEMESTER: VI									
S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PRE-REQUISITE	CONTACT PERIODS	L	T	P	C
THEORY & EMBEDDED COURSES									
1	22ECC15	VLSI and Chip Design	PCC	-	3	3	0	0	3
2	22ECC16	Embedded Systems and IOT Design	PCC	-	3	3	0	0	3
3	E4	Elective (PEC)	PEC	-	3	3	0	0	3
4	E5	Elective(PEC)	PEC	-	3	3	0	0	3
5	E6	Elective(PEC)	PEC		3	3	0	0	3
6	E7	Elective(OEC/PEC)	OEC/PEC	-	3	3	0	0	3
PRACTICALS									
7	22ECP08	VLSI Design Laboratory	PCC	-	4	0	0	4	2
8	22ECP09	Embedded Systems and IOT Design Laboratory	PCC	-	4	0	0	4	2
				TOTAL	**26**	**18**	**0**	**8**	**22**

SEMESTER: VII									
S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PRE-REQUISITE	CONTACT PERIODS	L	T	P	C
THEORY & EMBEDDED COURSES									
1	22GEA01	Universal Human Values	HSMC	-	2	2	0	0	2
2	EM1	Elective (Management)	HSMC	-	3	3	0	0	3
3	E8	Elective(OEC)	OEC	-	3	3	0	0	3
4	E9	Elective(OEC)	OEC		3	3	0	0	3
5	E10	Elective(OEC)	OEC	-	3	3	0	0	3
PRACTICALS									
6	22GED02	Internship/ Industrial Training	EEC	-	-	0	0	0	2
7	22ECD01	Project Work - I	EEC	-	4	0	0	4	2
				TOTAL	**23**	**15**	**0**	**8**	**18**

SEMESTER: VIII									
S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PRE-REQUISITE	CONTACT PERIODS	L	T	P	C
PRACTICALS									
1	22ECD02	Project Work - II	EEC	-	20	0	0	20	10
				TOTAL	**20**	**0**	**0**	**20**	**10**

(C) Programme Elective Courses (PEC)									
Vertical 1: Semiconductors									
S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PREREQUISITE	CONTACT PERIODS	L	T	P	C
1.	22ECX01	ASIC Design	PEC	-	3	3	0	0	3
2.	22ECX02	System on Chip Design	PEC	-	3	3	0	0	3
3.	22ECX03	System Verilog	PEC	-	3	3	0	0	3
4.	22ECX04	VLSI Testing and Testability	PEC	-	3	3	0	0	3
5.	22ECX05	Electronic System Design	PEC	-	3	3	0	0	3
6.	22ECX06	Electronic Circuit Board Design	PEC	-	3	3	0	0	3
7.	22ECX07	Semiconductor Device Modelling and Simulation	PEC	-	3	3	0	0	3
8.	22ECX08	Electronic System Packaging	PEC	-	3	3	0	0	3
Vertical 2: Communication									
S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PREREQUISITE	CONTACT PERIODS	L	T	P	C
1.	22ECX11	Mobile Communication	PEC	-	3	3	0		3
2.	22ECX12	Satellite Communication	PEC	-	3	3	0		3
3.	22ECX13	Optical Communication	PEC	-	3	3	0		3
4.	22ECX14	Information Theory and Coding	PEC	-	3	3	0		3
5.	22ECX15	Radar Communication	PEC	-	3	3	0		3
6.	22ECX16	Digital Communication receivers	PEC	-	3	3	0		3
7.	22ECX17	Software Defined Radio	PEC	-	3	3	0		3
8.	22ECX18	4G / 5G Communication Networks	PEC	-	3	3	0		3
Vertical 3: Networks									
S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PREREQUISITE	CONTACT PERIODS	L	T	P	C
1.	22ECX21	Computer System and Hardware	PEC	-	3	3	0	0	3
2.	22ECX22	Network Information Security	PEC	-	3	3	0	0	3
3.	22ECX23	Cryptography and Network Security	PEC	-	3	3	0	0	3
4.	22ECX24	High Performance Communication Networks	PEC	-	3	3	0	0	3
5.	22ECX25	Wireless Adhoc and Sensor Networks	PEC	-	3	3	0	0	3
6.	22ECX26	Automotive Electronics and Networking	PEC	-	3	3	0	0	3
7.	22ECX27	Neural Networks	PEC	-	3	3	0	0	3
8.	22ECX28	Artificial Intelligence	PEC	-	3	3	0	0	3

Vertical 4: Signal and Image Processing									
S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PREREQUISITE	CONTACT PERIODS	L	T	P	C
1.	22ECX31	Digital Image Processing	PEC	-	3	3	0	0	3
2.	22ECX32	Speech Signal Processing	PEC	-	3	3	0	0	3
3.	22ECX33	Multimedia Compression Techniques	PEC	-	3	3	0	0	3
4.	22ECX34	Deep Learning	PEC	-	3	3	0	0	3
5.	22ECX35	Computer Vision	PEC	-	3	3	0	0	3
6.	22ECX36	Machine Learning	PEC	-	3	3	0	0	3
7.	22ECX37	Soft Computing	PEC	-	3	3	0	0	3
8.	22ECX38	Pattern Recognition	PEC	-	3	3	0	0	3
Vertical 5: Embedded and IOT									
S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PREREQUISITE	CONTACT PERIODS	L	T	P	C
1.	22ECX41	Control Systems	PEC	-	3	3	0	0	3
2.	22ECX42	Virtual Instrumentation	PEC	-	3	3	0	0	3
3.	22ECX43	Wearable Devices	PEC	-	3	3	0	0	3
4.	22ECX44	Real Time Embedded Systems	PEC	-	3	3	0	0	3
5.	22ECX45	Internet Of Things & Its Applications	PEC	-	3	3	0	0	3
6.	22ECX46	IOT With Single Board Computers	PEC	-	3	3	0	0	3
7.	22ECX47	Industrial IOT And Industry 4.0	PEC	-	3	3	0	0	3
8.	22ECX48	Automation for Robotics	PEC	-	3	3	0	0	3

(C) MANAGEMENT ELECTIVES									
1.	22GEA02	Principles of Management	MEC	-	3	3	0	0	3
2.	22GEA03	Total Quality Management	MEC	-	3	3	0	0	3
3.	22GEA04	Professional Ethics and Human Values	MEC	-	3	3	0	0	3
(D) OPEN ELECTIVES									
1.	22ECZ01	Fundamentals of IoT	OEC	-	3	3	0	0	3
2.	22ECZ02	Sensors and transducers	OEC	-	3	3	0	0	3
3.	22ECZ03	Principles of Communication	OEC	-	3	3	0	0	3
4.	22ECZ04	VLSI technology	OEC	-	3	3	0	0	3

(E) Employability Enhancement Courses (EEC)									
S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PRE REQUISITE	CONTACT PERIODS	L	T	P	C
1.	22GED02	Internship/ Industrial Training	EEC	-	4	0	0	0	2
2.	22ECD01	Project Work - I	EEC	-	4	0	0	4	2
3.	22ECD02	Project Work - II	EEC	-	20	0	0	20	10

Minor Courses									
Semi Conductor Technologies									
S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PRE REQUISITE	CONTACT PERIODS	L	T	P	C
1.	22ECM01	Fundamentals of Semiconductor Devices	OEC	-	3	3	0	0	3
2.	22ECM01	Semiconductor devices and circuits	OEC	-	3	3	0	0	3
3.	22ECM01	Semiconductor Device Modelling and Simulation	OEC	-	3	3	0	0	3
4.	22ECM01	Basic Electronics	OEC	-	3	3	0	0	3
5.	22ECM01	Semiconductor Optoelectronics	OEC	-	3	3	0	0	3
6.	22ECM01	Micro Electro Mechanical Systems	OEC	-	3	3	0	0	3
7.	22ECM01	Electronic system Packaging	OEC	-	3	3	0	0	3
8.	22ECM01	System on a chip Design	OEC	-	3	3	0	0	3

SUMMARY

S. No.	SUBJECT AREA	CREDITS AS PER SEMESTER								CREDITS TOTAL
		I	II	III	IV	V	VI	VII	VIII	
1.	HSMC	4	4	0	0	0	0	5	0	13
2.	BSC	8	8	4	0	3	0	0	0	23
3.	ESC	10	7	3	5	0	0	0	0	25
4.	PCC	0	4	16	17	10	10	0	0	57
5.	PEC	0	0	0	0	9	9/12	0	0	18/21
6.	OEC	0	0	0	0	0	3	9	0	9/12
7.	EEC	0	0	0	0	0	0	4	10	14
CREDITS TOTAL		22	23	23	22	22	22	18	10	162
CREDITS %		8%	14.2%	35.2%	15.4%	8.6%	13%	7.4%		
AICTE CREDITS		12	25	48	24	15	24	12		160
AICTE %		8%	16%	30%	15%	9%	15%	8%		

22ECC11 - DIGITAL SIGNAL PROCESSING				
	L	T	P	C
	3	0	2	4

PREREQUISITE : 22ECC06

Course Objective:	• To learn discrete Fourier transforms and Fast Fourier Transform and its properties. • To know the characteristics of FIR filters and IIR filters and design of filters for filtering undesired signals. • To understand Finite word length effects. • To understand the fundamental concepts of multi rate signal processing and its applications

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the knowledge of signal processing to solve Engineering problems on Discrete Fourier Transform and Filters.	Ap	30%
CO2	Apply transform technique concepts in realizing Digital filters.	Ap	20%
CO3	Analyze the concepts of finite word length effects and multirate signal processing to minimize the errors and improve the performance.	An	20%
CO4	Design of Digital Filters for given specifications.	E	30%
CO5	Use appropriate tools to conduct experiments involving implementation of DSP concepts and filters.	E	Laboratory Exam

UNIT I - FAST FOURIER TRANSFORMS	**(9)**
Introduction to DFT and IDFT, Properties of DFT, FFT Algorithm-Radix-2 - Decimation in Time (DIT)-Decimation in Frequency (DIF)Fast Convolution-Overlap Save method-Overlap Add Method.	
UNIT II – DIGITAL IIR FILTERS	**(9)**
Review of design techniques for analog low pass filter (Butterworth and Chebyshev type-1), Frequency transformation in Analogue domain, IIR filter Design: Bilinear and Impulse Invariant Techniques, Realization structures for IIR filters	
UNIT III - DIGITAL FIR FILTERS	**(9)**
Design characteristics of FIR filters with linear phase – Frequency response of linear phase FIR filters - Design of FIR filters using window functions (Rectangular, Hamming, Hanning, and Blackman) - Realization structures for FIR filters(Direct form I and II).	
UNIT IV - FINITE WORD LENGTH EFFECTS	**(9)**
Fixed point and floating point number representation - ADC - quantization - truncation and rounding-quantization noise - input / output quantization - coefficient quantization error - product quantization error - overflow error - limit cycle oscillations due to product quantization and summation	

UNIT V - MULTIRATE SIGNAL PROCESSING	(9)
Multirate signal processing: Decimation, Interpolation, Sampling rate conversion by a rational factor I/D – Implementation of sampling rate conversion : Polyphase filter Structures- Interchange of filters and Downsamplers /Upsamplers –Application of Multirate signal processing.	

LIST OF PROGRAMS USING MATLAB (Laboratory Component**):**

1. Implementation of DIT and DIF Algorithms.
2. Implementation of Low pass and high pass FIR filter for a given sequence.
3. Implementation of Low pass and high pass IIR filter for a given sequence.
4. Verification of Sampling Theorem.
5. Implementation of Decimation Process

TOTAL (L:45 P:30) : 75 PERIODS

TEXT BOOKS:

1. J.G.Proakis, D.G.Manolakis and D.Sharma, "Digital Signal Processing, Algorithms and Applications", Pearson Education, 2012.

REFERENCES:

1. S. Salivahanan, A. Vallavaraj and G.Gnanapriya, "Digital Signal Processing", Tata McGraw-Hill Company Publication Limited, 21 st Reprint 2007.
2. Oppenheim V.A.V and Schaffer R.W, "Discrete – time Signal Processing", 2nd Edition, Prentice Hall, 2013.
3. S.K.Mitra, Digital Signal Processing, 4th Edition, TMH, 2010.
4. Lawrence R Rabiner and Bernard Gold, "Theory and Application of Digital Signal Processing", PHI 2010.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												2	1
2	3												1	2
3		3											2	2
4			3										1	2
5					3				2	1			2	3
CO (W.A)	**3**	**3**	**3**		**3**				**2**	**1**			**2**	**2**

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22ECC12 - ANALOG AND DIGITAL COMMUNICATION				
	L	T	P	C
	3	0	0	3

PREREQUISITE : 22ECC06

Course Objective:	• To provide knowledge on complete analysis of Amplitude and Angle modulation schemes. • To deliberate the performance of Pass band, base bandand spread spectrum communication. • To learn the concepts of information theory and basics of error control coding.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply various concepts of theorems and Transforms for computing parameters of Communication systems.	Ap	20%
CO2	Analyze performance of different types of Analog modulation Techniques and information theory concepts for a given set of parameters.	An	20%
CO3	Analyze performance of different types of Digital modulation Techniquesfor a given set of parameters.	An	40%
CO4	Design Analog and Digital Communicationsubsystems for given set of specifications.	C	20%
CO5	Engage in independent/team learning, communicate effectively, develop a project that implement Analog and Digital Communication concepts and give oral presentation.	U	Internal Assessment

UNIT I - AMPLITUDE MODULATION	**(9)**
Functional block diagram of communication systems- Linear modulation schemes: Generation of AM: DSBFC using balanced modulator- Introduction to DSBSC, SSBSC and VSB Signals- Comparison of Amplitude Modulation Systems. Super heterodyne receivers- Noise in AM receivers - coherent detection, envelope detection.	
UNIT II - ANGLE MODULATION	**(9)**
Frequency modulation and Phase modulation, Relation between FM and PM waves Narrowband FM, Wideband FM-Generation of FM: indirect method-FM demodulation: frequency discriminator-Non linear effects in FM systems-Noise in FM receivers-capture effect-pre emphasis and de-emphasis in FM.	
UNIT III - INFORMATION THEORY AND CODING	**(9)**
Entropy and its properties-source coding theorem: Shanon-Fano coding, Discrete memory less channel-mutual information and its properties-channel coding theorem-information capacity theorem; Hamming codes,	

UNIT IV - PULSE MODULATION AND BASEBAND TRANSMISSION	(9)
Sampling process-PAM, PPM, PWM-Quantization process-PCM-DPCM-Delta Modulation-Adaptive delta modulation-Classification of line coding and Decoding-Matched Filter –Error rate due to noise –Inter symbol Interference-Eye patterns - Nyquist criterion for distortion less base band Binary Transmission-Correlative level coding: Duo binary with and without precoder- Modified duo binary with and without precoder.	
UNIT V - PASSBAND DATA AND SPREAD SPECTRUM MODULATION	**(9)**
Pass band Transmission model-Generation, detection ,signal space diagram, bit error probability and power spectra of Binary Modulation schemes (ASK,FSK,PSK), Quadrature Modulation schemes (QPSK,QAM) – Comparison of Binary and Quadrature modulation techniques. Spread Spectrum: PN sequence and its properties- Direct sequence spread spectrum-Frequency Hopping spread spectrum.	
TOTAL (L:45) : 45 PERIODS	

TEXT BOOKS:

1. Simon Haykin, "Communications Systems", Wiley Education, 5th Edition, 2009.
2. T L Singal, "Analog & Digital Communications", Tata McGraw-Hill Education, 4th Edition, 2012

REFERENCES:

1. Taub H and Schilling D L, "Principles of Communication Systems", McGraw Hill, 4th Edition, 2017.
2. Wayne Tomasi, "Electronic Communications Systems–Fundamentals Through advanced", Pearson Education, 4th Edition, 2007.
3. Praokis J.G., "Digital Communications" 5th Edition, McGraw Hill, 2014.
4. Bernard Sklar, Pabitra Kumar Ray "Digital Communications: Fundamentals & Applications", Pearson Education, 2nd Edition, 2009.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												2	
2		3											2	
3		3											2	
4			3										3	
5									2	2	2	2	2	
CO (W.A)	**3**	**3**	**3**						**2**	**2**	**2**	**2**	**2.2**	

22ECP05 – ANALOG AND DIGITAL COMMUNICATION LABORATORY				
	L	T	P	C
	3	0	0	3

PREREQUISITE : 22ECC06

Course Objective:	• To demonstrate the concepts of generation and detection of AM and FM modulation schemes. • To demonstrate the concepts of generation and detection of digital modulation and pulse modulation schemes.

Course Outcomes The Student will be able to		**Cognitive Level**
CO1	Apply the concepts of modulation, demodulation of AM,FM and ASK,FSK,PSK communication systems	Ap
CO2	Analyze the concepts and related to Pre-emphasis and De-emphasis, QPSK modulation schemes.	An
CO3	Conduct experiments to demonstrate concepts related to Analog and digital pulse modulation using suitable electronic components.	E
CO4	Use modern tools to design and analyze the Amplitude and Angle modulation systems.	C
CO5	Involve in Independent/team learning effectively and engage in lifelong learning.	E

LIST OF EXPERIMENTS

1. Generation and Detection of Amplitude modulation signals.
2. Generation and Detection of Frequency Modulation.
3. Generation and Detection of Amplitude modulation signals.
4. Generation and Detection of Frequency Modulation.
5. Response of Pre-Emphasis / De-emphasis Circuits.
6. Sampling process - (PAM)
7. Generation of Pulse Modulation waveforms– PWM / PPM
8. Generation of Line Coding and Decoding techniques.
9. Generation and detection of digital modulation schemes- ASK, PSK, FSK.
10. Implementation of Error Control Coding using MATLAB

TOTAL : 60 PERIODS

Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												2	1
2		2											1	2
3					3								3	
4		2			2								2	2
5									2			1	1	1
CO (W.A)	**3**	**2**			**2.5**				**2**			**1**	**1.8**	**1.5**

- **Ratified by Twelfth Academic Council**

22ECC13 - MICROPROCESSOR AND MICROCONTROLLER INTERFACING				
	L	T	P	C
	3	0	0	3
PREREQUISITE : NIL				

Course Objective:	• To know the internal architecture, instruction set, and operational principles of 8-bit Microprocessor, 8-bit Microcontroller and their associated peripherals. • To expertise in assembly language and high level language programming for 8-bit Microprocessor and Microcontroller. • To illustrate the methods and techniques for interfacing various peripherals with microcontrollers and providing practical examples.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the Architectural concepts to operate and interface an 8-bit microprocessor, microcontroller, and its peripherals in various practical scenarios.	Ap	20%
CO2	Apply diverse programming techniques for developing Microprocessor and Microcontroller based systems.	AP	30%
CO3	Analyze memory and input/output systems for efficient data handling and processing in Microprocessor and Microcontroller environment.	An	30%
CO4	Design Microprocessor and Microcontroller based real time applications using modern engineering tools.	C	20%
CO5	Engage independently or collaboratively, demonstrate designs and deliver oral presentations on the applications of Microprocessor and Microcontroller based systems.	U	Internal Assessment

UNIT I - 8 BIT MICROPROCESSOR &MEMORY ORGANIZATION	**(9)**
Origin and classification of Microprocessor - 8085 Architecture- Addressing mode – Instruction Set- Computer system Memory Overview- Cache Memory Principles – Elements of Cache Design.	
UNIT II - 8051 MICROCONTROLLER	**(9)**
8051 Microcontroller: Architecture– Signals – Memory Organization - Interrupts – Timer/counter - Serial communication	
UNIT III - 8051 ASSEMBLY LANGUAGE PROGRAMMING	**(9)**
8051 Addressing mode – Instruction Set – Programming 8051 Timers – Serial Port programming – Interrupt Programming.	
UNIT IV - HIGH LEVEL LANGUAGE PROGRAMMING	**(9)**
Data types and time delay in 8051 C – I/O Programming in 8051 C – Logical operations in 8051 C – Accessing code ROM space in 8051 C – Timer programming in C – Serial port programming in C – Interrupt programming in C	
UNIT V- UNIT V - 8051 EXTERNAL INTERFACING	**(9)**
LCD & Keyboard Interfacing - ADC, DAC & LM35 Temperature Sensor Interfacing - External Memory Interface- Stepper Motor Interfacing	
TOTAL (L:45) : 45 PERIODS	

TEXT BOOKS:

1. Mohamed Ali Mazidi, Janice GillispieMazidi, RolinMcKinlay, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", Second Edition, Pearson education, 2011
2. Ramesh S. Goankar, "Microprocessor Architecture: Programming and Applications with the8085", Sixth edition, Penram International, 2015 Reprint
3. William Stallings, "Computer organization and architecture Designing for Performance", Tenth Edition, Pearson Education, 2016.

REFERENCES:

1. Senthilkumar, Saravanan, Jeevanantham, Shan "Microprocessor & Interfacing", Oxford University press, 2012.
2. K.UmaRao. AndhePallavi, "The 8051 Microcontroller Architecture, Programming and Applications" Pearson Education 2011, Second Impression.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3													
2	3												3	
3		3											3	
4			3								2			3
5				3	2				3	2		1		3
CO (W.A)	3	3	3	3	2				3	2	2	1	3	3

22ECC14 – DATA COMMUNICATION AND NETWORKS				
	L	T	P	C
	3	0	0	3

PREREQUISITE :NIL

Course Objective:	• To understand the concepts of computer networks. • To study about multipleaccess techniques, network protocols. • To get awareness about the performance of internetworking and networking technologies.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the Communication and Networking concepts to Communicate across computer networks.	Ap	20%
CO2	Analyze the data communication systems, including network architecture, Protocols and performance metrics	An	30%
CO3	Implement network protocols and technologies to ensure efficient data transfer.	An	30%
CO4	Evaluate and analyze the security and privacy aspects of data communication systems including encryption, firewalls and access control	E	20%
CO5	Give a presentation on recent technological development in data communication and network protocols	U	Internal Assessment

UNIT I –FUNDAMENTALS OF DATA COMMUNICATION	**(9)**
Introduction – Data communication-network types – Connecting devices: Hubs-Link layer Switches, Routers- ISO/OSI model-TCP/IP- Transmission Media: Guided and Unguided media-Switching Techniques	
UNIT II –DATA LINK LAYER	**(9)**
Introduction –- Data Link Control-Error Control: types of errors-Redundancy- coding: block coding- Hamming Distance- parity check codes – cyclic codes – Media Access Control-Link layer Addressing- Ethernet – WiFi, IEEE 802.11 Project – Bluetooth	
UNIT III –NETWORK LAYER	**(9)**
Network Layer services – Packet Switching –Network Layer performance - IPv4 Addresses- ICMPv4- Forwarding of IP Packets- Next Generation Internet Protocol(IPV6)- Transition from IPV4 to IPV6 - Routing Algorithms: Distance Vector Routing, Link State Routing, Path Vector Routing	
UNIT IV –TRANSPORT LAYER	**(9)**
Transport Layer Services- Transport Layer Protocols: – User Datagram Protocol (UDP) –Transmission Control Protocol (TCP) –SCTP- Quality of service – Data flow characteristics – Flow control to improve QoS: Token Bucket and Leaky Bucket	
UNIT V- APPLICATION LAYER	**(9)**
Introduction- Client/Server Paradigm- Standard Applications: World wide web and HTTP – FTP- Email – Telnet – SSH- Domain Name System- Multimedia Data- Multimedia in the Internet -Cryptography and Network security: Introduction –Confidentiality – Other aspects of Security	
TOTAL (L:45) : 45 PERIODS	

TEXT BOOKS:

1. Behrouz A. Forouzan, "Data Communication and Networking", 6th India Edition, Tata McGraw-Hill, 2017.

REFERENCES:

1. Tanenbaum, Andrew S and David Wetherall, —Computer Networks, 5th Edition, PHI Learning, New Delhi,2010.
2. Kurose, James F. and Ross, Keith W., —Computer Networking: A Top-Down Approach Featuring the Internet,6th Edition, Pearson Education, New Delhi, 2012.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3													
2		3											3	
3			3										3	
4				3	3								3	
5							2		2				2	
CO (W.A)	3	3	3	3	3		2		2				2.8	

22ECP06 - MICROPROCESSOR AND MICROCONTROLLER INTERFACING LABORATORY

	L	T	P	C
	0	0	4	2

PREREQUISITE : NIL

Course Objective:	• To enable the student to analyze various arithmetic, logical and control transfer operations using 8085 Microprocessor. • To provide the student with practice in the 8051 Microcontroller arithmetic, Logical operations. • To motivate the students to learn the I/O interfacing concepts in 8051 using HLP.

The Student will be able to	**Course Outcomes**	**Cognitive Level**
CO1	Apply theassembly language programming knowledge to operate and interface an 8-bit Microprocessor, Microcontroller, and its peripherals	Ap
CO2	Apply the diverse programming techniques in Microprocessor and Microcontroller based system development for various real-world applications.	An
CO3	Examine the functionalities of arithmetic, logical, and control transfer operations performed by 8-bit Microprocessors and Microcontrollers.	E
CO4	Verify the operational capabilities of different peripherals within a Microcontroller environment through High level language programming.	E
CO5	Implement the functionality of fundamental peripherals for various real-world applications using modern engineering tools.	C

LIST OF EXPERIMENTS :

1. Assembly language programming for 8/16 bit Arithmetic operators Using 8085.
2. Assembly language programming with control instructions Using 8085 (Increment / Decrement, Ascending / Descending order, Maximum / Minimum of numbers.
3. Assembly language programming for arithmetic and logical operations using 8051.
4. Interfacing and Programming of DC Motor Speed control using 8051.
5. Interfacing and Programming of Stepper Motor control using 8051.

High Level Language Programming:

The following programs have to be tested on 8051 Development board/equivalent using Embedded C Language on KEIL IDE or Equivalent.

1. Program to toggle all the bits of Port P1 continuously with delay.
2. Program to toggle P1.5 continuously with delay. Use Timer in mode 0, mode 1, mode 2 and mode 3 to create delay using 8051.
3. Program to interface 7 segments display to display a message on it using 8051.
4. Program to interface keypad. Whenever a key is pressed, it should be displayed on LCD using 8051.
5. Program to get analog input from Temperature sensor and display the temperature Value on LCD using ADC with 8051 Microcontroller.
6. Program to handle interrupts with 8051 Microcontroller.

TOTAL (P:60) = 60 PERIODS

Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3													
2	3												3	
3		3											3	
4				3										3
5			3		2									3
CO (W.A)	**3**	**3**	**3**	**3**	**2**								**3**	**3**

22ECP07 – DATA COMMUNICATION AND NETWORKS LABORATORY				
	L	T	P	C
	0	0	4	2

PREREQUISITE : NIL

Course Objective:	• To learn the various routing algorithms. • To gain knowledge about the various open source simulation tools for packet tracing and network design. • To understand the peer to peer communication application using different protocols.

Course Outcomes The Student will be able to		**Cognitive Level**
CO1	Demonstrate working knowledge of computer hardware & Operating Systems, software and networking skills.	U
CO2	Design and simulate simple networking models using the Network simulator modeling.	Ap
CO3	Compare and analyze the concepts of protocols, network interfaces and design LAN, MAN and WAN.	An
CO4	Troubleshoot and repair network problems demonstrating professionalism, team work and adaptability.	E
CO5	Develop and test network applications using socket programming.	C

LIST OF EXPERIMENTS :

1. Implementation of Stop and Wait Protocol and sliding window.
2. Implementation and study of Go back-N and selective repeat protocols.
3. Create scenario Transfer of files from PC to PC using Windows socket processing.
4. Analyze the performance of CSMA/CD protocol through simulation.
5. Evaluate the performance of network with CSMA / CA protocol and compare with CSMA/CD protocols.
6. Implementation of distance vector routing algorithm.
7. Implementation of Link state routing algorithm.
8. Data encryption and decryption using Data Encryption Standard algorithm.
9. Implement and realize the Network Topology - Star, Bus and Ring using NS2.
10. Implement and perform the operation of CSMA/CD and CSMA/CA using NS2.

TOTAL (P:60) = 60 PERIODS

Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3												2	
2			3		3								3	
3			3										3	
4		3		2									3	
5									2				2	
CO (W.A)	**3**	**3**	**3**	**2**	**3**				**2**				**3**	

22ECC15 - VLSI AND CHIP DESIGN				
	L	T	P	C
	3	0	0	3
PREREQUISITE : NIL				
Course Objective:	• To understand the I-V and DC characteristics of MOS transistors and layout of CMOS Circuits by means of stick diagram • To study about the static and dynamic CMOS combinational and sequential circuits using different logic styles • To obtain knowledge about Interconnects, Floor planning, routing and Verilog HDL-modeling Concepts			

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the basic knowledge of digital and analog electronics to analyze MOS transistor characteristics and design the layout of CMOS circuits.	Ap	20%
CO2	Apply the various combinational and sequential circuit concepts to realize different logic styles.	An	30%
CO3	Analyze the diverse static and dynamic combinational and sequential CMOS circuits using different logic styles	An	30%
CO4	Design system level physical design and implement the modeling concepts using modern software tools.	C	20%
CO5	Engage independently to deliver oral presentations on the applications of VLSI systems.	U	Internal Assessment

UNIT I - MOS TRANSISTORS AND FABRICATION	**(9)**
Basic MOS Transistors – Enhancement and Depletion Mode Transistor Action - Ideal I-V Characteristics of MOS Transistors - Non Ideal I-V Effects - DC transfer characteristics - CMOS Fabrication: n-well – p-well – twin tub - stick diagram and layout design rules.	
UNIT II - COMBINATIONAL CIRCUITS DESIGN	**(9)**
Circuit Families - Static CMOS - Pseudo NMOS Logic - Clocked CMOS Logic - Domino Logic - Cascode Voltage Switch Logic - Dynamic Logic - Pass transistor Logic -Transmission gate logic.	
UNIT III - SEQUENTIAL CIRCUITS DESIGN	**(9)**
Sequencing static circuits - Circuit design of latches and flip-flops - Conventional CMOS Latches and flip-flops: Pulsed latches - Resettable latches and flip-flops - enabled latches and flip flops - Incorporating Logic into latches - TSPC Latches and flip-flops - Sequencing dynamic circuits	
UNIT IV - VLSI SUBSYSTEMS DESIGN AND MEMORIES	**(9)**
Bit Adders - Ripple Carry Adder - Carry look-ahead adder - Subtractor -One/Zero detectors - Comparators- Shifters - 2's complement array multipliers - Wallace tree multiplier - Series multiplier -Series and Parallel division - SRAM and Dynamic RAM	
UNIT V- SYSTEM LEVEL PHYSICAL DESIGN AND MODELING CONCEPTS	**(9)**
Large Scale physical design - Interconnect delay modeling - cross talk - Interconnect scaling – Floor planning and routing – Power distribution and consumption - Low power design considerations - Overview of Verilog HDL-Modeling Concepts	
TOTAL (L:45) : 45 PERIODS	

TEXT BOOKS:

1. Neil H.E.Weste, David Harris "CMOS VLSI Design - A Circuits and Systems Perspective", Pearson Education, 4th Edition, 2015.
2. John P.Uyemura, "Introduction to VLSI Circuits and Systems", John Wiley & Sons, 2009.

REFERENCES:

1. Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, "Digital Integrated Circuits A Design Perspective", Prentice Hallof India, 2nd Edition, 2012.
2. Eugene D.Fabricius," Introduction to VLSI Design", Tata McGraw Hill, 1st Edition, 1990.
3. Gary K. Yeap, "Practical Low Power Digital VLSI Design", Kluwer Academic Publishers, Boston, 1st Ediiton, 1998.
4. Neil H.E. Weste and Kamran Eshraghian, "Principles of CMOS VLSI Design: A System Perspective", Addison Wesley, New Delhi, 2nd Edition, 2009.
5. Charles H.Roth and Lizy Kurian John, "Digital System design using VHDL", John Wiley& Sons, 2nd Edition, 2013.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3													2
2	3													
3		3											1	3
4			3										1	3
5									2	1				1
CO (W.A)	3	3	3						2	1			1	2

22ECC16 - EMBEDDED SYSTEMS AND IOT DESIGN

L	T	P	C
3	0	0	3

PREREQUISITE : NIL

Course Objective:

- To gain knowledge about PIC Microcontroller.
- To understand the embedded systems and IoT.

Course Outcomes (The Student will be able to)		Cognitive Level	Weightage of COs in End Semester Examination
CO1	Apply knowledge of 16-bit microcontroller with necessary Input/Output and Memory Operations to build an embedded processor.	Ap	20%
CO2	Analyze the combinational, sequential, and timing circuits in recognizing functional blocks of embedded systems and their working mechanisms	An	20%
CO3	Design simple programming modules in machine and higher-level programming language using simulators to develop logical skills and testing skills	Ap	40%
CO4	Select and implement appropriate IoT techniques to provide valid conclusions.	An	20%
CO5	Build simple Embedded Applications using Input and output devices with IoT and a controller.	U	Internal Assessment

UNIT I- PIC MICROCONTROLLER	**(9)**
PIC 16F877 Microcontroller Architecture - Memory organization -Interrupts Timer/Counter - Compare/Capture/PWM modules (CCP) - Master Synchronous Serial Port module (MSSP).	
UNIT II - EMBEDDED SYSTEMS	**(9)**
Embedded System Design Process – Model Train Controller – Instruction Set : Preliminaries – ARM Processor – CPU: Programming Input and Output – Supervisor Mode, Exceptions and Trap – Co-Processors – Memory System Mechanisms – CPU Performance.	
UNIT III - PROCESSES AND OPERATING SYSTEMS	**(9)**
Introduction – Multiple Tasks and Multiple Processes – Preemptive real time Operating systems – Priority based scheduling – Interprocess Communication Mechanisms– Design Example – Audio Player, Engine Control Unit and Video Accelerator.	
UNIT IV – INTERNET OF THINGS	**(9)**
Introduction – Physical Design – Logical Design – IoT Enabling Technologies – Domain Specific IoTs: Retail, Logistics, Industry, Health and Lifestyle – IoT and M2M – IoT System Management with NETCONF-YANG – IoT Platform Design Methodology: IoT Level Specification, Domain Model.	
UNIT V - IOT SYSTEM DESIGN	**(9)**
Basic building blocks of an IoT device – Raspberry Pi – Board – Linux on Raspberry Pi – Interfaces – Programming with Python – Case Studies: Home Automation, Smart Cities, Environment and Agriculture.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. John B Peatman, "Design with PIC Microcontrollers", Pearson Education Asia, 2013, Twenty third Impression
2. Marilyn Wolf, "Computers as Components – Principles of Embedded Computing System Design", Third Edition, Morgan Kaufmann, 2012
3. Arshdeep Bahga, Vijay Madisetti, "Internet – of- Things – A Hands on Approach", Universities Press, 2015.

REFERENCES:

1. Mayur Ramgir, Internet – of – Things, Architecture, Implementation and Security, First Edition, Pearson Education, 2020.
2. Lyla B.Das, Embedded Systems: An Integrated Approach, Pearson Education 2013.
3. Jane.W.S .Liu, Real – Time Systems, Pearson Education, 2003.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3													
2		3												2
3			2		2									3
4				2										
5					2									
CO (W.A)	3	3	2	2	2									3

22ECP08 - VLSI DESIGN LABORATORY				
	L	T	P	C
	3	0	0	3
PREREQUISITE : 22ECC05				

Course Objective:	• To design and simulate combinational logic and sequential logic circuits using Verilog HDL. • To implement the digital logic circuits using Xilinx FPGA. • To understand and design the CMOS logic circuits using Tanner software.

Course Outcomes The Student will be able to		**Cognitive Level**
CO1	Apply the knowledge of digital design and develop code for digital logic circuits using Hardware Description Language.	Ap
CO2	Simulate and Synthesize the place and route for digital logic circuits using ModelSim.	Ap
CO3	Analyze the digital modules in Xilinx FPGA kit.	An
CO4	Design and simulate the CMOS blocks using EDA tool.	Ev
CO5	Prepare an effective record for all the experiments.	U

LIST OF EXPERIMENTS :

1. Design an 8-bit Adder and 8-bit Subtractor and simulate using Xilinx software
2. Design an ALU and simulate using Xilinx software.
3. Simulation and Implementation of Encoder and Decoder using Xilinx.
4. Simulation and Implementation of 4 * 4 Multiplier using Xilinx.
5. Design T, JK and SR flipflops. Simulate and Implement using Xilinx.
6. Design and implementation of Shift registers using Xilinx.
7. Design 3-bit synchronous up/down counters. Simulate and implement using Xilinx.
8. Design 4-bit Asynchronous up/down counter. Simulate and implement using Xilinx.
9. Design and simulation of Frequency Dividers and implement using Xilinx.
10. Design and simulation of CMOS Inverter using Tanner software.
11. Design CMOS NAND and NOR Gates using PMOS and NMOS Transistors and simulate using Tanner software.
12. Design and simulation of CMOS Latch using Tanner software.

TOTAL (P:60) = 60 PERIODS

Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3								2					
2					3				2					2
3					3									
4			3		3									3
5								3	2	3		2		
CO (W.A)			**3**		**3**			**3**	**2**	**3**		**2**		**2.5**

22ECP09 - EMBEDDED SYSTEMS AND IOT DESIGN LABORATORY				
	L	T	P	C
	3	0	0	3
PREREQUISITE : NIL				

Course Objective:	• To obtain a broad understanding of the emerging technologies in embedded system • To gain knowledge about I/O models.

Course Outcomes The Student will be able to		**Cognitive Level**
CO1	Apply the knowledge of PIC, ARM, IoT and Arduino using IDE platform.	Ap
CO2	Analyze the virtual circuits of digital devices using Proteus.	An
CO3	Design and synthesize a digital circuit for the given specifications and conduct the experiment.	Ap
CO4	Develop the high level programming knowledge using Keil and MPLAB.	An
CO5	Involve in independent / team learning, communicate effectively and engage in life long learning.	C

LIST OF EXPERIMENTS :

1. Program to interface Traffic Light Controller using PIC Microcontroller.
2. Program to control the external devices using GPIO ports of PIC16FXX Microcontroller.
3. Program to Develop an IoT Dashboard for Sensors on Android Phone.
4. Program to Develop an IoT Camera System using Android Phones.
5. Program to control the external devices using GPIO ports of ARM Processor.
6. Program to interface the ADC using ARM Processor.
7. Program to interface the DAC using ARM Processor.
8. Program to interface the keyboard using ARM Processor.
9. Program to Design a Heart Beat sensor using Arduino controller.
10. Program to Design a fire detecting system using Arduino controller.

TOTAL (P:60) = 60 PERIODS

Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3													
2		3												2
3			3											2
4			3											
5									2	2		1		2
CO (W.A)	**3**	**3**	**3**						**2**	**2**		**1**		**2**

22GED02- INTERNSHIP/INDUSTRIAL TRAINING				
	L	T	P	C
	0	0	4	2

PREREQUISITE : NIL

Course Objective:	• To obtain a broad understanding of the emerging technologies in Industry • To gain knowledge about I/O models.

Course Outcomes The Student will be able to		**Cognitive Level**
CO1	Engage in Industrial activity which is a community service.	U
CO2	Prepare the project report, three minute video and the poster of the work.	Ap
CO3	Identify and specify an engineering product that can make their life comfortable.	An
CO4	Prepare a business plan for a commercial venture of the proposed product, together with complying to relevant norms.	Ap
CO5	Identify the community that shall benefit from the product.	E

During semester break, students are encouraged to engage in industrial training or undergo internship in an industry related to the field of study. The duration of the activity shall be of 4 to 6 weeks. The work carried out in the semester break is assessed through an oral seminar accompanied by a written report. It is expected that this association will motivate the student to develop simple Electronic (or other) products to make their life comfortable and convert new ideas into projects.

Every student is required to complete 12 to 16 weeks of internship (with about 40 hours per week), during the Summer/Winter semester breaks. The Internships are evaluated through Internship Reports and Seminars during the VI and VIII semesters. The internships can be taken up in an industry, government organization, a research organization or an academic institution, either in the country or outside the country, that include activities like:

- Successful completion of Internships/ Value Added Programs/Training
- Programs/ workshops organized by academic Institutions and Industries
- Soft skill training by the Placement Cell of the college
- Active association with incubation/ innovation /entrepreneurship cell of the institute
- Participation in Inter-Institute innovation related competitions like Hackathons
- Working for consultancy/ research project within the institutes
- Participation in activities of Institute's Innovation Council, IPR cell, Leadership Talks, Idea/ Design/ Innovation contests
- Internship with industry/ NGO's/ Government organizations/ Micro/ Small/ Medium enterprises
- Development of a new product/ business plan/ registration of a start-up

Mapping of COs with POs / PSOs														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1						2								
2										3				
3		1												
4							2	3			2			
5						2								
CO (W.A)		1				2	2	3		3	2			

22ECD01- PROJECT WORK - I				
	L	T	P	C
	3	0	0	3

PREREQUISITE : NIL

Course Outcomes The Student will be able to		Cognitive Level	Weightage of COs in End Semester Examination
CO1	Engage in independent study to research literature in the identified area and consolidate the literature search to identify and formulate the engineering problem.	Ap	10 % - First Review (Internal)
CO2	Prepare the Gantt Chart for scheduling the project , engage in budget analysis, and designate responsibility for every member in the team and identify the community that shall benefit through the solution to the identified research work and also demonstrate concern for environment	Ap, E	15 % - Second Review (Internal)
CO3	Identify, apply the mathematical concepts, science concepts, and engineering concepts necessary to implement the identified engineering problem, select the engineering tools /components required to reproduce the identified project.	Ap, An, C	15 % - Third Review (Internal)
CO4	Engage in effective written communication through the project report, the one-page poster presentation, and effective oral communication through presentation of the project work and demonstration of the project.	E	30 % - Final Review (External)
CO5	Perform in the team, contribute to the team and mentor/lead the team, demonstrate compliance to the prescribed standards/ safety norms and abide by the norms of professional ethics and clearly specify the outcome of the project work	Ap, An	30 % - Final Review (External)

DESCRIPTION

Project work may be allotted to a single student or to a group of students not exceeding 4 per group. The title of project work is approved by head of the department under the guidance of a faculty member and student(s) shall prepare a comprehensive project report after completing the work to the satisfaction of the guide. The Head of the department shall constitute a review committee for project work. There shall be three internal reviews and one external review during the semester by the committee to review the progress. Student(s) shall make presentation on the progress made by him / her / them before the committee and evaluation is done as per Rules and Regulations

TOTAL (P: 120) = 120 PERIODS

Mapping of COs with POs / PSOs														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1		3										3	3	3
2						3	3				3		3	3
3	3	3	3	3	3								3	3
4								3		3			3	3
5									3		3	3	3	3
CO (W.A)	3	3	3	3	3	3	3	3	3	3	3	3	3	3

22ECD02- PROJECT WORK - II					
		L	T	P	C
		3	0	0	3
PREREQUISITE : NIL					
Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**		
CO1	Design, implement, analyze and interpret results of the implemented project and improvise the performance of the project.	Ap, An, C	10 % - First Review (Internal)		
CO2	Preparation of the four page IEEE format of the work, presentation of the project work and demonstration of the project in Project Expo, Presentation in International/ National Conferences, Conversion of project to start-up/ product/ research paper/ patent.	Ap, An, E	15 % - Second Review (Internal)		
CO3	Design, implement, analyze and interpret results of the implemented project and improvise the performance of the project.	Ap, An, C	15 % - Third Review (Internal)		
CO4	Engage in effective written communication through the project report, the one-page poster presentation, and preparation of the video about the project and effective oral communication through presentation of the project work and demonstration of the project.	E	30 % - Final Review (External)		
CO5	Perform in the team, contribute to the team and mentor/lead the team, demonstrate compliance to the prescribed standards/ safety norms and abide by the norms of professional ethics and clearly specify the outcome of the project work.	Ap, An	30 % - Final Review (External)		

DESCRIPTION
Project work may be allotted to a single student or to a group of students not exceeding 4 per group. The title of project work is approved by head of the department under the guidance of a faculty member and student(s) shall prepare a comprehensive project report after completing the work to the satisfaction of the guide. The Head of the department shall constitute a review committee for project work. There shall be three internal reviews and one external review during the semester by the committee to review the progress. Student(s) shall make presentation on the progress made by him / her / them before the committee and evaluation is done as per Rules and Regulations
TOTAL (P:300) = 300 PERIODS

Mapping of COs with POs / PSOs														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1		3										3	3	3
2						3	3				3		3	3
3	3	3	3	3	3								3	3
4								3		3			3	3
5									3		3	3	3	3
CO (W.A)	3	3	3	3	3	3	3	3	3	3	3	3	3	3

VERTICAL 1: SEMICONDUCTORS

22ECX01 - ASIC DESIGN				
	L	T	P	C
	3	0	0	3

PREREQUISITE : NIL

Course Objective:	• To understand ASICs, CMOS Logic, ASIC Library and Programmable ASICs. • To identify, apply and design a system using different VLSI design methodologies such as Full custom and Semi-custom approaches. • To apply industry standard CAD tools for designing VLSI systems.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the knowledge of VLSI to design digital integrated circuits.	Ap	20%
CO2	Ability to identify, apply and design a system using different VLSI design methodologies such as Full custom and Semi-custom approaches.	An	30%
CO3	Ability to apply industry standard CAD tools for designing VLSI systems.	An	30%
CO4	Ability to analyze and investigate the performance of VLSI systems.	E	20%
CO5	Understand ASICs, CMOS Logic, ASIC Library and Programmable ASICs.	U	Internal Assessment

UNIT I - Introduction to ASICs, CMOS Logic, ASIC Library Design, Programmable ASICs	**(9)**
Types of ASICs - Design flow – CMOS transistors- Transistor as resistors - Transistor parasitic capacitance – Logical effort-Antifuse - Static RAM - EPROM and EEPROM technology.	
UNIT II - Programmable ASICs, logic cells and I/O Cells	**(9)**
Actel ACT: Multiplexer Logic,ACT2 and ACT3 Logic Modules, timing model, critical path, speed grading, worst case timing,Actel logic module analysis, Xilinx LCA:XC3000CLB, XC4000, XC5200, Xilinx CLB, DC & AC inputs and outputs – Clock & power inputs.	
UNIT III - Programmable Interconnects and Logic Synthesis	**(9)**
Actel ACT – Xilinx LCA – Design synthesis:Xilinx, Actel, Altera, logic synthesis,Combinational logic, multiplexers, Case statement, decoders, arithmetic and Sequential logic.	
UNIT IV - Partitioning, Floorplanning and Placement	**(9)**
Physical design flow -System partitioning - FPGA partitioning:KL algorithm –Floorplanning –Placement : Constructive and iterative placement algorithms.	
UNIT V- Routing	**(9)**
Global routing - Detailed routing –Area routing-Maze Algorithm-Channel routing- Left Edge Algorithm-Special routing.	
TOTAL (L:45) =45 PERIODS	

TEXT BOOKS:
1. 1. Smith M.J.S, "Application Specific Integrated Circuits", 12th Edition, Pearson Education Pvt. Ltd, New Delhi, 2013.
REFERENCES:
1. Wayne Wolf, "FPGA-Based System Design", 1st Edition, PHI, New Delhi, 2009. 2. Erik larson, "Introduction to Advanced System-on-Chip Test Design and Optimization", 1st Edition, Springer, USA, 2005. 3. Farzad Nekoogar and Faranak Nekoogar, From ASICs to SOCs: A Practical Approach, Prentice Hall PTR, 2003 4. R. Rajsuman, System-on-a-Chip Design and Test. Santa Clara, CA: Artech House Publishers, 2000. 5. F. Nekoogar. Timing Verification of Application-Specific Integrated Circuits (ASICs).Prentice Hall PTR, 1999.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3													3
2	3													3
3		2	2											3
4			2											3
5												1		3
CO (W.A)	3	2	2									1		3

22ECX02– SYSTEM ON CHIP DESIGN				
	L	T	P	C
	3	0	0	3

PREREQUISITE :Nil

Course Objective:	• To understand the system architectures and components in system design. • To study about system level design and co design concepts. • To get awareness about the implementation of SoC and its Testing.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply SoC testing techniques.	Ap	20%
CO2	Discern system level interconnection and co-design concepts.	An	30%
CO3	Compare system level design and interconnection.	An	30%
CO4	Illustrate the co-design concepts.	E	20%
CO5	Understand system architectures and components in system design.	U	Internal Assessment

UNIT I - SYSTEM ARCHITECTURE	**(9)**
Introduction to system Architecture, Components of a system, Hardware and Software: Programmability Versus Performance, Processor Architectures, Memory and Addressing, System-Level Interconnection, An Approach for SOC Design, System Architecture and Complexity	
UNIT II - SYSTEM-LEVEL DESIGN	**(9)**
Processor selection-Concepts in Processor Architecture: Instruction set architecture (ISA), elements in Instruction Handing-Robust processors: Vector processor, VLIW, Superscalar, CISC, RISC—Processor evolution: Soft and Firm processors, Custom-Designed processors-IP based design - on - chip memory.	
UNIT III - SYSTEM-LEVEL INTERCONNECTION	**(9)**
Overview: Interconnect Architecture, On-chip Buses: basic architecture, Bus standards: AMBA, Core Connect, Wishbone, Avalon-Network-on-chip – Architecture – topologies - switching strategies - routing algorithms - flow control, quality-of-service - Reconfigurability in communication architectures	
UNIT IV - CO-DESIGN CONCEPTS	**(9)**
Nature of hardware & software- quest for energy efficiency- driving factors for hardware-software co-design- Co-design space-Dualism of Hardware design and Software design - Modeling Abstraction Level-Concurrency and Parallelism- Hardware Software tradeoffs- Introducing Dataflow modeling.	
UNIT V- SOC IMPLEMENTATION AND TESTING	**(9)**
Study of Microblaze RISC processor - Real-time operating system (RTOS), peripheral interface and components, High-density FPGAs-Introduction to tools used for SOC design: Xilinx SOC based development kit. Manufacturing test of SOC: Core layer, system layer, application layer-P1500 Wrapper Standardization- SOC Test Automation (STAT).	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Michael J.Flynn, Wayne Luk, "Computer system Design: System-on-Chip", Wiley- India, 2012.

REFERENCES:

1. Patrick Schaumont "A Practical Introduction to Hardware/Software Co-design", 2nd Edition, Springer, 2012.
2. Lin, Y-L.S. (ed.), "Essential issues in SOC design: designing complex systems-on- chip", Springer, 2006
3. SudeepPasricha, NikilDutt, "On Chip Communication Architectures: System on Chip Interconnect", Morghan Kaufmann Publishers, 2008
4. W.H.Wolf, "Computers as Components: Principles of Embedded Computing System Design", Elsevier, 2008.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3													3
2	3													3
3		3	3											3
4				1	3									3
5												2		3
CO (W.A)	3	3	2	1	3							2		3

22ECX03 –SYSTEM VERILOG				
	L	T	P	C
	3	0	0	3

PREREQUISITE : 22ECC05

Course Objective:	• To apply the fundamentals of digital electronics and through programming the designs. • To apply object oriented programming concepts for VLSI designs. • To create the test benches to analysis the designs • To implement the advanced design using modern tools. • To enhance their design skill through lifelong learning.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the fundamentals of digital electronics and through programming the designs.	Ap	25%
CO2	Apply object oriented programming concepts for VLSI designs.	Ap	25%
CO3	Create the test benches to analysis the designs.	C	30%
CO4	Implement the advanced design using modern tools.	D	20%
CO5	Enhance their design skill through lifelong learning.	U	Internal Assessment

UNIT I - VERIFICATION GUIDELINES	**(9)**
Introduction, The Verification Process, The Verification Plan, The Verification Methodology, Manual, Basic Testbench Functionality, Directed Testing, Methodology Basics, Constrained-Random Stimulus, Functional Coverage, Testbench Components, Layered Testbench, Building a Layered Testbench, Simulation Environment Phases, Maximum Code Reuse, Testbench Performance.	
UNIT II - DATA TYPES	**(9)**
Introduction to data types, Built-in Data Types, Fixed-Size Arrays, Dynamic Arrays, Queues, Associative Arrays, Linked Lists, Array Methods, choosing a Storage Type, Creating New Types with typedef, Creating User-Defined Structures, Enumerated Types, Constants, Strings, Expression Width, Net Types. Array manipulation methods, Array querying functions, Queue.	
UNIT III - PROCEDURAL STATEMENTS AND ROUTINES	**(9)**
Introduction, Procedural Statements, Tasks, Functions, and Void Functions, Task and Function Overview, Routine Arguments, Returning from a Routine, Local Data Storage, Time Values. Process and process control.	
UNIT IV - BASIC OOPS	**(9)**
Introduction, Think of Nouns, not Verbs, Your First Class, Where to Define a Class, OOP Terminology, Creating New Objects, Object Deallocation, Using Objects, Static Variables vs. Global Variables, Class Routines, Defining Routines Outside of the Class, Scoping Rules, Using One Class Inside Another, Understanding Dynamic Objects, Copying Objects, Public vs. Private Straying Off Course, Building a Testbench.	
UNIT V- CONNECTING THE TEST BENCH AND DESIGN	**(9)**
introduction, Separating the Testbench and Design, The Interface Construct, virtual interface, Stimulus Timing, Interface Driving and Sampling, Connecting It All Together, Top-Level Scope, Program – Module Interactions, System Verilog Assertions, Call back. The Four-Port ATM Router. Modport and Clocking block. Mailbox.	
	TOTAL (L:45) = 45 PERIODS

TEXT BOOKS:

1. Chris Spear, Greg Tumbush, "System Verilog for Verification: A Guide to Learning the Test bench Language Features", 3rd Edition, Springer, US, 2012.

REFERENCES:

1. Stuart Sutherland, Simon Davidmann, "System Verilog for design: a guide to using System Verilog for hardware design and modeling", Springer, 2004.
2. Palnitkar Samir, "Verilog HDL: Guide to Digital Design and synthesis", 2nd Edition, Pearson Education, New Delhi, 2017.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3													3
2	3													3
3		2	3											3
4					2									3
5												2		3
CO (W.A)	**3**	**2**	**3**		**2**							**2**		**3**

22ECX04 – VLSI TESTING AND TESTABILITY				
	L	T	P	C
	3	0	0	3

PREREQUISITE : 22ECC05

Course Objective:	• To apply the various techniques to diagnosis fault in digital circuit. • To analysis the faults presence and investigate system level faults. • To design testable digital circuit by testability techniques. • To design the self checking systems. • To develop new fault diagnosing algorithms through lifelong learning.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the various techniques to diagnosis fault in digital circuit.	Ap	25%
CO2	Analysis the faults presence and investigate system level faults.	Ap	25%
CO3	Design testable digital circuit by testability techniques.	C	30%
CO4	Design the self checking systems.	E	20%
CO5	Develop new fault diagnosing algorithms through lifelong learning.	E	Internal Assessment

UNIT I - FAULT MODELLING AND SIMULATION	**(9)**
Introduction to Testing - Faults in digital circuits - Modeling of faults - Logical Fault Models - Fault detection- Fault location - Fault dominance – Single stuck fault model and multiple stuck fault model - Logic Simulation- Types of simulation - Delay models - Gate level Event-driven simulation- Fault Simulation Techniques Serial , Parallel and Deductive	
UNIT II - TESTING FOR SINGLE STUCK AT FAULTS	**(9)**
Test Generation algorithms for combinational circuits – Fault oriented ATG – D Algorithm-Examples – PODEM - Fault independent ATG - Random Test generation - ATGs for SSFs in sequential circuits – TG using iterative array models- Random Test Generation.	
UNIT III - DELAY TEST	**(9)**
Delay test problem – Path delay test – Test generation for Combinational circuits, Number of paths in a circuit Transition fault – Delay test methodologies-Slow clock combinational test, Enhanced scan test, normal scan sequential test, Variable- clock Non-scan sequential test, Rated- clock Non-scan sequential test.	
UNIT IV- DESIGN FOR TESTABILITY	**(9)**
Testability- Controllability and observability, Ad-hoc design for testability Techniques – Controllability and observability by means of scan registers- Storage cells for scan design- Level sensitive scan design (LSSD)- Partial scan using I-Paths – Boundary scan standards.	
UNIT V-FAULT DIAGNOSIS	**(9)**
Logical Level Diagnosis – Diagnosis by UUT reduction – Fault Diagnosis for Combinational Circuits – Self checking design – System Level Diagnosis.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Parag K. Lala "An Introduction to Logic Circuit Testing" Springer International Publishing, 2022.
2. Abramovici, M., Brever, A., and Friedman, D., "Digital Systems Testing and Testable Design", Jaico Publishing House, 2002.

REFERENCES:

1. Michael L Bushnell and Vishwani D Agarwal, "Essentials of Electronic Testing for Digital, Memory and Mixed Signal Circuits", Springer, verlag 2000.
2. Parag K Lala, "Fault Tolerant and Fault Testable Hardware Design" BS Publications, 2002
3. Sebastian Huhn, Rolf Drechsler "Design for Testability, Debug and Reliability", Springer International Publishing, 2021.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3													3
2		3												3
3			3											3
4			3											3
5												2		3
CO (W.A)	**3**	**3**	**3**									**2**		**3**

22ECX05 – ELECTRONIC SYSTEM DESIGN				
	L	T	P	C
	3	0	0	3
PREREQUISITE : 22ECC04				
Course Objective:	• To apply design rules for PCB designing of circuits. • To perform various analysis on the designed circuits. • To design the layouts of PCB including R, L, C spacing and spacing requirements. • To design the PCB using different PCB technology. • To Utilize the SPICE tool to design and analysis the electronic circuits.			

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply design rules for PCB designing of circuits.	Ap	20%
CO2	Perform various analyses on the designed circuits.	An	20%
CO3	Design the layouts of PCB including R, L, C, spacing and spacing requirements.	D	20%
CO4	Design the PCB using different PCB technology.	D	20%
CO5	Utilize the SPICE tool to design and analysis the electronic circuits.	Ap	20%

UNIT I – BASIC ANALYSIS OF CIRCUITS	**(9)**
Introduction to Or CAD capture – DC bias point analysis – DC analysis- AC analysis – Stimulus Editor – Transient Analysis –Convergence problems and Error Messages - Transformers.	
UNIT II – ADVANCED ANALYSIS OF CIRCUITS	**(9)**
Monte Carlo analysis – Worst case analysis – Performance analysis – Noise Analysis – Temperature analysis – Transmission lines – Digital simulation – Mixed simulation.	
UNIT III - PRINTED CIRCUIT BOARD	**(9)**
Layout planning: General considerations - PCB sizes - Layout approaches - Layout, General rules and parameters: Resistance, capacitance, inductance, conductor spacing, cooling requirements and package density, layout check.	
UNIT IV- DESIGN RULES FOR DIGITAL & ANALOG CIRCUIT PCB's	**(9)**
Digital circuit PCB: Introduction – Reflection - Cross talk - Around and supply line noise - Electromagnetic interference from pulse type EM fields. Analog circuit PCB: Component placing - Signal conductor - Supply and ground conductors.	
UNIT V-PCB TECHNOLOGY TRENDS	**(9)**
Introduction - Fine line conductors with ultra-thin copper foil - Multilayer board - Multi wire board - Subtractive additive process - Semi additive process - Additive process - Flexible PCB - Metal core circuit boards - Mechanical milling of PCB.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Dennis Fitzpatrick "Analog Design and Simulation using OrCAD Capture and PSpice" Elsevier Science Publication, 2017
2. Reinhold Luduig and PavelBretchko, "RF Circuit Design – Theory and Applications", Pearson Education, USASecond Edition, 2012.
3. Walter C.Bosshart, "Printed circuit Boards – Design and Technology", Tata McGraw-Hill, New Delhi, SecondEdition, 2012.
4. Douglas Brooks, Johannes Adam "PCB Design Guide to Via and Trace Currents and Temperatures" Artech House, 2021

REFERENCES:

1. Keith H.Billings, "Handbook of Switched Mode Power Supplies" McGraw-Hill Publishing Co., New Delhi, ThirdEdition 2011.
2. Michael Jacob, "Applications and Design with Analog Integrated Circuits", PHI, New Delhi, Second Edition, 1999.
3. F.H.Mitchell, "Introduction to Electronic Design", Prentice Hall of India, New Delhi, Second Edition, 1992.
4. Sydney Soclof, "Design of Applications of Analog Integrated Circuits", Prentice Hall of India, New Delhi, Second Edition 1997.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												2	3
2		3											2	3
3			3										2	
4			3										2	
5					3									
CO (W.A)	**3**	**3**	**3**		**3**								**2**	**3**

22ECX06 - ELECTRONIC CIRCUIT BOARD DESIGN				
	L	T	P	C
	3	0	0	3

PREREQUISITE : NIL

Course Objective:	• To know the basics of electro-magnetic components • To acquire knowledge in basics of PCB and partitioning and traces • To expertise in basics of electrical parameters • To illustrate the methods and effects in PCB design

	Course Outcomes The Student will be able to	**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the concepts on fundamental components of electro magnetics to the solution of PCB designing and router topology	Ap	20%
CO2	Apply techniques to minimize crosstalk and ensure reliable circuit operation.	Ap	30%
CO3	Analyze the combined effects of parallel capacitors on circuit performance.	An	30%
CO4	Design and implement grounded heat sinks effectively in PCB layouts.	E	20%
CO5	Communicate effectively as an individual and as a part of team during oral presentations	U	Internal Assessment

UNIT I - FUNDAMENTALS	**(9)**
Electromagnetic Compatibility, Electromagnetic Interference, Radio Frequency (RF). Immunity-types-Elements of the electromagnetic environment-Nature of interference-EMC analysis-Standards-Classification of ITE Products-Immunity requirements -Printed circuit board basics-Hidden RF characteristics of passive components	
UNIT II - ROUTING TOPOLOGY CONFIGURATIONS	**(9)**
Microstrip, stripline, Layer stackup assignment, Single-sided assembly, Double-sided assembly, Four-layer stackup, Six-layer stackup, Eight-layer stackup, Radial migration, Common-mode and differential-mode currents, RF current density distribution, Grounding methodologies, Single-point grounding-Multipoint grounding, Ground and signal loops, Functional partitioning	
UNIT III - BYPASSING AND DECOUPLING	**(9)**
Review of resonance- Series resonance, Parallel resonance, Parallel C-Series RL resonance -Physical Characteristics-Impedance, Capacitor types, Energy storage, Resonance, Capacitors in parallel, Power and ground planes, Selecting a capacitor, Power and ground planes-Calculating power and ground plane capacitance, Combined effects of planar and Discrete capacitors	
UNIT IV - CLOCK CIRCUITS, TRACE ROUTING, AND TERMINATIONS	**(9)**
Topology configurations, Component placement- Calculating trace lengths (electrically long traces), Trace routing, Routing layers, Crosstalk, Trace separation, Partitioning, Isolation and partitioning (moating), Filtering and grounding, Local Area Network I/O layout, Electrostatic discharge protection, Design techniques for ESD protection, Guard band implementation	

UNIT V - DESIGN TECHNIQUES	(9)
Localized decoupling, Capacitor implementation, 20-H rule, Trace routing for corners, selecting ferrite components, Grounded heatsinks, Lithium battery circuits, BNC connectors, Creepage and clearance distances current, Carrying capacity of copper traces, Film, Footprint Design for High-Speed Boards-Component Footprint Shapes, Pad Shapes for High-Speed PCB Design, Best Routing Practices for High Speed Routing	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Mark I. Montrose and Edward M. Nakauchi. "Printed Circuit Board Design Techniques for EMC Compliance", 2nd Edition 2004.

REFERENCES:

1. Amit Bahl "High-Speed PCB Design Guide" Sierra Circuits Inc 2020.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3													
2	3												3	
3		3											3	
4			3											3
5									3	2				3
CO (W.A)	3	3	3	3					2	2			3	3

22ECX07 - SEMICONDUCTOR DEVICE MODELLING AND SIMULATION

L	T	P	C
3	0	0	3

PREREQUISITE : NIL

Course Objective:

- To know the basics of Si based nano electronics and devices
- To acquire knowledge in fundamentals of density of states
- Apply principles of metal-semiconductor contacts to design
- To understand the semiclassical transport theory and various simulation tools.

Course Outcomes The Student will be able to		Cognitive Level	Weightage of COs in End Semester Examination
CO1	Apply the concept of nanoscale devices to model nanoscale devices	Ap	20%
CO2	Analyze the characteristics of semiconductor devices and BJT for design for engineering problem	An	30%
CO3	Apply quantum mechanical models relevant to modern semiconductor devices and technologies.	Ap	30%
CO4	Design and use modern tools to provide solutions in semiclassical transport theory	E	20%
CO5	Communicate effectively about modern semiconductor devices as individual and team	U	Internal Assessment

UNIT I - SI BASED NANOELECTRONICS	**(9)**
Si-Based Nanoelectronics and Device Scaling, Beyond Conventional Silicon-Nanoscale and Heterostructure Devices, Modeling of Nanoscale Devices, Crystal structure - Classification of Crystals-Miller Indices, Doping, Band Structure, Effective Mass - density of states.	
UNIT II - SEMICONDUCTOR THEORY	**(9)**
Diode - Electron Mobility, Semiconductor Statistics- Fermi - Dirac function and carrier concentration calculation, PN junction under equilibrium, I-V Characteristics-derivation of I-V relation, Minority carrier diffusion equation, Zener diode characteristics, Breakdown - Applications of Zener diode.	
UNIT III - BIPOLAR JUNCTION TRANSISTOR	**(9)**
Transistor configuration-Ebers-Moll model, Non-idealities in BJT, Gummel Poon Model, HBT, BJT Transient and small signal behaviour, Metal-Semiconductor contact (Schottky Barrier/Diode, Ohmic Contacts) and capacitance characteristics, Thermionic emission current flow and fermi-level pinning, Field Effect Transistors (JFET, MESFET, HEMT), MOS Band diagram and C-V characteristics, Threshold voltage and Interface charges, MOSFET I-V characteristics.	
UNIT IV - SEMICLASSICAL TRANSPORT THEORY	**(9)**
Distribution Function, Boltzmann Transport Equation (BTE), Relaxation-Time Approximation (RTA), Drift-Diffusion Model Derivation - Normalization and Scaling Linearization of Poisson's Equation- Scharfetter - Gummel Discretization of the Continuity Equation Newton's Method	

UNIT V - QUANTUM TRANSPORT MODELS	(9)
Tunnelling, Stationary states for a free particle, Potential step, Tunnelling through a single barrier. Transfer matrix approach - Basic description of the method - Piecewise constant potential barrier tool-Quantum mechanical corrections to standard approach. simulation tools, Models for DD, Hydrodynamic simulations, Mobility and G-R models.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. D Vasileska, SM. Goodnick, G Klimeck, "Computational Electronics: Semiclassical and Quantum Device Modeling and Simulation," CRC Press 2010.
2. G. Streetman, and S. K. Banerjee, "Solid State Electronic Devices," 7th edition, Pearson, 2014.

REFERENCES:

1. S.Salivahanan, N. Suresh kumar and A. Vallavanraj, —Electronic Devices and Circuitsll, Tata McGraw Hill Third Edition (2013).
2. D Vasileska, SM. Goodnick, G Klimeck, "Computational Electronics: Semiclassical and Quantum Device Modeling and Simulation", CRC Press ,2017
3. https://onlinecourses.nptel.ac.in/noc23_ee35/preview

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3													
2		3											3	
3	3												3	
4			3		3									3
5									3	2				
CO (W.A)	3	3	3		3				3	2			3	3

22ECX08 - ELECTRONIC SYSTEM PACKAGING				
	L	T	P	C
	3	0	0	3

PREREQUISITE : NIL

Course Objective:	• To know the concepts of IC Packaging systemand system level PWP technologies • To gain comprehensive knowledge about failure mechanism and thermal management • To expertise in various types of packaging techniques • To illustrate the methods and techniques of packaging material and processes

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply design principles for reliability, thermal management and electronic cooling methods	Ap	20%
CO2	Apply knowledge to conduct life-cycle assessments to ensure performance of microsystems	Ap	30%
CO3	Analyze the properties and characteristics of packaging systems relevant to microsystems.	An	30%
CO4	Utilize CAD tools for PWB design and understand the limitations and processes involved in standard and microvia board assembly.	E	20%
CO5	Communicate effectively about electronic packaging systems as an individual and team	U	Internal Assessment

UNIT I - INTRODUCTION TO PACKAGING SYSTEM	**(9)**
Introduction to Microsystems - microsystem technologies-microsystem packaging, Importance of micropackaging - System level microsystem technologies - Future trends-Role of packaging in microelectronics - Microelectronic devices - Semiconductor road map-IC packaging challenges	
UNIT II - FAILURE MECHANISM AND THERMAL MANAGEMENT	**(9)**
Microsystems failure and failure mechanism - Fundamentals of design for reliability - Thermo Mechanically-Induced Failures – Electrically Induced Failures – Chemically Induced Failures - Future trends - Thermal Management - Cooling Requirements for Microsystems - Thermal Management Fundamentals - Electronic Cooling Methods	
UNIT III - SINGLE CHIP AND MULTICHIP PACKAGING	**(9)**
Functions of Single Chip Packages, Types of Single Chip Packages, Fundamentals of Single Chip Packaging Materials, Processes, and Properties - Characteristics of Single Chip Packages Multichip Module Functionality - Multichip Module Advantages- Multichip Modules at the System Level - Types of Multichip Module Substrates –Multichip Module Design –Multichip Module Technology Comparisons	
UNIT IV - SYSTEM LEVEL PWB TECHNOLOGIES	**(9)**
System Level Printed Wiring Board - Types of Printed Wiring Boards -Anatomy of a Printed Wiring Board -Fundamentals of Printed Wiring Boards - CAD Tools for Printed Wiring Board Design-Printed Wiring Board Materials - Standard Printed Wiring Board Fabrication - Limitations in Standard Printed Wiring Board - Process - Microvia Boards - Fundamentals of board assembly - Surface Mount Technology-Through - Hole Assembly.	

UNIT V - PACKAGING MATERIALS AND PROCESSES	(9)
The Role of Materials in Microsystems Packaging - Packaging Materials and Properties - Materials Processes - Future Trends-Electrical Testing- Anatomy of System - Level Electrical Testing - Fundamentals of Electrical Tests - Interconnection Tests -Active Circuit Testing - Design for Testability- Life - Cycle Assessment	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Rao R. Tummala, Fundamentals of Microsystems Packaging, The McGraw-Hill (2001)

REFERENCES:

1. The Electronic Packaging Handbook Ed. Blackwell, G.R.Boca Raton: CRC Press LLC, 2000

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3													
2	3												3	
3		3											3	
4			3		3									3
5									3	2		1		
CO (W.A)	3	3	3		3				3	2		1	3	3

VERTICAL 2: COMMUNICATION

22ECX11 - MOBILE COMMUNICATION				
	L	T	P	C
	3	0	0	3
PREREQUISITE : NIL				
Course Objective:	• To understand the mobile radio communication principles and the recent trends adopted in cellular systems and investigate different radio propagation models. • To explore the concept of Equalizers and Diversity techniques. • To analyze the different multiple access concepts in wireless communication and design the modern wireless networks.			

Course Outcomes The Student will be able to		Cognitive Level	Weightage of COs in End Semester Examination
CO1	Apply the knowledge of communication techniques to understand the different cellular technology and solve problems.	Ap	30%
CO2	Analyze the given parameters for different propagation models of wireless networks.	An	30%
CO3	Analyze the architecture of software radio and develop architecture according to the needs.	An	20%
CO4	Compare the performance of Equalizers and diversity techniques and design components to adapt modern wireless networks.	An	20%
CO5	Perform in a team to prepare a report and make an effective oral presentation of the study on topics related to Networks protocols, contribution of cellular systems to the society and its effect on environment.	U	Internal Assessment

UNIT I - CELLULAR CONCEPT	**(9)**
Introduction to wireless communication systems - Modern wireless communication systems: 2G/3G/4G cellular networks - Cellular concept: Frequency reuse - channel assignment - hand off -interference & system capacity – trunking & grade of service - Coverage and capacity improvement - Basics of 5G technology: requirements.	
UNIT II - MOBILE RADIO PROPAGATION	**(9)**
Free space propagation model - Three basic propagation mechanisms: Reflection - Two-Ray model - Diffraction - Knife-edge diffraction model - Scattering - Log-normal shadowing - Okumara model - Hata model - Log-distance path loss model - Small-scale multipath propagation - Parameters of mobile multipath channels - Types of small scale fading - Rayleigh and Rician distributions.	
UNIT III - MULTIPLE ACCESS SCHEMES AND DIVERSITY	**(9)**
FDMA, TDMA, CDMA, SDMA and CSMA, OFDMA. Diversity Techniques – Frequency diversity, Time diversity, Code diversity, Antenna diversity –RAKE Receiver - SIMO, MISO, MIMO, MIMO-OFDM Technique.	

UNIT IV - CAPACITY OF WIRELESS CHANNELS	(9)
AWGN channel capacity – capacity of flat fading channels , Frequency- selective fading channels, Multiuser capacity, Downlink channel capacity, Uplink channel capacity, Outage capacity.	
UNIT V - MODERN WIRELESS NETWORKS	**(9)**
IEEE 802.11a/b/g/n/ac wireless local area networks - 60 GHz millimeter wave gigabit wireless networks - Vehicular wireless networks - Wireless protocols for Internet of Things including Bluetooth, BLE, 802.15.4, Zigbee, LoRA and SigFox.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Rappaport S. Theodore, "Wireless Communications", Pearson Education, 2nd Edition, 2010.
2. Erik Dahlman, Stefan Parkvall and Johan Skold, "4G, LTE-Advanced Pro and The Road to 5G", Elsevier, 3rd Edition, 2016. Rao R. Tummala, Fundamentals of Microsystems Packaging, The McGraw-Hill (2001)

REFERENCES:

1. W.C.Y.Lee, "Mobile Communications Engineering: Theory and applications", McGraw-Hill International, 2nd Edition, 2009.
2. Martin Sauter, "From GSM to LTE–Advanced Pro and 5G: An Introduction to Mobile Networks and Mobile Broadband", Wiley-Blackwell, 2016".
3. Erik Dahlman, Stefan Parkvall and Johan Skold, "5G NR: The Next Generation Wireless Access Technology", Elsevier, 1st Edition, 2018

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3													2
2		3											3	
3		3											3	3
4		3											2	3
5							2	2	2					1
CO (W.A)	**3**	**3**					**2**	**2**	**2**				**2.6**	**2**

22ECX12 - SATELLITE COMMUNICATION				
	L	T	P	C
	3	0	0	3

PREREQUISITE : NIL

Course Objective:	• To understand the orbital mechanics and orbital effects on communication system. • To recognize the satellite power design and earth station systems • To gain knowledge about different multiplexing techniques for satellite communication

Course Outcomes The Student will be able to		Cognitive Level	Weightage of COs in End Semester Examination
CO1	Apply the fundamental concepts of satellite orbits to determine the orbital parameters of different satellite types	Ap	20%
CO2	Analyze the subsystems of uplink & downlink satellite communication systems and earth station systems	An	30%
CO3	Analyze the link design for signal to noise ratio calculations	An	20%
CO4	Design a satellite system that utilizes various multiplexing techniques	E	20%
CO5	Evaluate the contributions of satellite communication to sustainability for various applications	E	10%

UNIT I - SATELLITE ORBITS AND TRAJECTORIES	**(9)**
Orbital Mechanics: Orbit Equations, Kepler's Laws, Orbital Period, Orbit types - Look angle determination - Orbital effects on communication system performance - Satellite Launch.	
UNIT II - SATELLITE AND EARTH STATION SUBSYSTEMS	**(9)**
Satellite Subsystems: Power, Transponders, Antennas - AOCS, TTC&M - Control - Effects of earth - Perturbation, sun transit, moon transit - Satellite power design, Reliability - MTBF Basic Equations - System Noise and G/T ratio - Earth Station subsystems Uplink, Downlink and Design for a specified C/N ratio with GEO and LEO examples	
UNIT III - LINK DESIGN, MODULATION AND ERROR CONTROL	**(9)**
Single link design - Double link design aspects - PAM, Baseband processing - Digital Modulation for satellite links: BPSK, QPSK and QAM - TDM standards for satellite systems - Error control for satellite link: Requirements, ARQ, Concatenated Codes, Interleaving, Turbo codes.	
UNIT IV - MULTIPLE ACCESS FOR SATELLITE COMMUNICATIONS	**(9)**
FDM - FM-FDMA - TDMA - Structure and system design, Onboard Processing systems - DAMA and PAMA - CDMA system design and capacity	

UNIT V- APPLICATIONS	(9)
Remote sensing - Navigation - Scientific and military application - VSAT: Network architecture, Access Control protocols and techniques, VSAT Earth stations - Satellite Mobile Telephony - Global star - DBS/DTH Television - GPS - Weather satellites	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. T.Pratt, C. Bostian and J.Allnutt, "Satellite Communications", John Wiley and Sons, 3rd Edition, 2021.
2. Dennis Roddy, "Satellite Communications", Mc Graw Hill, 4th Edition, 2017

REFERENCES:

1. W.L.Pritchard, H G Suyderhoud and R A Nelson, "Satellite Communication System Engineering", 2nd Edition, PrenticeHall, 2013.
2. Tri. T. Ha, "Digital Satellite Communications", McGraw Hill, 2nd Edition, 2017.
3. Manojit Mithra ,"Satellite Communication", Prentice Hall,2005.
4. M. Richharia, "Satellite systems for Personal Applications", John Wiley, 2010

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												2	
2		3											2	
3		3											2	
4			3										2	
5			3		2		3							
CO (W.A)	3	3	3		2		3						2	

22ECX13 - OPTICAL COMMUNICATION				
	L	T	P	C
	3	0	0	3

PREREQUISITE : NIL

Course Objective:	• To learn and understand the basic concepts in optical fiber cable. • To gain knowledge on different losses in fiber optic cable. • To know about optical sources, coupling mechanisms, optical networks and optical measurement standards.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply field theory concepts in optical signal, optical sources and detectors.	Ap	30%
CO2	Apply the modal concepts in different mode fibers and determine the losses encountered in optical cable	Ap	30%
CO3	Use the optical equipments to measure the parameters in optical networks.	Ap	20%
CO4	Analyze analog and digital links using link design and rise time budget analysis for a given Optical Fiber communication link.	An	20%
CO5	Give an oral presentation of developments in Optical Fiber Communication with respect to standards, applications, challenges and impacts.	U	Internal Assessment

UNIT I - OPTICAL FIBERS - STRUCTURE	**(9)**
Evolution of Fiber Optic Systems , Elements of an Optical fiber Transmission link , Basic laws and definitions, Optical fiber modes and configurations , Mode theory of circular waveguides - Overview of modes, Key modal concepts , Linearly Polarized waves , Single Mode and Multi Mode Fibers, Graded Index Fiber Structure.	
UNIT II - ATTENUATION AND DISPERSION	**(9)**
Attenuation, Signal dispersion in fibers – Modal Delay, Group delay , Material dispersion , Wave Guide dispersion , Dispersion in single mode fibers, Polarization mode dispersion , RI profile and cut off wavelength, Dispersion Management, Dispersion Shifted Fibers.	
UNIT III - OPTICAL SOURCES	**(9)**
LED's - Surface and Edge emitters, Modulation of LED, LASER Diodes - Fabry-Perot Lasers , Distributed Feedback (DFB) Lasers , Modulation of LASER diodes , Power Launching and Coupling - Source to fiber power launching , Lensing Schemes for Coupling improvement , LED coupling to single mode fibers, Fiber connectors, Fiber splicers.	
UNIT IV - PHOTODETECTOR AND OPTICAL RECEIVER OPERATION	**(9)**
PIN Photo detector, Avalanche Photodiodes, Photodetector noise - Detector response time, Avalanche multiplication of Noise, Fundamental Receiver operation-Error sources, Front End Amplifiers, Digital Receiver Performance- Probability of error, Quantum limit, Point to point link systems considerations - Link Power budget, Rise time budget.	

UNIT V- OPTICAL NETWORKS AND PERFORMANCE MEASUREMENTS	(9)
Operational principles of WDM, EDFA, Solitons, Basic concepts of SONET/SDH, Performance Measurement- Measurement standards, Test Equipments, Power Measurements, Attenuation Measurements, Dispersion Measurements, OTDR.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Gerd Keiser, "Optical Fiber Communications", McGraw-Hill Education, 5th Edition, 2017.

REFERENCES:

1. John M. Senior, "Optical Fiber Communications", Pearson Education, 3rd Edition, 2014.
2. Govind P.Agrawal, "Fiber-optic Communication Systems", A John Wiley & Sons, 3rd Edition, 2015.
3. R.P.Khare, "Fiber Optics and Optoelectronics", Oxford University, 2004.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3													
2	3	2												
3	3	2											3	
4		3											2	
5								3	2	3		2		
CO (W.A)	3	2.6						3	2	3		2	2.5	

22ECX14 - INFORMATION THEORY AND CODING				
	L	T	P	C
	3	0	0	3

PREREQUISITE : NIL

Course Objective:	• To enable the student to investigate different channel coding techniques in text, audio and video. • To make the students to analyze the different block coding techniques. • To make the students to investigate different convolutional codes.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	The Students will be able to apply the coding techniques and design a channel.	Ap	20%
CO2	The Students will be able to analyze and implement the different source coding techniques.	An	20%
CO3	The Students will be able to analyze and solve the different channel coding techniques.	An	20%
CO4	The students will be able to apply different block coding techniques and design.	Ap	20%
CO5	The students will be able to design the convolutional codes.	C	20%

UNIT I - INFORMATION THEORY	**(9)**
Information – Information rate - Entropy – Classification of codes – K-raft McMillan inequality –source coding theorem Shannon Fano coding - Huffman coding - Extended Huffman coding – joint and conditional entropies- Mutual Information Discrete memory less channels: BSC, BEC and channel capacity - Shannon limit.	
UNIT II - SOURCE CODING	**(9)**
Text: Adaptive Huffman coding, arithmetic coding and latex format - Audio: Perceptual coding, masking techniques, psychoacoustic model, MPEG audio layers - I,II & III - Dolby AC3 – Image and video formats: GIF, TI F, BMP, PNG , SIF, CIF & QCIF – Image compression: JPEG – Video compression: Principles-I,B,P frame s and motion estimation.	
UNIT III - CHANNEL CODING	**(9)**
Characteristics of speech signals - Quantization techniques – Channel vocoder - Linear predictive coding – Information capacity theorem – Implication of the information capacity theorem- Information capacity of colored noise channel – Rate distortion theory - Data compression.	
UNIT IV - BLOCK CODES	**(9)**
Hamming codes: Hamming weight, hamming distance, minimum distance decoding – Single parity Codes Repetition codes: Linear block codes, cyclic codes – Syndrome calculation, encoder and decoder - CRC	

UNIT V- CONVOLUTIONAL CODES	(9)
Convolutional codes – Code tree, trellis, state diagram - Encoding - Decoding: Sequential search and Viterbi algorithm - Principle of turbo coding – Other codes: RS code, Gola y code and Burst error correcting code.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. R. Bose, Information Theory, Coding and Cryptography, Tata McGraw Hill, New Delhi, Third Edition, 2016
1. Fred Halsall, Multimedia Communications: Applications, Networks, Protocols and Standards, Pearson Education Asia, Fourth Edition, 2009.

REFERENCES:

1. K.Sayood, Introduction to Data Compression, Elsevier, Netherlands, Fifth Edition, 2017.
2. S.Gravano, Introduction to Error Control Codes, Oxford University Press, England, First Edition, 2007.
3. Amitabha Bhattacharya, Digital Communications, Tata McGraw Hill, New Delhi, First Edition, 2013.
4. Theodore Rappaport, Wireless Communications - Principles and Practice, Pearson Education, Bengaluru, Second Edition, 2012.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												2	
2		3											2	
3		3											2	
4			3										3	
5									2	2	2	2	2	
CO (W.A)	3	3	3						2	2	2	2	2.2	

22ECX15 - RADAR COMMUNICATION				
	L	T	P	C
	3	0	0	3

PREREQUISITE : NIL

Course Objective:	• To enable the student to explore the concept RADAR transmitters and detectors. • To make the students to analyze the different antennas used for RADAR applications. • To make the students to learn and understand the different types of RADAR and Doppler concepts.

Course Outcomes The Student will be able to		Cognitive Level	Weightage of COs in End Semester Examination
CO1	The Students will be able to discuss and summarize the RADAR communication principles.	Ap	20%
CO2	The Students will be able to analyze the different probabilities and calculate the amount of noise and RADAR signals.	An	20%
CO3	The Students will be able to design RADAR receivers and transmitters for specified application.	An	20%
CO4	The students will be able to construct different antenna for various RADAR applications.	C	20%
CO5	The students will be able to design RADAR by applying the Doppler concepts.	C	20%

UNIT I - INTRODUCTION TO RADAR	**(9)**
Basics of RADAR, EM Waves & properties- applications of RADAR, RADAR frequencies- RADAR block diagram, RADAR Coordinates, Radar equation for hard targets and the SNR- RADAR cross section of targets, RADAR Resolution Elements, Pulse, CW and FMCW RADARS –configurations, transmitter power- pulse repetition frequency, Duty Ratio, Pulse Compression, Coding	
UNIT II - DETECTION OF SIGNALS IN NOISE AND RADAR WAVEFORMS	**(9)**
Probability density functions – probabilities of detection and false alarm-matched filter receiver-detection criteria – integration of radar pulses - constant-false alarm rate receivers - RADAR Waveforms, Pulse Compression, Ambiguity Diagram.	
UNIT III - RADAR TRANSMITTER AND RECEIVER	**(9)**
Introduction- Types of Transmitters - linear-beam power tubes- solid-state RF power sources- magnetron-Klystron, crossed-filed amplifier- RADAR receiver- receiver noise figure- super heterodyne receiver, Digital Receivers, duplexers and receiver protectors- RADAR displays-Human Machine Interface(HMI)	
UNIT IV - RADAR ANTENNA	**(9)**
Functions of RADAR antenna- antenna parameters- antenna radiation pattern and aperture illumination - reflector antennas- electronically steered phased array antennas- phase shifters – frequency - scan arrays-- architectures for phased arrays, radiators for phased arrays- mechanically steered planar array antennas- radiation pattern synthesis -effect of errors on radiation patterns - low side lobes antennas.	

UNIT V- MTI AND PULSE DOPPLER RADAR	(9)
Introduction to Doppler and MTI RADAR - delay –line cancellers- staggered pulse repetition frequencies- doppler filter banks- digital MTI processing - Moving target detector- limitations to MTI performance pulse Doppler radar- MTD, Tracking radar- mono pulse tracking- conical scan and sequential lobing- comparison of trackers. Tracking accuracy- low-angle tracking- Atmospheric & Weather RADARS: Precipitation RADAR, Doppler Weather RADAR, Polarimetric RADAR, Clear Air RADARS.	
TOTAL(L:45) = 45 PERIODS	

TEXT BOOKS:

1. Merril I Skolnik , "Introduction to Radar Systems", Mc Graw-Hill, 2017.
2. Peebles P Z , "Radar Principles", Wiley, 2016.

REFERENCES:

1. Richard J Doviak , Dusan S Zrnic , "Doppler Radar and Weather Observations", Academic Press, 2014.
2. Bringi V N, Chandrasekar V , "Polarimetric Doppler Weather Radar", Cambridge University Press, 2012.
3. Richards M A, Scheer J A and Holm W A , "Principles of Modern Radar", Scitech Publishing, 2014.
4. Levanon N , "Radar Signals", Wiley-IEEE Press, 2012.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												2	
2		3											2	
3		3											2	
4			3										3	
5									2	2	2	2	2	
CO (W.A)	**3**	**3**	**3**						**2**	**2**	**2**	**2**	**2.2**	

22ECX16 - DIGITAL COMMUNICATION RECEIVERS				
	L	T	P	C
	3	0	0	3

PREREQUISITE : NIL

Course Objective:	• To provide knowledge on complete analysis of synchronization techniques. • To deliberate the performance of Pass band, base band and spread spectrum communication. • To learn and design the fading channels.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	The students will be able to describe Baseband data transmission and reception.	Ap	20%
CO2	The students will be able to analyze the performance of various Pass band data transmission, reception techniques.	An	20%
CO3	The Students will be able to compare the performance of synchronization algorithms .	An	40%
CO4	The students will be able to analyze the performance of synchronizers.	An	20%
CO5	The students will be able to design the receivers of fading channels.	U	Internal Assessment

UNIT I - BASEBAND COMMUNICATION	**(9)**
Baseband PAM, Clock Synchronizers - Error tracking and spectral line generating synchronizers, Squaring synchronizers, Mueller and Muller synchronizers.	
UNIT II - PASSBAND COMMUNICATION	**(9)**
Pass band Transmission, Receivers for PAM, Sufficient Statistics for Reception in Gaussian Noise, Optimum ML receivers - Synchronized detection, Digital matched filter.	
UNIT III - SYNCHRONIZATION ALGORITHMS	**(9)**
ML synchronization algorithms – Estimator Structures for Slowly Varying Synchronization Parameters, Non-Data Aided and Data Aided algorithms. Timing parameter and carrier phase estimation, Phasor Locked Loop.	
UNIT IV - PERFORMANCE ANALYSIS OF SYNCHRONIZERS	**(9)**
Tracking Performance of Carrier and Symbol Synchronizers, Feedback and feed forward synchronizers. Cycle slipping, Acquisition of carrier phase and symbol timing.	
UNIT V- RECEIVERS FOR FADING CHANNELS	**(9)**
Characterization of Fading channels, Detection and parameter synchronization on Fading channels, Receiver structures for fading channels – Outer and Inner receivers, parameter synchronization for flat fading and selective fading channels.	
TOTAL(L:45) = 45 PERIODS	

TEXT BOOKS:

1. H.Meyer, M. Moeneclaey, S. A. Fechtel , "Digital Communication Receivers", Wiley, 2015.
2. U.Mengali, A.N.D.Andrea , "Synchronization Techniques for Digital Receivers", Kluwer, 2014.

REFERENCES:

1. Proakis J G, Salehi M , "Digital communications", Tata McGraw Hill, New York, 2018.
2. Rohde U L, Whitaker J C, Zahnd H , "Communications Receivers", McGraw-Hill, 2017.
3. Bernard Sklar , "Digital Communications- Fundamentals and applications", Prentice Hall, 2017.
4. Lathi B P, "Modern Digital and Analog communication Systems", Oxford University Press, 2017.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												2	
2		3											2	
3		3											2	
4			3										3	
5									2	2	2	2	2	
CO (W.A)	**3**	**3**	**3**						**2**	**2**	**2**	**2**	**2.2**	

22ECX17 - SOFTWARE DEFINED RADIO				
	L	T	P	C
	3	0	0	3

PREREQUISITE : NIL

Course Objective:	• To learn and understand the concept of the evolution and technology needs and investigate the essential functional components and architecture of Software Defined Radio. • To comprehend the concepts, architecture, components, radio procedure knowledge and design considerations of Cognitive Radio. • To explore the concepts of next generation wireless networks.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the concepts of analog and digital technologies to the systems required by a software-defined radio to function and the trade-offs and limitations encountered in the design of a software-defined radio system.	Ap	30%
CO2	Apply the cognitive radio design concepts to develop a cognitive radio environment.	Ap	30%
CO3	Analyze the architecture of software radio and develop architecture according to the needs.	An	20%
CO4	Design next generation wireless network with the application of spectrum management techniques	E	20%
CO5	Conduct experiments using simulation tools to demonstrate the implementation of Cognitive Radio.	U	Internal Assessment

UNIT I - SDR EVOLUTION	**(9)**
Definitions and potential benefits - software radio architecture evolution - foundations - technology tradeoffs and architecture implications - Antenna for Cognitive Radio.	
UNIT II - SDR ARCHITECTURE	**(9)**
Essential functions of the software radio - architecture goals - quantifying degrees of programmability - top level component topology - computational properties of functional components - interface topologies among plug and play modules – architecture partitions.	
UNIT III - INTRODUCTION TO COGNITIVE RADIOS	**(9)**
Marking radio self-aware - cognition cycle - organization of cognition tasks - structuring knowledge for cognition tasks – Enabling location and environment awareness in cognitive radios - concepts - architecture - design considerations.	
UNIT IV - COGNITIVE RADIO ARCHITECTURE	**(9)**
Primary Cognitive Radio functions - Behaviors - Components - A-Priori Knowledge taxonomy - observe - phase data structures - Radio procedure knowledge encapsulation - components of orient - plan - decide phases - act phase knowledge representation - design rules	

UNIT V - NEXT GENERATION (XG) WIRELESS NETWORKS	(9)
The XG Network architecture - spectrum sensing - spectrum management - spectrum mobility - spectrum sharing - upper- layer issues - cross-layer design.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Alexander M. Wyglinski, Maziar Nekovee, and Y. Thomas Hou, "Cognitive Radio Communications and Networks – Principles and Practice", Elsevier Inc., 2010.
2. Huseyin Arslan , "Cognitive Radio, Software Defined Radio and Adaptive wireless system, Springer, 1st Edition, 2007.

REFERENCES:

1. Bruce A Fette, "Cognitive Radio Technology", Academic Press, 2009.
2. E. Biglieri, A.J. Goldsmith., L.J. Greenstein, N.B. Mandayam, H.V. Poor, "Principles of Cognitive Radio", Cambridge University Press, 2013.
3. Kwang- Cheng Chen and Ramjee Prasad, "Cognitive Radio Networks", John Wiley & Sons, Ltd, 2009.
4. Khattab, Ahmed, Perkins, Dmitri, Bayoumi, Magdy, "Cognitive Radio Networks - From Theory to Practice", Springer Series: Analog Circuits and Signal Processing, 2009.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3													
2	3												3	
3		3											3	
4			3										2	
5					3			2	2				2	
CO (W.A)	**3**	**3**	**3**		**3**			**2**	**2**				**2.5**	

22ECX18 - 4G / 5G COMMUNICATION NETWORKS				
	L	T	P	C
	3	0	0	3

PREREQUISITE : NIL

Course Objective:	• To familiar with evolution of wireless networks and fundamentals of 5G networks. • To acquire knowledge on spectrum sharing, spectrum trading and the processes associated with 5G architecture. • To understand the security features in 5G networks.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the knowledge of communication in finding the protocols and spectrum management.	Ap	30%
CO2	Apply the concepts of wireless networks in 5G through its architecture.	Ap	20%
CO3	Determine the specifications of 5G components.	Ap	30%
CO4	Analyze different network architecture, security features and threats in 5G networks.	An	20%
CO5	Perform in a team to prepare an effective oral presentation on topics related to 5G concepts, spectrum sharing and trading.	U	Internal Assessment

UNIT I - EVOLUTION OF WIRELESS NETWORKS	**(9)**
Networks evolution: 2G, 3G, 4G, evolution of radio access networks, need for 5G. 4G versus 5G, Next Generation core (NG-core), visualized Evolved Packet Core (vEPC).	
UNIT II - 5G CONCEPTS AND CHALLENGES	**(9)**
Fundamentals of 5G technologies, overview of 5G core network architecture, 5G new radio and cloud technologies, Radio Access Technologies (RATs), EPC for 5G.	
UNIT III - NETWORK ARCHITECTURE AND THE PROCESSES	**(9)**
5G architecture and core, network slicing, Multi Access Edge Computing (MEC), visualization of 5G components, end-to-end system architecture, service continuity, relation to EPC, edge computing. 5G protocols: 5G NAS, NGAP, GTP-U, IPSec and GRE.	
UNIT IV - DYNAMIC SPECTRUM MANAGEMENT AND MM-WAVES	**(9)**
Mobility management, Command and control, spectrum sharing and spectrum trading, cognitive radio based on 5G, millimeter waves.	
UNIT V- SECURITY IN 5G NETWORKS	**(9)**
Security features in 5G networks, network domain security, user domain security, flow based QoS framework, mitigating the threats in 5G.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:
1. Stephen Rommer, "5G Core networks: Powering Digitalization", Academic Press,2019 2. Saro Velrajan, "An Introduction to 5G Wireless Networks: Technology, Concepts and Use cases", First Edition, 2020.
REFERENCES:
1. Jyrki. T.J.Penttinen, "5G Simplified: ABCs of Advanced Mobile Communications", Copyrighted Material. 2. Wan Lee Anthony, "5G system Design: An end to end Perspective", Springer Publications, 2019.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3													
2	3													2
3	3													2
4	2	3												3
5								2	3	3		2		
CO (W.A)	2.3	3						2	3	3		2		2.6

VERTICAL 3: NETWORKS

22ECX21 - COMPUTER SYSTEMS AND HARDWARE				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

PREREQUISITE : NIL

Course Objective:	• To understand the concepts of computer hardware and motherboards. • To provide an adequate knowledge of processors and memory. • To accord basic knowledge in obtaining the features, working and installation concepts of various storage devices. • To learn the concepts of the type, features, specification, working of various input and output devices

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the knowledge of effective troubleshooting and maintenance of hardware components.	Ap	20%
CO2	Analyzethe developmental stages and architectural details of CPUs and memory to solve related hardware issues.	An	30%
CO3	Apply the knowledge ofelaborate features, installation, and maintenance of input and output devices.	Ap	30%
CO4	Design assemble, and configure complete computer systems, ensuring proper installation of components, operating systems, and device drivers.	E	20%
CO5	Give a presentation on self-learning, collaborate in teamwork, and ethically assemble hardware systems to address complex technical challenges.	U	Internal Assessment

UNIT I - HARDWARE AND MOTHERBOARDS	**(9)**
Basic computer hardware structure - Hardware and software - Different type of computers- Features of computer systems: Features of desktop system, Features of server computer, Features of laptops, Features of tablets - Motherboards: Features, components, processor support, controller, BIOS -Trouble shooting and maintenance of motherboards.	
UNIT II - PROCESSING UNIT AND MEMORY	**(9)**
Processor features - Developmental stages of CPU - Towards multiple core processors - Processor architectural details -Processor specifications – Installing and uninstalling CPU – CPU overheating issues – Memory: Features, types, working, memory map, installing and uninstalling memory modules, troubleshooting and maintenance of memory.	
UNIT III -STORAGE DEVICES	**(9)**
Storage Devices, Hard Disks: Details, working, feature, installation, selection, specifications, partitioning and formatting, maintenance and troubleshooting – optical storage devices features, working of optical storage drives, installing optical drives, troubleshooting and maintenance.	

UNIT IV - INPUT AND OUTPUT DEVICES	(9)
LCD monitors: Installing, specification, maintenance and troubleshooting of LCD monitors – LED monitors and touchscreens – Keyboard: Types and features, interfaces, installing, maintenance and troubleshooting – Mouse: types, working, features, interfaces, maintenance and troubleshooting	
UNIT V - ASSEMBLING AND CONFIGURING COMPUTERS	**(9)**
Assembling and configuring: Caution and safety, Setting up the cabinet - Installing heat sink and cooling fan – Installing memory module - Mounting motherboard – Installing hard disk – Connecting motherboard - Connecting to front panel – Connecting mouse, keyboard and monitor – Switching on the computer – Configuring – BIOS Installing operating system – Installing device drivers –Installing add-on cards.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. K. L. James, "Computer Hardware: Installation, Interfacing, Troubleshooting and Maintenance", PHI Learning, Delhi, 1st edition, 2013.
2. B. Govindarajalu, "IBM PC and Clones – Hardware, Troubleshooting and Maintenance", Tata McGraw-Hill, NewDelhi, 1st edition, 2002..

REFERENCES:

1. Jean Andrews, "Guide to Hardware Managing, Maintaining and Troubleshooting", Cengage Learning (Course Technology), Noida, 9th Edition, 2016.
2. Craig Zacker and John Rourke, "PC Hardware: The Complete Reference, McGraw-Hill, New Delhi, 1st edition2017.
3. Michael W. Graves, "A+ Guide to PC Hardware Maintenance and Repair", Cengage Learning, Noida, 1st edition, 2004.
4. Scott M. Mueller, "Upgrading and Repairing PCs", Que Publishing, Ahmedabad, 22nd Edition, 2015..

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												2	
2		3											2	
3	3												2	
4			3										2	
5							2	1	2				2	
CO (W.A)	3	3	3				2	1	2				2	

22ECX22 - NETWORK INFORMATION SECURITY				
	L	T	P	C
	3	0	0	3

PREREQUISITE : NIL

Course Objective:	• To understand the different security model. • To study about risk management

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the knowledge of network security to protect data.	Ap	20%
CO2	Analyze the threat factors in the network system	An	20%
CO3	Analyze the security technology in information theory	An	40%
CO4	Develop skills in securing communication protocols.	An	20%
CO5	Oral presentation on the application of network security	U	Internal Assessment

UNIT I - INTRODUCTION TO INFORMATION SECURITY	**(9)**
The History of Information Security- Critical Characteristics of Information - CNSS Security Model - Components of an Information System - Balancing Information Security and Access - The Systems Development Life Cycle - The Security Systems Development Life Cycle.	
UNIT II - RISK MANAGEMENT	**(9)**
Introduction - An Overview of Risk Management - Risk Identification -Risk Assessment - Risk Control Strategies - Selecting a Risk Control Strategy - Risk Management Discussion Points- Recommended Practices in Controlling Risk.	
UNIT III - PLANNING FOR SECURITY	**(9)**
Introduction - Information Security Policy, Standards and Practices - The Information Security Blueprint: The ISO 27000 Series, NIST Security Models, Design of Security Architecture - Security Education, Training and Awareness Program - Continuity Strategies.	
UNIT IV - SECURITY TECHNOLOGY	**(9)**
Introduction - Intrusion Detection and Prevention Systems: IDPS Terminology, Use of IDPS, Strengths and Limitations of IDPS - Honey Pots, Honey Nets, and Padded Cell Systems - Scanning and Analysis Tools - Biometric Access Controls.	
UNIT V - IMPLEMENTING INFORMATION SECURITY	**(9)**
Introduction - Information Security Project Management - Technical Aspects of Implementation - Nontechnical Aspects of Implementation - Information Systems Security Certification and Accreditation.	
TOTAL(L:45) = 45 PERIODS	

TEXT BOOKS:

1. Michael E Whitman and Herbert J Mattord, "Principles of Information Security", Course Technology, New Delhi, Seventh Edition, 2021 Reprint.

REFERENCES:

1. Nina Godbole, "Information Systems Security-Security Management, Metrics, Frameworks and Best Practices", Wiley India Pvt. Ltd., New Delhi, First Edition, 2009.(Biometric Controls, Security of Wireless Networks, Laws and Legal Framework)
2. Thomas R.Peltier, "Information Security Fundamentals", Auerbach Publications, Second Edition, 2013.
3. Micki Krause and Harold F.Tipton, "Information Security Management Handbook", Auerbach Publications, Sixth Edition,2008.
4. Mark Merkow and Jim Breithaupt," Information Security - Principles & Practices", Second Edition, Pearson Education,2014.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3													
2		3											2	
3		2											2	
4			3											
5										2				
CO (W.A)	3	3	3							2			2	

22ECX23 - CRYPTOGRAPHY AND NETWORK SECURITY				
	L	T	P	C
	3	0	0	3

PREREQUISITE : NIL

Course Objective:	• To learn and understand the concepts and mechanism of security services and attacks in computing and various Network and System Security methods. • To investigate Symmetric Cryptography, its types and Public Key Cryptography Algorithms. • To analyze the Message Authentication algorithms like HASH function and HMAC.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the knowledge of mathematics to cryptography, examine the various system security schemes and apply in the design of communication networks.	Ap	30%
CO2	Analyze algorithms and techniques of Block and Stream ciphers to solve problems in simple substitution ciphers.	An	30%
CO3	Analyze the concepts of message integrity, digital signature and key management schemes to improve the security mechanism.	An	20%
CO4	Examine the various system security schemes and apply in the design of communication networks.	E	20%
CO5	Give oral presentation in teams on a case study of a real time security applied in network platforms.	U	Internal Assessment

UNIT I – SECURITY IN COMPUTING	**(9)**
Security services- Attacks- Mechanism- Points of Security Vulnerability - Methods of Defense- Controls, Effectiveness of Control- Introduction to Cryptography and Steganography- Plan of attack - Attack on Encryption – Standards: Standard Setting Organizations - IEC 62443, ISO 27001.	
UNIT II – SYMMETRIC CRYPTOGRAPHY	**(9)**
Encryption and Decryption- Substitution- Transposition- Traditional Block Cipher Structure- Data Encryption Standard- Advance Encryption Standard- Triple DES, Stream Ciphers, RC4 Ciphers.	
UNIT III – PUBLIC KEY CRYPTOGRAPHY	**(9)**
Introduction to Number Theory-Requirements of Public Key Cryptography - Rivest-Shamir-Adleman(RSA) algorithm - Key Management – Diffie - Hellman Key Exchange - Elliptic Curve Cryptography.	
UNIT IV – MESSAGE AUTHENTICATION	**(9)**
Hash functions –Secure Hash algorithm- Message Authentication Requirements, Functions - HMAC- Digital signatures.	

UNIT V – NETWORK AND SYSTEM SECURITY	(9)
Authentication applications - E-mail Security - IP security - Web security – Malicious Software - Intruders - Firewalls- Art cyber security- Defense in depth.	
	TOTAL(L:45) = 45 PERIODS

TEXT BOOKS:

1. William Stallings, "Cryptography & Network Security: Principles & Practices", 7th Edition, Pearson Education, New Delhi, 2017.

REFERENCES:

1. Behrouz A Forouson, "Cryptography & Network Security", Tata McGraw Hill, New Delhi, 2010.
2. Charles P Pleeger, "Security in Computing", Prentice Hall, New Delhi, 2011.
3. Paul C Van Oorschot and Scott A Vanstone, "Handbook of Applied Cryptography", CRC Press.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3													
2		3											3	
3		3											3	
4			3										2	
5							2	2	2				2	
CO (W.A)	3	3	3				2	2	2				2.5	

22ECX24 - HIGH PERFORMANCE COMMUNICATION NETWORKS				
	L	T	P	C
	3	0	0	3
PREREQUISITE : NIL				

Course Objective:	• To understand the concept of networks and functionalities of high speed networks. • To study about different types protocols for real time operations, queuing disciplines and differentiated services • To explore connection-oriented services with reference to MPLS & VPN

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply networking concepts to configure, troubleshoot, and optimize network systems and protocols.	Ap	20%
CO2	Apply the principles and concepts of high speed networks in performance computing.	An	30%
CO3	Analyze various networking technologies, protocols, and services for their effectiveness in meeting specific network requirements.	An	30%
CO4	Ability to analyze the different levels of quality of service (QoS) to different applications.	E	20%
CO5	Perform as an individual or in team, prepare a report on connection-oriented services and give oral presentation.	U	Internal Assessment

UNIT I - NETWORK CONCEPTS	**(9)**
Introduction - Principles - Applications - Services: Network Types- Network architectures - Layered architecture: layered network - Limitations	
UNIT II - HIGH SPEED NETWORKS	**(9)**
Frame Relay Networks – Asynchronous transfer mode – ATM Protocol Architecture,– ATM Service Categories – AAL, High Speed LANs: Fast Ethernet, Gigabit Ethernet, Fiber Channel – Wireless LANs: applications, requirements – Architecture of 802.11	
UNIT III - PROTOCOLS FOR QOS SUPPORT	**(9)**
RSVP – Goals & Characteristics, Data Flow, RSVP operations, Protocol Mechanisms – Multiprotocol Label Switching – Operations, Label Stacking, Protocol details – RTP – Protocol Architecture.	
UNIT IV - INTEGRATED AND DIFFERENTIATED SERVICES	**(9)**
services - Queuing discipline: Fair queuing, processor sharing, bit round fair queuing, generalized processor sharing, weighted fair queuing - Random early detection - Differentiated services.	
UNIT V- ADVANCED NETWORK CONCEPTS	**(9)**
VPN: Remote access, site-to-site, tunneling and point to point protocol - Security in VPN - MPLS: Operation, routing, tunneling and use of FEC, traffic engineering and MPLS based VPNs - Peer to peer connection.	
TOTAL(L:45) = 45 PERIODS	

TEXT BOOK:
1. Jean Warland, Pravin Varaiya, "High Performance Communication Networks", Morgan Kaufmann Publishers, San Francisco ,2nd edition, 2011.
REFERENCES:
1. Lenon Garcia Widjaja, "Communication Networks", Tata McGraw-Hill, New Delhi, 2nd edition, 2007. 2. Ranier Handel Manfred N Huber, Stefan Schroder, "ATM Networks - Concepts, Protocols Applications", Addison Wesley, New York, 3rd edition, 2006. 3. Irvan Pepelnjk, Jim Guichard& Jeff Apcar, "MPLS and VPN Architecture", Volume 1 and 2, Cisco Press, 2007.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3													
2		3												
3		3												3
4			3											2
5						2			2		2			
CO (W.A)	**3**	**3**	**3**			**2**			**2**		**2**			**2.5**

22ECX25 - WIRELESS ADHOC AND SENSOR NETWORKS				
	L	T	P	C
	3	0	0	3
PREREQUISITE : NIL				
Course Objective:	• To understand the concept of networks • To study about different types sensor networks. • To study about sensor network security and tools.			

Course Outcomes The Student will be able to		Cognitive Level	Weightage of COs in End Semester Examination
CO1	Apply the challenges and considerations of various routing protocols to design routing protocols for ad hoc networks.	Ap	20%
CO2	Apply layer-wise attack concepts to propose solutions to counteract threats such as jamming and tampering.	Ap	30%
CO3	Analyze the energy consumption factors of sensor nodes and discuss strategies for energy optimization.	An	30%
CO4	Evaluate various routing and MAC protocols, security measures, and platform tools to make informed decisions based on network requirements.	E	20%
CO5	Develop solutions for real-world problems related to energy efficiency, security, and performance optimization in ad hoc and sensor networks and give oral presentation as an individual or in groups.	C	Internal Assessment

UNIT I - AD HOC NETWORKS – INTRODUCTION AND ROUTING PROTOCOLS	**(9)**
Elements of Ad hoc Wireless Networks, Ad hoc wireless Internet, Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks, Classifications of Routing Protocols, Table Driven Routing Protocols – Destination Sequenced Distance Vector (DSDV)–Ad hoc On–Demand Distance Vector Routing (AODV).	
UNIT II - SENSOR NETWORKS – INTRODUCTION & ARCHITECTURES	**(9)**
Challenges for Wireless Sensor Networks, Enabling Technologies for Wireless Sensor Networks, Single-Node Architecture – Hardware Components, Energy Consumption of Sensor Nodes, Network Architecture –,Transceiver Design Considerations, Optimization Goals and Figures of Merit.	
UNIT III - WSN NETWORKING CONCEPTS AND PROTOCOLS	**(9)**
MAC Protocols for Wireless Sensor Networks– S-MAC, The Mediation Device Protocol, PAMAS, Schedule based protocols –IEEE 802.15.4 MAC protocol, Routing Protocols- Energy Efficient Routing, Challenges and Issues in Transport layer protocol.	
UNIT IV - SENSOR NETWORK SECURITY	**(9)**
Network Security Requirements,-Network Security Attacks, Layer wise attacks in wireless sensor networks, possible solutions for jamming, tampering, -Key Distribution and Management, Secure Routing – SPINS, reliability requirements in sensor networks	

UNIT V- SENSOR NETWORK PLATFORMS AND TOOLS	(9)
Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms – TinyOS, CONTIKIOS, Node-level Simulators -TOSSIM, Programming beyond individual nodes – State centric programming.	
TOTAL(L:45) = 45 PERIODS	

TEXT BOOKS:

1. C. Siva Ram Murthy and B. S. Manoj, "Ad Hoc Wireless Networks Architectures and Protocols", Prentice Hall, PTR, 2004.
2. Holger Karl , Andreas willig, "Protocol and Architecture for Wireless Sensor Networks", John Wiley publication, Jan 2006.

REFERENCES:

1. Feng Zhao, Leonidas Guibas, "Wireless Sensor Networks: an information processing approach", Elsevier publication, 2004
2. Charles E. Perkins, "Ad Hoc Networking", Addison Wesley, 2000.
3. I.F. Akyildiz, W. Su, Sankarasubramaniam, E. Cayirci, "Wireless sensor networks: a survey", Computer Networks, Elsevier, 2002

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3													
2	3												3	
3		3											3	
4					3									3
5									3	2		1		
CO (W.A)	3	3			3				3	2		1	3	3

22ECX26 - AUTOMOTIVE ELECTRONICS AND NETWORKING				
	L	T	P	C
	3	0	0	3

PREREQUISITE : NIL

Course Objective:	• To apply fundamentals and innovative concept to optimize the automotive industry • To analyze the ignition system and enhance them with new techniques • To develop the electronic control for vehicle system • To evaluate the physical parameters of automobile system using advanced sensors • To design a advanced automotive communication network

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply fundamentals and innovative concept to optimize the automotive industry	Ap	20%
CO2	Analyze the ignition system and enhance them with new techniques	An	20%
CO3	Develop the electronic control for vehicle system	C	20%
CO4	Evaluate the physical parameters of automobile system using advanced sensors	E	20%
CO5	Design a advanced automotive communication network	C	20%

UNIT I - FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS	**(9)**
Automobile systems: Engine and its control - Ignition systems - Steering systems - Control systems: proportion controller, Proportional Integral controller and Proportional Integral differential controller.	
UNIT II - AUTOMOTIVE SENSORS	**(9)**
Sensor basics & its Functions - Air mass flow sensor- Crankshaft angular position sensor - Throttle valve sensor - Eddy	
UNIT III - AUTOMOTIVE ACTUATORS	**(9)**
Fuel Injectors - Exhaust gas recirculation Actuator - Electronic Ignition sub-systems - Digital Engine control systems: Speed density method - Idle speed control method- EGR control - Distributor-less Ignition control	
UNIT IV - VEHICULAR ELECTRONICS ARCHITECTURE	**(9)**
Intelligent Power distribution module - Supplemental restraint systems - Body control module – Engine control modules - Automatic drive positioned control unit - Driver seat control module - Front air control unit and transmission control unit	
UNIT V- AUTOMOTIVE NETWORKING	**(9)**
Networking basics topologies - Addressing - Control mechanisms: Event control & Timer control - Network topologies for new generation vehicles - Bus systems: CAN Bus, High speed CAN, LIN bus, MOST bus, Bluetooth: Piconet and scatternet.	
TOTAL(L:45) = 45 PERIODS	

TEXT BOOKS:

1. Konrad Reif, "Automotive Mechatronics Automotive Networking, Driving Stability Systems, Electronics",Vieweg-Teubner Verlag (2015).
2. Najamuz Zaman (auth.), "Automotive Electronics Design Fundamentals", Springer International Publishing (2015)

REFERENCES:

1. Robert Bosch GmbH, Bosch, "Automotive Electrics and Automotive Electronics Systems and Components, Networking and Hybrid Drive", Springer Vieweg (2014)
2. William Ribbens, "Understanding Automotive Electronics, Fifth Edition-Newnes (1998).
3. W.H.Crouse, "Automobile Electrical Equipment", McGraw-Hill, 1996.
4. P.L.Kholi, "Automotive Electrical Equipment", Tata McGraw-Hill, 1995.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												3	
2		3											3	
3			2										3	2
4				3									3	2
5				3									3	
CO (W.A)	3	3	2	3									3	2

22ECX27 - NEURAL NETWORKS

L	T	P	C
3	0	0	3

PREREQUISITE : NIL

Course Objective:	• To understand artificial neural model and architecture of neural networks • To study about to develop learning algorithms of neural networks. • To learn about the application areas of neural networks.

Course Outcomes The Student will be able to		Cognitive Level	Weightage of COs in End Semester Examination
CO1	Apply neural network concepts through analysis and implementation of neural network models	Ap	20%
CO2	Apply the steps needed to improve performance of the selected neural network.	Ap	20%
CO3	Analyze vector quantization and self organization feature maps.	An	20%
CO4	Design appropriate neural networks to specific application.	E	20%
CO5	Develop neural network models for complex real-world problems, considering societal impacts and ethics.	E	20%

UNIT I – ARCHITECTURE	**(9)**
Biological Neuron- Artificial Neural Model- Types of activation functions- Feedforward and Feedback- Convex Sets- Convex Hull and Linear Separability- Non-Linear Separable Problem- XOR Problem- Multilayer Networks- Convolutional Neural Networks- Backpropagation Neural Network	
UNIT II - SUPERVISED LEARNING	**(9)**
Perceptron learning and Non Separable sets- Least Mean Square Learning- MSE Error surface- Steepest Descent Search- JL-LMS approximate to gradient descent- Application of LMS to Noise Cancelling- Multi-layered Network Architecture	
UNIT III - SUPPORT VECTOR MACHINES	**(9)**
Statistical Learning Theory- Support Vector Machines- SVM application to Image Classification- Radial Basis Function Regularization theory- Generalized RBF Networks- Learning in RBFNs- RBF application to face recognition.	
UNIT IV - ATTRACTOR NEURAL NETWORKS	**(9)**
Associative Learning- Attractor Associative Memory- Linear Associative memory- Hopfield Network- application of Hopfield Network- Brain State in a Box neural Network- Simulated Annealing- Boltzmann Machine- Bidirectional Associative Memory.	
UNIT V- VECTOR QUANTIZATION	**(9)**
Maximal Eigenvector Filtering- Extracting Principal Components- Generalized Learning Laws- Vector Quantization- Self organization Feature Maps- Application of SOM- Growing Neural Gas	
TOTAL(L:45) = 45 PERIODS	

TEXT BOOKS:
1. Satish Kumar, "Neural Networks A Classroom Approach", McGraw Hill Education Pvt. Ltd, 2nd Edition, 2017
REFERENCES:
1. J.M. Zurada," Introduction to Artificial Neural Systems", Jaico Publications, 1994. 2. B. Yegnanarayana, "Artificial Neural Networks", 2nd Edition, Pearson Education / PHI, 2004. 3. S. Sivanandam," Introduction to Artificial Neural Networks", 1st Edition, Sangam Ltd, 2003.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												2	
2	3												2	
3		3												
4			3										3	
5			3			2		2						
CO (W.A)	3	3	3			2		2					2.3	

22ECX28 - ARTIFICIAL INTELLIGENCE				
	L	T	P	C
	3	0	0	3

PREREQUISITE : NIL

Course Objective:	• To understand the core concepts and historical evolution of AI, principles of logical reasoning, and methods for quantifying uncertainty using probability and Bayes' Rule. • To master informed and uninformed search techniques, applying them to solve various AI problems effectively. • To gain proficiency in classical planning methods, including state space search and planning graphs, for effective problem-solving in AI.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply AI fundamentals to real-world scenarios, demonstrating an understanding of its history, definitions, and key components.	Ap	20%
CO2	Analyze un-informed and informed search strategies to solve AI and constraint satisfaction problems, avoiding repeated states and searching with partial information.	An	30%
CO3	Design logical reasoning systems using knowledge-based agents and first-order logic to solve problems with incomplete or uncertain information.	An	30%
CO4	Formulate and solve planning problems using classical planning algorithms and graph-based methods.	Ap	20%
CO5	Engage in independent learning to stay updated with AI advancements and continuously improve problem-solving skills.	E	Internal Assessment

UNIT I - FUNDAMENTALS OF ARTIFICIAL INTELLIGENCE	**(9)**
Introduction–Definition – History of AI - Intelligence, Knowledge, and Human artifice -Future of Artificial Intelligence – Characteristics of Intelligent Agents–Typical Intelligent Agents – Problem Solving Approach to Typical AI problems- Searching for solutions -Un-informed search strategies –Avoiding repeated states -Searching with partial information.	
UNIT II - INFORMED SEARCHING TECHNIQUES	**(9)**
Informed search and search strategies -Heuristic function -Local search algorithms and optimistic problems –Constraint Satisfaction Problems (CSP) -Backtracking search -Structure of problems.	
UNIT III - LOGICAL REASONING	**(9)**
Logical agents: Knowledge-based agents – The Wumpus world. Logic – Propositional logic: A very simple logic Propositional theorem proving. First order logic: Representation – Syntax and semantics of first order logic –Inference in first order logic: Propositional versus first order inference– Unification and lifting – Forward chaining – Backward chaining – Resolution.	

UNIT IV - PLANNING AND DECISION MAKING	(9)
Classical Planning: Definition – Algorithms for planning as state space search- Planning graphs –classical planning approaches. Making simple Decisions-Combining beliefs and desires under Uncertainty-Utility theory, Utility functions-Multi attribute utility functions-Decision networks- The value of information-Decision theoretic expert systems.	
UNIT V- LEARNING	**(9)**
Quantifying uncertainty: Acting under uncertainty - Probability basics – Bayes' Rule. Probabilistic reasoning: Representing knowledge in uncertain domain- The semantics of Bayesian networks. Forms of learning - Supervised learning - Learning decision trees.	
TOTAL(L:45) = 45 PERIODS	

TEXT BOOKS:

1. Stuart Russell and Peter Norvig, 'Artificial Intelligence –A Modern Approach', 3rd Edition, Pearson Education, 2016.
2. Deepak Khemani, 'Artificial Intelligence', Tata McGraw Hill Education, 2013

REFERENCES:

1. Kevin Night and Elaine Rich, Nair B., 'Artificial Intelligence (SIE)', 3rd Edition, McGraw Hill,2008.
2. Dan W. Patterson, 'Introduction to AI and ES', 3rd Edition, Pearson Education, 2007.
3. Peter Jackson, 'Introduction to Expert Systems', 3rd Edition, Pearson Education, 2007.
4. Nils J. Nilsson, 'Artificial Intelligence: A new Synthesis', Harcourt Asia Pvt. Ltd., 2000.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	2	1										2	
2	3			3	2									2
3		3	3		2								2	2
4	3		3								1		1	
5									2		3		1	
CO (W.A)	3	2.5	2.3	3	2				2		2		1.5	2

VERTICAL 4: SIGNAL AND IMAGE PROCESSING

22ECX31 - DIGITAL IMAGE PROCESSING				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**
PREREQUISITE : NIL				
Course Objective:	• To gain knowledge about different image processing techniques. • To understand use of various transforms for different types of images.			

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply transform-domain representation of images using different transformation techniques.	Ap	20%
CO2	Analyze various techniques in image enhancement in spatial and frequency domain.	An	20%
CO3	Implement the compression techniques for images and videos.	Ap	40%
CO4	Design various segmentation algorithms and representation techniques.	C	20%
CO5	Apply the concepts of image processing in gray and color data	U	Internal Assessment

UNIT I - DIGITAL IMAGE FUNDAMENTALS	**(9)**
Elements of digital image processing systems - Elements of visual perception - Brightness-Contrast-Hue-Saturation-Mach band effect - Image sampling-Quantization-Basic relationship between pixels - Zooming and Shrinking of Digital Images - Color image fundamentals- RGB-HSI models.	
UNIT II - IMAGE TRANSFORMS	**(9)**
2D transforms-DFT-DCT-Discrete Sine, Walsh-Hadamard, Slant-Haar, KL transforms and SVD -properties of all transforms.	
UNIT III - IMAGE ENHANCEMENT AND RESTORATION	**(9)**
Spatial Domain enhancement: gray level transformations–histogram equalization-Image averaging-Spatial filtering: Smoothing, Sharpening filters- Frequency domain filters: Smoothing-Sharpening filters-Homomorphic filtering. Image Restoration: Degradation model-Unconstrained and Constrained restoration-Inverse filtering-Wiener filtering.	
UNIT IV - IMAGE COMPRESSION	**(9)**
Need for data compression-Error free compression-Variable length coding-Bit-Plane coding-Lossless and Lossy Predictive coding, JPEG and MPEG Compression Standards.	
UNIT V - IMAGE SEGMENTATION AND REPRESENTATION	**(9)**
Point- Line and edge detection- Thresholding – Region based segmentation: Region splitting and merging. Image representation: chain codes-polygonal approximations-signatures-boundary segments-skeletons	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:
1. Rafael C. Gonzales, Richard E. Woods, "Digital Image Processing", Pearson Education, 4th Edition, 2018.
REFERENCES:
1. Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, "Digital Image Processing Using MATLAB", Tata McGraw Hill Pvt. Ltd., 3rd Edition, 2011. 2. Anil Jain K. "Fundamentals of Digital Image Processing", PHI Learning Pvt. Ltd., Second Edition, 2004. 3. William K Pratt, "Digital Image Processing", Willey India Pvt Ltd., Fourth Edition, 2010.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1		3												
2			2										2	
3			2										2	
4					3									
5							2							
CO (W.A)		3	2		3		2						2	

22ECX32 - SPEECH SIGNAL PROCESSING				
	L	T	P	C
	3	0	0	3

PREREQUISITE : NIL

Course Objective:	• To understand the speech production mechanism and the various speech analysis techniques and speech models. • To acquire concepts of the speech compression techniques and linear predictive coding. • To study the speaker recognition and text to speech synthesis techniques.

Course Outcomes The Student will be able to		Cognitive Level	Weightage of COs in End Semester Examination
CO1	Apply knowledge of speech production mechanisms to optimize speech processing.	Ap	20%
CO2	Apply speech compression techniques using various modulation methods.	Ap	20%
CO3	Analyze Hidden Markov Model using speech recognition techniques	An	20%
CO4	Analyze speaker recognition and text to speech synthesis systems.	An	30%
CO5	Design speech signal processing systems with consideration for environmental sustainability	E	10%

UNIT I - SPEECH SIGNAL CHARACTERISTICS & ANALYSIS	**(9)**
Speech production process - Speech sounds and features- - Phonetic representation of speech - Representing- speech in time and frequency domains - Short-Time Analysis of Speech - Short-Time Energy and Zero-Crossing Rate - Short-Time Fourier Transform(STFT) - Speech Spectrum- Cepstrum - Mel-Frequency Cepstrum Coefficients -Hearing and Auditory Perception	
UNIT II - SPEECH COMPRESSION	**(9)**
Sampling and Quantization of Speech (PCM) - Adaptive differential PCM - Delta Modulation -Vector Quantization- Linear predictive coding (LPC) - Code excited Linear predictive Coding(CELP)	
UNIT III - SPEECH RECOGNITION	**(9)**
LPC for speech recognition- Hidden Markov Model (HMM)- training procedure for HMM- subword unit model based on HMM- language models for large vocabulary speech recognition – Overall recognition system based on subword units - Context dependent subword units	
UNIT IV - SPEAKER RECOGNITION	**(9)**
Acoustic parameters for speaker verification- Feature space for speaker recognition-similarity measures- Text dependent speaker verification-Text independent speaker verification techniques	

UNIT V- TEXT TO SPEECH SYNTHESIS	(9)
Text to speech synthesis(TTS)- Concatenative and waveform synthesis methods, sub-word units for TTS, intelligibility and naturalness-role of prosody- Natural Language Processing	
TOTAL(L:45) = 45 PERIODS	

TEXT BOOKS:

1. L. R. Rabiner and R. W. Schafer, "Introduction to Digital Speech Processing", Vol.1, Now publishers inc, 2007.
2. Ben Gold and Nelson Morgan "Speech and Audio signal processing : processing and perception of speech and music", John Wiley and sons 2011

REFERENCES:

1. Lawrence Rabiner, Biiing and– Hwang Juang and B.Yegnanarayana, "Fundamentals of Speech Recognition", Pearson Education, 2009.
2. Claudio Becchetti and Lucio Prina Ricotti, "Speech Recognition", John Wiley and Sons, 1999.
3. Donglos O shanhnessy, "Speech Communication: Human and Machine ", 2nd Ed. University press 2001.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3													
2	3												2	
3		3											2	
4		3			2								2	
5			2				3	2						
CO (W.A)	3	3	2		2		3	2					2	

22ECX33 - MULTIMEDIA COMPRESSION TECHNIQUES				
	L	T	P	C
	3	0	0	3

PREREQUISITE : NIL

Course Objective:	• To gain deep knowledge about various compression techniques. • To learn the representations, perceptions and applications of multimedia.

	Course Outcomes The Student will be able to	**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply different compression techniques for text files.	Ap	20%
CO2	Analyze the different audio compression coding and speech compression techniques.	An	20%
CO3	Implement the different compression approaches, coding and JPEG standards.	C	40%
CO4	Analyze the techniques used for video compressions.	An	20%
CO5	Apply the concepts of information theory, models and coding.	Ap	Internal Assessment

UNIT I - INTRODUCTION	**(9)**
Overview of Information theory-models and coding- rate distortion theory-scalar quantization-vector quantization structured vector quantizes.	
UNIT II - TEXT COMPRESSION	**(9)**
Compaction techniques - Static Huffman coding - Dynamic Huffman coding - Arithmetic coding - Lempel-Ziv coding - Lempel-Ziv Welsh coding.	
UNIT III-AUDIO AND SPEECH COMPRESSION	**(9)**
Audio compression techniques – frequency domain and filtering - Basic sub band coding - Application to speech coding - G.722 - Application of audio coding: MPEG audio - Silence compression – Speech compression techniques.	
UNIT IV -IMAGE COMPRESSION	**(9)**
Approaches to image compression - Predictive techniques - PCM, DPCM, JPEG, Quad tree DCT coding-EZW coding- SPIHT coding- JPEG 2000 standards.	
UNIT V- VIDEO COMPRESSION	**(9)**
Video signal representation - Video compression techniques - MPEG1, 2, 4 - Motion estimation - H.261, H.263, and H.264 - Overview of wavelet based compression- Real time compression.	
TOTAL(L:45) = 45 PERIODS	

TEXT BOOKS:
1. I Sayood Khaleed, "Introduction to Data Compression", Morgan Kauffman, 4th Edition, Morgan Kaufmann publishers2014. 2. Fred Halsall, James F. Kurose, "Multimedia communication - Applications, Networks, Protocols and standards", Pearson Education Limited, 2004
REFERENCES:
1. I David Solomon, "Data Compression the complete reference", Springer, 4th Edition, 2007. 2. Jerry D. Gibson, "Multimedia Communications: Directions and Innovations", Morgan Kaufmann, 2nd Edition, 2001.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1			3										1	3
2					2									
3					2								1	
4				2										
5												2		
CO (W.A)			3	2	2							2	1	3

22ECX34 - DEEP LEARNING

	L	T	P	C
	3	0	0	3

PREREQUISITE : NIL

Course Objective:	• To equip students with a comprehensive understanding of fundamental deep learning concepts, including backpropagation and optimization algorithms for training neural networks. • To enable students to apply regularization techniques and diverse hyperparameter tuning strategies to improve model performance. • To empower students to practically implement convolutional neural networks (CNN) and recurrent neural networks (RNN) in real-world applications related to speech and computer vision.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply machine learning concepts such as overfitting, underfitting, and hyper parameter tuning to improve learning algorithms.	Ap	20%
CO2	Analyze gradient-based learning techniques and deep learning fundamentals, including back propagation, regularization, and optimization algorithms.	An	30%
CO3	Design optimization strategies using advanced techniques like momentum-based gradient descent, stochastic gradient descent, and learning rate schedulers.	An	30%
CO4	Implement regularization methods to address challenges like vanishing and exploding gradients, and optimize neural network performance using techniques such as dropout and batch normalization.	Ap	20%
CO5	Explore advanced architectures like CNNs, RNNs, and Transformers, and apply them to vision and speech tasks.	E	Internal Assessment

UNIT I –INTRODUCTION TO MACHINE LEARNING	**(9)**
Machine learning Basics: Learning algorithms - Overfitting - Underfitting -digital camera and lightning, Hyper parameters Estimators - Validation - Maximum Likelihood estimation - Bayesian Statistics - Challenges in Machine☐Learning	
UNIT II - DEEP LEARNING FUNDAMENTALS	**(9)**
Gradient based learning - Hidden Units - Architectural design - Back - propagation for MLP - Regularization - Parameter Regularization - Data Augmentation - Dropout - Optimization algorithms - Adaptive learning rates.	
UNIT III - OPTIMIZATION	**(9)**
Introduction to Optimization – Convex Optimization - Drawback of Gradient Descent – Momentum based GD - Nesterov Accelerated GD – Stochastic GD- mini batch GD-learning rate schedulers.	

UNIT IV - REGULARIZATION	(9)
Vanishing and exploding gradients-Activation functions (tanh, relu ,leaky relu)-bias-variance tradeoff – L2-Regularization- Batch Normalization –Dropout- Initialization Strategies.	
UNIT V- ADVANCED ARCHITECTURES	**(9)**
CNN-Basic of Convolution – Cross entropy loss – Architectures: LeNet - AlexNet .Resnet, RNN: BPTT – LSTM - GRU–Transformers. Applications to vision and speech.	
TOTAL(L:45) = 45 PERIODS	

TEXT BOOKS:

1. Ian Goodfellow, YoshuaBengio, Aaron Courville , "Deep Learning", MIT Press, USA, 2016.
2. Adam Gibson, Josh Patterson , "Deep Learning A practitioner's approach", O'Reilly, USA, 2016

REFERENCES:

1. Yusuke Sugomori , "Deep Learning: Practical Neural Networks with Java", Packt Publisher, New York, 2016.
2. Jeff Heaton , "Artificial Intelligence for Humans: Deep Learning and Neural Networks", Lightning Source Inc, Tennessee, 2015

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3				2						1		2	
2		3		3	2									2
3			3		2				2					2
4	3		3								1		2	
5											2	3		1
CO (W.A)	3	3	3	3	2				2		1.3	3	2	1.6

22ECC35 – COMPUTER VISION				
	L	T	P	C
	3	0	0	3
PREREQUISITE : NIL				
Course Objective:	• To equip students with fundamental concepts related to image formation and processing, as well as feature detection, matching, and detection. • To gain a comprehensive understanding of feature-based alignment, motion estimation, and 3D reconstruction principles, including various techniques and model-based reconstruction. • To become familiar with image-based rendering and recognition.			

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply image processing techniques like geometric transformations, photometric image formation, and digital camera operations to solve computer vision problems.	Ap	20%
CO2	Analyze feature detection, matching, and segmentation methods to identify significant image features.	An	30%
CO3	Design alignment and motion estimation systems using 2D/3D alignment, pose estimation, and optical flow to track motion in visual data.	An	30%
CO4	Implement 3D reconstruction techniques to recover 3D models from visual data.	Ap	20%
CO5	Engage in independent learning to stay updated with advancements in image-based rendering and recognition, improving computer vision systems.	E	Internal Assessment

UNIT I - IMAGE PROCESSING FOUNDATIONS	**(9)**
Computer Vision - Geometric primitives and transformations - Photometric image formation – Thedigital camera - Point operators - Linear filtering - Neighborhood operators - Pyramids and wavelets - Geometric transformations - Global optimization.	
UNIT II - FEATURE DETECTION, MATCHING AND SEGMENTATION	**(9)**
Points and patches - Edges - Lines - Segmentation - Active contours - Split and merge - Mean shiftand mode finding - Normalized cuts - Graph cuts and energy-based methods.	
UNIT III - FEATURE-BASED ALIGNMENT & MOTION ESTIMATION	**(9)**
2D and 3D feature-based alignment - Pose estimation - Geometric intrinsic calibration - Triangulation- Two-frame structure from motion - Factorization - Bundle adjustment - Constrained structure and123motion - Translational alignment - Parametric motion - Spline-based motion - Optical flow – Layeredmotion.	
UNIT IV - 3D RECONSTRUCTION	**(9)**
Shape from X - Active rangefinding - Surface representations - Point-based representationsVolumetric representations - Model-based reconstruction - Recovering texture maps	

UNIT V- IMAGE-BASED RENDERING AND RECOGNITION	(9)
Interpolation Layered depth images - Light fields and Lumigraphs - Environment mattes -Video-based rendering-Object detection - Face recognition - Instance recognition – Categoryrecognition - Context and scene understanding- Recognition databases and test sets.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer- Texts in Computer Science, Second Edition, 2022
2. Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, Second Edition, 2015.

REFERENCES:

1. D. L. Baggio et al., Mastering OpenCV with Practical Computer Vision Projectsǁ, Packt Publishing, 2012.
2. Simon J. D. Prince, —Computer Vision: Models, Learning, and Inferenceǁ, Cambridge University Press, 2012

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3				2						1		2	
2		3		3	2									2
3			3		2				2					2
4	3		3								1		2	
5											2	3		1
CO (W.A)	3	3	3	3	2				2		1.3	3	2	1.6

22ECX36 - MACHINE LEARNING				
	L	T	P	C
	3	0	0	3
PREREQUISITE : NIL				

Course Objective:	• To understand the Machine Learning Concepts. • To obtain knowledge about reinforcement learning techniques and its applications • To get awareness Graphical Model and Ensemble methods

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply appropriate techniques for classification and regression.	Ap	20%
CO2	Analyze basic concepts of Machine Learning	An	30%
CO3	Evaluate and analyze various learning algorithms for the graphical model.	An	30%
CO4	Design and implement various unsupervised models.	E	20%
CO5	Implement the developments of various machine learning algorithms in real time applications and prepare a report for the same.	E	Internal Assessment

UNIT I – INTRODUCTION TO MACHINE LEARNING	**(9)**
Introduction-Types of Machine Learning – Supervised and unsupervised Learning– theory of generalization – generalization bound – approximation-generalization tradeoff – bias and variance – learning curve.	
UNIT II – SUPERVISED LEARNING	**(9)**
Linear regression- Bayesian regression- Regression with Basis functions- Logistic regression- Perceptrons- Large margin classification- Kernel methods- Support Vector Machines-hard SVM, soft SVM- Classification and Regression Trees, Radial Basis Functions.	
UNIT III - UNSUPERVISED LEARNING AND DIMENSIONALITY REDUCTION	**(9)**
Nearest neighbour models - K means - hierarchical clustering - Dimensionality reduction - principle component analysis - linear discriminant analysis- factor Analysis – Independent Component Analysis.	
UNIT IV - GRAPHICAL MODEL AND ENSEMBLE METHODS	**(9)**
Markov Chain Monte Carlo Methods – Sampling – Proposal Distribution-Bayesian Belief Networks-Markov Random Fields- Hidden Markov Models -Boosting - Adaboost, Gradient Boosting; Bagging - Simple methods, Random Forest.	
UNIT V- REINFORCEMENT LEARNING	**(9)**
Passive reinforcement learning – direct utility estimation – adaptive dynamic programming – temporal difference learning – active reinforcement learning – exploration – learning an action-utility function – Generalization in reinforcement learning – policy search – applications in Health care – applications in robot control.	
TOTAL (L:45)= 45 PERIODS	

TEXT BOOK:
1. Ethem Alpaydin, 'Introduction to Machine Learning', 4th Edition, MIT Press, 2020.
REFERENCES:
1. Tom M Mitchell, 'Machine Learning', 1st Edition, McGraw Hill Education, 2017. 2. Peter Flach, 'Machine Learning: The art and science of algorithms that make sense of data', Cambridge University Press, 2012. 3. K. P. Murphy, 'Machine Learning: A probabilistic perspective', MIT Press, 2012.. 4. Christopher M. Bishop, Pattern Recognition and Machine Learning , Springer,2014. 5. Stephen Marsland, Machine Learning: An Algorithmic Perspective, 2nd Edition, 2014

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3													
2		3											3	
3		3											3	
4			3										3	
5			3					2		2				
CO (W.A)	3	3	3					2		2			3	

22ECX37 - SOFT COMPUTING				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

PREREQUISITE : NIL

Course Objective:	• To understand Artificial Neural Network & Fuzzy Logic models. • To obtain knowledge about Hybrid Soft Computing techniques and its applications. • To get awareness genetic algorithms.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply various soft computing frame works.	Ap	20%
CO2	Analyze various Neural Networks training algorithms.	An	30%
CO3	Develop systems using fuzzy logic.	E	30%
CO4	Evaluate and analyze various genetic algorithm and Hybrid Soft Computing techniques	E	20%
CO5	Give oral presentation as an individual or in groups in implementing the developments of various Computing algorithms.	U	Internal Assessment

UNIT I - ARTIFICIAL NEURAL NETWORK & FUZZY LOGIC	**(9)**
Artificial neural network: Introduction, characteristics- learning methods - taxonomy - Evolution of neural networks- basic models- important technologies - applications. Fuzzy logic: Introduction - crisp sets- fuzzy sets - crisp relations and fuzy relations: cartesian product of relation - classical relation, fuzzy relations, tolerance and equivalence relations, non-iterative fuzzy sets.	
UNIT II - NEURAL NETWORKS	**(9)**
McCulloch-Pitts neuron - linear separability - hebb network - supervised learning network: perceptron networks - adaptive linear neuron, multiple adaptive linear neuron, BPN, RBF, TDNN- associative memory network: auto-associative memory network, hetero-associative memory network, BAM, hopfield networks, iterative autoassociative memory network & iterative associative memory network - unsupervised learning networks: Kohonen self organizing feature maps, LVQ - CP networks, ART network.	
UNIT III - FUZZY SYSTEMS	**(9)**
Membership functions: features, fuzzification, methods of membership value assignments-Defuzzification: lambda cuts - methods- fuzzy arithmetic and fuzzy measures: fuzzy arithmetic - extension principle - fuzzy measures - measures of fuzziness -fuzzy integrals - fuzzy rule base and approximate reasoning : truth values and tables, fuzzy propositions, formation of rules-decomposition of rules, aggregation of fuzzy rules, fuzzy reasoning-fuzzy inference systems-overview of fuzzy expert system-fuzzy decision making.	
UNIT IV - GENETIC ALGORITHM	**(9)**
Genetic algorithm and search space - general genetic algorithm - operators - Generational cycle - stopping condition - constraints- classification - genetic programming - multilevel optimization - real life problem- advances in GA	

UNIT V- HYBRID SOFT COMPUTING TECHNIQUES & APPLICATIONS	(9)
Neuro-fuzzy hybrid systems - genetic neuro hybrid systems - genetic fuzzy hybrid and fuzzy genetic hybrid systems - simplified fuzzy ARTMAP - Applications: A fusion approach of multispectral images with SAR, optimization of traveling salesman problem using genetic algorithm approach, soft computing based hybrid fuzzy controllers	
TOTAL(L:45) = 45 PERIODS	

TEXT BOOK:

1. S.N.Sivanandam and S.N.Deepa, "Principles of Soft Computing", Wiley India Pvt Ltd, 2011.

REFERENCES:

1. J.S.R.Jang, C.T. Sun and E.Mizutani, "Neuro-Fuzzy and Soft Computing", PHI / Pearson Education 2004.
2. S.Rajasekaran and G.A.Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis & Applications", Prentice-Hall of India Pvt. Ltd., 2006.
3. George J. Klir, Ute St. Clair, Bo Yuan, "Fuzzy Set Theory: Foundations and Applications" , Prentice Hall, 1997.
4. David E. Goldberg, "Genetic Algorithm in Search Optimization and Machine Learning" Pearson Education India, 2013.
5. Simon Haykin, "Neural Networks Comprehensive Foundation" Second Edition, Pearson Education, 2005.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3													
2		3												
3			3										3	
4			3										3	
5						2			2			2	2	
CO (W.A)	3	3	3			2			2			2	2.6	

22ECX38 - PATTERN RECOGNITION				
	L	T	P	C
	3	0	0	3

PREREQUISITE : NIL

Course Objective:	• To gain knowledge about pattern classification. • To understand use of supervised and unsupervised algorithm.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the clustering concepts in unsupervised learning and classification.	Ap	20%
CO2	Apply appropriate algorithms and techniques for analyzing structural patterns.	Ap	20%
CO3	Implement the concepts of pattern recognition and analyze the type of pattern given.	An	40%
CO4	Implement various feature extraction algorithms for different types of data.	C	20%
CO5	Explore advanced tools in pattern recognition through research projects, or case studies,	U	Internal Assessment

UNIT I – PATTERN CLASSIFIER	**(9)**
Overview of pattern recognition - Discriminant functions - Supervised learning - Parametric estimation - Maximum likelihood estimation - Bayesian parameter estimation - Perceptron algorithm - LMSE algorithm -Problems with Bayes approach - Pattern classification by distance functions - Minimum distance pattern classifier.	
UNIT II - UNSUPERVISED CLASSIFICATION	**(9)**
Clustering for unsupervised learning and classification - Clustering concept - C-means algorithm - Hierarchical clustering procedures - Graph theoretic approach to pattern clustering - Validity of clustering solutions.	
UNIT III-STRUCTURAL PATTERN RECOGNITION	**(9)**
Elements of formal grammars - String generation as pattern description - Recognition of syntactic description -Parsing - Stochastic grammars and applications	
UNIT IV - FEATURE EXTRACTION AND SELECTION	**(9)**
Entropy minimization - Karhunen - Loeve transformation - Feature selection through functions approximation -Binary feature selection.	

UNIT V- NON-METRIC METHODS FOR PATTERN CLASSIFICATION AND APPLICATIONS	(9)
Non-numeric data or nominal data. Decision trees: Classification and Regression Trees (CART), Applications: Face recognition - preprocessing, face detection algorithms, selection of representative patterns, classification algorithms.	
TOTAL(L:45) = 45 PERIODS	

TEXT BOOKS:

1. O.Duda, P.E.Hart and D.G.Stork, "Pattern Classification", John Wiley, 2009.
2. S.Theodoridis and K.Koutroumbas, "Pattern Recognition", 4th Edition, Academic Press, 2009.

REFERENCES:

1. C.M.Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.
2. P.A Devijver and J. Kittler, "Pattern Recognition: A Statistical Approach", Prentice-Hall International, EnglewoodCliffs, NJ, 1980
3. K. Fukunaga, "Introduction to Statistical Pattern Recognition", 2nd Edition, Academic Press, New York, 1990.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2													
2		2											1	
3			3										1	
4			3		3									
5									2					
CO (W.A)	2	2	3		3				2				1	

22ECX41 - CONTROL SYSTEMS				
	L	T	P	C
	3	0	0	3

PREREQUISITE : NIL

Course Objective:	• To understand the concepts of mathematical models, transfer functions, block diagram reduction techniques, and signal flow graphs. • To provide adequate knowledge of systems in the time domain. • To accord basic knowledge in obtaining the open loop and closed loop frequency responses of systems. • To learn the concepts of stability analysis in the time domain.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the knowledge of the elements of control systems and their impact on system performance.	Ap	30%
CO2	Apply reduction techniques and, root locus method to simplify and analyze system stability	Ap	20%
CO3	Analyze the state equations, and interpret plot techniques for controllability and observability.	An	20%
CO4	Design controllers using various methods such as PID, lead-lag compensation, and state feedback.	E	20%
CO5	Give a presentation on a comprehensive understanding of control systems, incorporating recent technological advancements and practical applications	U	Internal Assessment

UNIT I - CONTROL SYSTEM MODELLING	**(9)**
Basic elements in control systems – Open and closed loop systems -Mathematical modelling of physical systems: Transfer function model of Mechanical and Electrical systems- Block diagram reduction techniques – Signal flow graphs.	
UNIT II - TIME RESPONSE ANALYSIS	**(9)**
Standard test signals - Type and order of systems -Time domain study of first and second order feedback control systems – Time domain specifications - Steady state errors - Error constants- Introduction to P, PI and PID Controllers.	
UNIT III - FREQUENCY RESPONSE ANALYSIS	**(9)**
Frequency response - Frequency domain specifications - Bode plot- Polar plot - Gain Margin - Phase Margin - Introduction to Compensators - Lead, Lag, and Lag- Lead Compensators.	
UNIT IV - STABILITY ANALYSIS	**(9)**
Concepts of stability - Location of roots on S-plane for stability - Necessary conditions for stability- Routh Hurwitz criterion-Root locus concept-Guidelines for sketching root locus-Nyquist stability criterion.	

UNIT V- CONTROL SYSTEM ANALYSIS USING STATE VARIABLE METHODS	(9)
State variable representation-Conversion of state variable models to transfer functions-Conversion of transfer functions to canonical state variable models-Solution of state equations-state transition matrix - Kalman test for Controllability and Observability.	
TOTAL(L:45) = 45 PERIODS	

TEXT BOOKS:

2. I.J. Nagrath& M. Gopal, "Control Systems Engineering", 6th Edition, New Age International Publishers, 2018.
2. M.Gopal, "Control Systems, Principles & Design", 4th Edition, Tata McGraw Hill, 2012.

REFERENCES:

1. 1. Norman S.Nise, "Control Systems Engineering", 8th Edition, Wiley, 2019.
2. K.Ogata, "Modern Control Engineering", 5th Edition, Pearson Education India,2015
3. Benjamin.C. Kuo, FaridGolnaraghi, "Automatic Control Systems", 10th Edition, McGraw-Hill Education, 2017.
4. S.K.Bhattacharya, "Control System Engineering", Pearson, 3rd Edition, 2013.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3													2
2	3													2
3		3											2	2
4			3										2	2
5							2	1	2					1
CO (W.A)	3	3	3				2	1	2				2	2

22ECX42 - VIRTUAL INSTRUMENTATION

L	T	P	C
3	0	0	3

PREREQUISITE : NIL

Course Objective:	• To make students to gain knowledge on various traditional instrumentation and software for instrumentation. • To make the students to understand basic data acquisition systems. • To enable the student to acquire knowledge on IMAQ Vision. • To make the students to gain knowledge on real time control systems. • To motivate the students to acquire knowledge on Hardware & Operating systems.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply virtual instrumentation concepts using modular programming	Ap	20%
CO2	Apply A/D, D/A Converters with timers and counters for data acquisition system	Ap	20%
CO3	Apply PC hardware and operating system for virtual instrumentation	Ap	20%
CO4	Analyze the given images using different image processing tools	An	20%
CO5	Analyze the implementation methods for virtual instrumentation	An	20%

UNIT I - INTRODUCTION	**(9)**
Virtual Instrumentation- Comparison with Traditional Instrumentation - Definition and Flexibility - Architecture - software for Virtual Instrumentation - Modular Programming, Loop and Charts, Arrays, Clusters and Graphs, Case and Sequence Structures, Formula nodes, String and File Input / Output.	
UNIT II - DATA ACQUISITION	**(9)**
A/D and D/A converters, Plug-in Analog Input / Output cards – Digital Input and Output Cards, Organization – Performing analog input and analog output – Scanning multiple analog channels – Issues involved in selection of Data acquisition cards – Data acquisition modules with serial communication – Design of digital voltmeter with transducer input –Timers and Counters	
UNIT III - IMAQ VISION	**(9)**
Vision basics- Image processing and analysis, particle analysis – Machine vision, Hardware modules, Building machine vision system - Image processing tools, Acquisition and implementation using NI- Driver software- Applications.	
UNIT IV - REAL TIME CONTROL	**(9)**
Designs using VI Software – ON/OFF controller – Proportional controller – Modeling and basic control of level and reactor processes – Case studies on development of HMI, SCADA in VI.	

UNIT V- HARWARE & OPERATING SYSTEM OVERVIEW	(9)
PC architecture, operating system requirements, PC based instrumentation, analog and digital interfaces-PXI and SCXI main frame - modular instruments-Real time I/O and compact RIO-Introduction to NI-ELVIS – Transducers – power, speed and timing considerations.	
TOTAL(L:45) = 45 PERIODS	

TEXT BOOKS:

1. Jovitha Jerome, "Virtual Instrumentation using LABVIEW", PHI Learning, New Delhi, 2010.
2. Gary W. Johnson and Richard Jennings, "LabVIEW Graphical Programming", 4th edition, McGraw-Hill Professional Publishing, 2011.

REFERENCES:

1. Barry Paton, "Sensor, transducers and Lab view", Prentice Hall of India 2000.
2. Buchanan, W. "Computer buses", CRC Press 2000.
3. Lisa K Wells, "Lab view for Everyone", Prentice Hall of India,1996.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3													
2	3													
3	3													2
4		3												
5		3	1									-	2	
CO (W.A)	3	3	1	-	-	-	-	-	-	-	-	-	2	2

22ECX43 - WEARABLE DEVICES

	L	T	P	C
	3	0	0	3

PREREQUISITE : NIL

Course Objective:

- To make students to gain knowledge on wearable systems and sensors.
- To make students to signal processing and energy harvesting for wearable devices.
- To enable the student to wireless health systems.
- To make the students to Smart Textile.
- To motivate the students to applications of wearable systems.

Course Outcomes The Student will be able to		Cognitive Level	Weightage of COs in End Semester Examination
CO1	Develop skills in signal acquisition, processing, and analysis specific to wearable devices	Ap	20%
CO2	Apply the concept of reactive sensors employed for real life applications	Ap	20%
CO3	Design and implement wearable devices for health monitoring	Ap	20%
CO4	Analyze taxonomy of the wearable devices and its design constraints for measuring physical and biological signals.	An	20%
CO5	Analyze special purpose sensors and the need for developing smart sensors	An	20%

UNIT I - INTRODUCTION TO WEARABLE SYSTEMS AND SENSORS	**(9)**
Wearable Systems- Introduction, Need for Wearable Systems, Drawbacks of Conventional Systems for Wearable Monitoring, Applications of Wearable Systems, Types of Wearable Systems, Components of wearable Systems. Sensors for wearable systems-Inertia movement sensors, Respiration activity sensor, Impedance plethysmography, Wearable ground reaction force sensor.	
UNIT II - SIGNAL PROCESSING AND ENERGY HARVESTING FOR WEARABLE DEVICES	**(9)**
Wearability issues -physical shape and placement of sensor, Technical challenges - sensor design, signal acquisition, sampling frequency for reduced energy consumption, Rejection of irrelevant information. Power Requirements- Solar cell, Vibration based, Thermal based, Human body as a heat source for power generation, Hybrid thermoelectric photovoltaic energy harvests, Thermopiles.	
UNIT III - WIRELESS HEALTH SYSTEMS	**(9)**
Need for wireless monitoring, Definition of Body area network, BAN and Healthcare, Technical Challenges- System security and reliability, BAN Architecture – Introduction, Wireless communication Techniques.	
UNIT IV - SMART TEXTILE	**(9)**
Introduction to smart textile- Passive smart textile, active smart textile. Fabrication Techniques- Conductive Fibres, Treated Conductive Fibres, Conductive Fabrics, And Conductive Inks. Case study- smart fabric for monitoring biological parameters - ECG, respiration.	

UNIT V- APPLICATIONS OF WEARABLE SYSTEMS	(9)
Medical Diagnostics, Medical Monitoring-Patients with chronic disease, Hospital patients, Elderly patients, neural recording, Gait analysis, Sports Medicine.	
TOTAL(L:45) = 45 PERIODS	

TEXT BOOKS:

1. Annalisa Bonfiglo and Danilo De Rossi, Wearable Monitoring Systems, Springer, 2011
2. Zhang and Yuan-Ting, Wearable Medical Sensors and Systems,Springer, 2013
3. Edward Sazonov and Micheal R Neuman, Wearable Sensors: Fundamentals, Implementation and Applications, Elsevier, 2014
4. Mehmet R. Yuce and JamilY.Khan, Wireless Body Area Networks Technology, Implementation applications,Pan Stanford Publishing Pte.Ltd, Singapore, 2012

REFERENCES:

1. Sandeep K.S, Gupta, Tridib Mukherjee and Krishna Kumar Venkatasubramanian, Body Area Networks Safety, Security, and Sustainability, Cambridge University Press, 2013.
2. Guang-Zhong Yang, Body Sensor Networks, Springer, 2006
3. NPTEL Course "https://onlinecourses.nptel.ac.in/noc23_ee95/preview"

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3													
2	3													
3	3		1											2
4		3												
5		3											3	
CO (W.A)	3	3	1										3	2

22ECX44 - REAL TIME EMBEDDED SYSTEMS				
	L	T	P	C
	3	0	0	3

PREREQUISITE : 22ECC13

Course Objective:	• To Learn the architecture and programming of ARM processor. • To familiar with the embedded computing platform design and analysis. • To exposed to the basic concepts of real time Operating system. • To Learn the system design techniques and networks for embedded systems. • To make the students to develop the real time solutions

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply knowledge of functional blocks in embedded system architecture.	Ap	20%
CO2	Apply instruction set and Assembly Language Programming in ARM Processors.	Ap	20%
CO3	Apply the concepts of embedded systems and explain concepts of real time Operating system design.	Ap	30%
CO4	Analyze architecture of different ARM processor cores.	An	20%
CO5	Develop and debug applications on an RTOS platform	E	10%

UNIT I - ARCHITECTURE OF EMBEDDED SYSTEMS	**(9)**
Categories of Embedded Systems- Characteristics of Embedded system -Recent trends in Embedded Systems Hardware Architecture - Software Architecture - Communication software - Process of generation of executable image development / testing tools	
UNIT II - THE ARM RISC ARCHITECTURE	**(9)**
The Reduced Instruction Set Computer –Embedded System Design Process - The ARM programmers model - ARM Development Tools.-ARM organization and implementation: 3 stage and 5 stage pipeline ARM organization-ARM instruction execution- ARM processor cores: ARM7 TDMI- Comparison of ARM8 TDMI-ARM9 TDMI.	
UNIT III - ARM INSTRUCTION AND ASSEMBLY LANGUAGE PROGRAMMING	**(9)**
Exceptions-Conditional execution-Branch and branch with link and exchange - Software interrupt-Data processing Instructions - Single word and unsigned byte data transfer and half word and signed byte data transfer instructions Multiple Register transfer instructions – Swap instructions – The thumb instruction set - Thumb applications.	
UNIT IV - RTOS CONCEPTS	**(9)**
Architecture of the Kernel-task and task scheduler-Interrupt Service Routines-Semaphores-Mutex-Mailboxes- Message Queues - Event Registers – Pipes -Signals-Timers- Memory Management – Priority Inversion Problem.	

UNIT V- RTOS IMPLEMENTATION	(9)
Off the shelf operating system - embedded operating system - Real time operating system: VX works- Micro C/OS-11 hand held operating system : Palm OS- Symbian OS - Case study of coding for an Automatic Chocolate Vending Machine using MUCOS -RTOS- Case study of an Embedded system for an Adaptive Cruise Control Systems in a Car- Case study of an Embedded Systems for a Smart Card.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Dr.K.V.K.K Prasad "Embedded Real-Time systems: concept, design & programming", Dream tech Reprint, 2010.
2. Steve furber "ARM system on Chip Architecture", Pearson 16th Edition 2013.

REFERENCES:

1. Rajkamal, "Embedded Systems Architecture Programming and Design", 2nd edition TMH, 2010.
2. Wayne Wolf, "Computers as Components – Principles of Embedded Computer System Design", Morgon Kaufmann Publisher, 2nd Edition 2006.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3													
2	3													
3	3													3
4		3												
5									2			3	3	
CO (W.A)	3	3							2			3	3	3

22ECX45 - INTERNET OF THINGS & ITS APPLICATIONS				
	L	T	P	C
	3	0	0	3
PREREQUISITE : NIL				
Course Objective:	• To study the fundamentals of IoT, M2M and IoT Design Methodology • To learn about different IoT components and network management protocols, interfacing of IoT using Arduino/ Raspberry Pi • To study about various IoT case studies and industrial applications			

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply IoT components and networks based on fundamental principles, incorporating various IoT protocols and communication models to facilitate IoT technologies.	Ap	20%
CO2	Analyze the necessity of software-defined networking (SDN) and network function virtualization (NFV) in the design methodology of IoT.	An	30%
CO3	Analyze the network operator requirements, communication modules for IoT network management, and the integration of NETCONF sensors and actuators.	An	30%
CO4	Design an IoT system using Arduino or Raspberry Pi platforms, employing Python for programming.	E	20%
CO5	Collaborate in team-based learning environments, effectively communicate concepts, and adopt continuous learning to develop foundational IoT applications.	U	Internal Assessment

UNIT I - FUNDAMENTALS OF IoT	**(9)**
Introduction-Definition and Characteristics of IoT- Physical design- IoT Protocols-Logical design - IoT communication models, IoT Communication APIs- Enabling technologies - Wireless Sensor Networks, Cloud Computing, Big data analytics, Communication protocols, Embedded Systems, IoT Levels and Templates	
UNIT II - M2M AND IoT DESIGN METHODOLOGY	**(9)**
IoT and M2M- difference between IoT and M2M - Software defined networks, network function virtualization– Needs IoT design methodology – SDN-NFV for IOT- software defined networking – Network function virtualization.	
UNIT III - IoT COMPONENTS AND NETWORKS	**(9)**
IoT System Management- Simple Network Management Protocol – Network operator requirement – NETCONF Sensors and actuators - Communication modules – Zigbee- Architecture – Zigbee and 802.15.4 – protocol layers – Introduction to RFIDs- Wi-Fi- Power sources.	

UNIT IV - BUILDING IoT WITH HARDWARE PLATFORMS	(9)
Logical Design using Phython – Data types & structures – control flow – functions- modules - Platform - Arduino/Raspberry Pi- Physical devices - Interfaces - Programming – Serial- SPI – I2C	
UNIT V- CASE STUDIES	**(9)**
Various Real time applications of IoT- Home automation-Automatic lighting-Home intrusion detection-Cities-Smart parking-Environment-Weather monitoring system- Agriculture- Smart irrigation	
TOTAL(L:45) = 45 PERIODS	

TEXT BOOKS:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things", Cisco Press, 2017
2. Arshdeep Bahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 2015
3. Rajkamal, "Internet of Things: Architecture, Design Principles And Applications", McGraw Hill Higher Education

REFERENCES:

1. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things – Key applications and Protocols", Wiley Publications 2012.
2. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things: Key applications and Protocols",Wiley Publications 2nd edition, 2013.
3. Manoel Carlos Ramon, "Intel Galileo and Intel Galileo Gen 2: API Features and Arduino Projects for LinuxProgrammers", Apress, 2014.
4. Marco Schwartz, "Internet of Things with the Arduino Yun", Packt Publishing, 2014.
5. Adrian McEwen, Hakim Cassimally, "Designing the Internet of Things", Wiley Publications, 2012.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												2	
2		3											2	
3		3											2	2
4			3											
5									1	1		1	2	
CO (W.A)	3	3	3						1	1		1	2	2

22ECX46 - IOT WITH SINGLE BOARD COMPUTERS				
	L	T	P	C
	3	0	0	3
PREREQUISITE : NIL				

Course Objective:	• To describe the concepts of IoT along with its applications and various sensors • To Identify different technologies used in IoT and communication Protocols, Build a prototype using Arduino Uno and Raspberry Pi • To Design an IoT application to interact with Django.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply IoT fundamentals by deploying various microcontrollers in conjunction with sensors and actuators	Ap	20%
CO2	Analyze different IoT protocols and technologies suitable for implementing diverse applications.	An	30%
CO3	Analyze the various Arduino prototypes that integrate with interfacing devices.	An	30%
CO4	Design IoT physical devices and endpoints using Linux on Raspberry Pi, incorporating interfacing devices.	E	20%
CO5	Participate in team learning, effectively communicate, and commit to lifelong learning to develop basic Embedded Applications with Raspberry Pi and Arduino.	U	Internal Assessment

UNIT I - INTRODUCTION TO IOT	**(9)**
Microprocessor, Microcontroller, Embedded System, Definition of IoT, Characteristics of IoT, Physical design of IoT, Logical design of IoT, IoT Enabling Technologies, IoT levels & Deployment Templates, IoT Applications. Sensors and Actuators- Introduction, Sensor, Types of Sensors, Actuators, classification of Actuators	
UNIT II – IOT TECHNOLOGIES	**(9)**
Bluetooth, Bluetooth Low Energy (BLE), WiFi, LiFi, Cellular Networks, Z-Wave, ZigBee, LoRaWAN, 6LowPAN, LPWAN, RFID and NFC,WSN. COMMUNICATION PROTOCOLS: CoAP, MQTT, XMPP, HTTP	
UNIT III - IOT WITH ARDUINO	**(9)**
Introduction to the Arduino-Types of Arduino, Creating an Arduino program Using the Arduino IDE, Using Libraries, Working with Digital Interfaces, Interfacing with Analog devices, Adding Interrupts, Communicating with devices- sensors, DC Motor, Servo motor, LCD	
UNIT IV - IOT WITH RASPBERRY PI	**(9)**
IoT physical devices & endpoints: Architecture of Raspberry Pi, Linux on Raspberry Pi, Raspberry Pi Interfaces, Programming Raspberry Pi with Python, Controlling LED with Raspberry Pi, Interfacing an LED and Switch with Raspberry Pi, Interfacing a Light Sensor (LDR) with Raspberry Pi	

UNIT V- IOT PHYSICAL SERVERS & CLOUD OFFERINGS	(9)
Python Packages for IoT, WAMP - AutoBahn for IoT, Python Web Application Framework – Django, Amazon Web Services for IoT, SkyNet IoT messaging platform	
TOTAL(L:45) = 45 PERIODS	

TEXT BOOKS:

1. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2016.
2. Richard Blum, "Arduino Programming in 24 Hours, Sams Teach Yourself", Pearson Education, 2017.
3. Jain, Prof. Satish, Singh, Shashi," Internet of Things and its Applications", 1st Edition, BPB, 2020.

REFERENCES:

1. 11.Donald Norris, "Internet of things do-it-yourself projects with Arduino, Raspberry Pi, and Beagle Bone Black", 1st Edition, McGraw-Hill,2015.
2. Adeal Javed Lake Zurich, Illinois, "Building Arduino Projects for the Internet: Experiments with Real-World Applications", 1st Edition, USA, A press,2016.
3. Yashavant Kanetkar, Shrirang Korde, "21 IOT Experiments", 1st Edition, BPB Publications, 2018.
4. 4. Dr. Rajesh Singh, Dr. Anita Gehlot, Dr. Lovi Raj Gupta, Navjot Rathour, Mahendra Swain, Bhupendra Singh, "IoT based Projects Realization with Raspberry Pi, NodeMCU and Arduino", 1 st Edition, BPB Publications, 2020.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												2	
2		3											2	
3		3											2	2
4			3											
5									1	1		1	2	
CO (W.A)	3	3	3						1	1		1	2	2

22ECX47 - INDUSTRIAL IOT AND INDUSTRY 4.0				
	L	T	P	C
	3	0	0	3

PREREQUISITE : NIL

Course Objective:	• To impart basic idea in Industry 4.0. and Cyber Physical System • To study about Big Data Analytics and Software Defined Networks, design and development of smart grid • To provide students with good depth of knowledge of designing Industrial 4.0 Systems for various application

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the foundational principles of Industrial Internet of Things (IIoT) and Industry 4.0 across diverse applications.	Ap	20%
CO2	Apply Cyber Physical Systems (CPS) and advanced sensors to strengthen the security of Augmented Reality (AR) and Virtual Reality (VR) environments.	Ap	30%
CO3	Analyze the utilization of machine learning, data science, and fog computing in IoT networks, focusing on R programming and data management with Hadoop	An	30%
CO4	Design and develop industrial IoT applications for smart grids, addressing their associated challenges.	E	20%
CO5	Engage in team-based learning, proficiently communicate ideas, and embrace lifelong learning to cultivate fundamental IoT applications tailored for diverse sectors such as the food industry, healthcare, power plants and quality control.	U	Internal Assessment

UNIT I - INTRODUCTION TO INDUSTRY 4.0	**(9)**
Introduction to Industry 4.0 -Historical Context, General framework- Sensing & actuation- Globalization and Emerging Issues, The Fourth Revolution- LEAN Production Systems,-Smart and Connected Business Perspective- Application areas, Dissemination of Industry 4.0, Artificial intelligence, Additive manufacturing, Robotization and automation, Current situation of Industry 4.0, Industry 5.0 Advances	
UNIT II - INDUSTRY 4.0 AND CYBER PHYSICAL SYSTEM	**(9)**
Introduction to Cyber Physical Systems (CPS) and Next Generation Sensors, Architecture of CPS-Components, Data science and technology for CPS, Emerging applications in CPS in different fields. Collaborative Platform and Product Lifecycle Management- Augmented Reality and Virtual Reality	
UNIT III - BIG DATA ANALYTICS AND SOFTWARE DEFINED NETWORKS	**(9)**
Introduction to Big Data Analytics and Software Defined Networks, Artificial Intelligence, Big Data and Advanced Analysis ,Introduction- Machine Learning and Data Science, R Programming, Data Management with Hadoop. Data Center Networks, Security and Fog Computing: Cloud Computing in IIoT	

UNIT IV - SMART GRID	(9)
Smart grid definition - Smart Grid development, Smart grid solutions, Design challenges of smart grid and Industry 4.0	
UNIT V- Industrial IoT- Smart applications	**(9)**
Understanding smart appliances, Smart operation, Smart monitoring and maintenance, Factories and Assembly Line, Food Industry. Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications), Case study- Google's Self-Driving Car, Milk Processing and Packaging Industries	
TOTAL(L:45) = 45 PERIODS	

TEXT BOOKS:

1. Jean-Claude André, "Industry 4.0", Wiley- ISTE, July 2019, ISBN: 781786304827, 2019.
2. Diego Galar Pascual, Pasquale Daponte, Uday Kumar, "Handbook of Industry 4.0 and SMART Systems", Taylor and Francis,2020.
3. S. Misra, C. Roy, and A. Mukherjee, "Introduction to Industrial Internet of Things and Industry 4.0", CRC Press.

REFERENCES:

1. S. Misra, A. Mukherjee, and A. Roy, 2020. Introduction to IoT. Cambridge University Press.
2. Pengwei Du and Ning Lu, —Energy storage for smart grids: planning and operation for renewable and variable energy resources VERs ll, Academic Press, 2018, Reprint edition.
3. Hossam A. Gabbar, —Smart Energy Grid Engineeringll, Academic Press, 2017.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												2	
2	3												2	
3		3											2	2
4			3											
5									1	1		1	2	2
CO (W.A)	3	3	3						1	1		1	2	2

22ECX48 – AUTOMATION FOR ROBOTICS				
	L	T	P	C
	3	0	0	3
PREREQUISITE : NIL				

Course Objective:	• To make the students to understand the concept of robotics. • To facilitate the students to study about technologies applicable for robotics. • To know about different sensing devices of robot. • To study the algorithms applicable for robotics. • To encourage the students to develop 4-axis and 6-axis robot.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the concepts of motion and potential functions to model and control robot movements.	Ap	20%
CO2	Apply mobile robot navigation techniques to real-world scenarios and applications.	Ap	30%
CO3	Implement vision systems for pattern detection and processing, and integrate these systems into robotic applications.	Ap	30%
CO4	Analyze and enhance images by implementing edge detection algorithms and digital filtering techniques.	An	20%
CO5	Develop 4-axis and 6-axis robot for Various Applications.	C	Internal Assessment

UNIT I - INTRODUCTION TO ROBOTICS	**(9)**
Motion - Potential function -Representing Position and Orientation - Cell decomposition sensor and sensor planning - Kinematics - types- Transformation matrix - Inverse kinematics - Geometric methods and algebraic methods - Varying Pose –Applications.	
UNIT II - COMPUTER VISION	**(9)**
Optics, projection on the Image plane and radiometry - Image processing - Connectivity - Images - - Blob filling – Thresholding - Convolution - Digital convolution and filtering and Masking techniques - Edge detection - Mono and stereo vision - Face detection.	
UNIT III - MOBILE ROBOT VEHICLES	**(9)**
Introduction to various Mobile Robot Vehicles- Flying Robots - Navigation – Map-Based Planning - Dead Reckoning - Creating a Map - Rao-Blackwellized SLAM - Pose Graph SLAM - Carlo Localization – Applications.	
UNIT IV –TYPES OF ROBOTICS	**(9)**
Arm -Type Robots - Forward Kinematics -Inverse Kinematics - Jacobian Condition and Manipulability - Resolved-Rate Motion Control - Computing the Manipulator Jacobian Using Twists - Independent Joint Control - RigidBody Dynamics Compensation.	
UNIT V- INTEGRATION TO ROBOT	**(9)**
Building of 4 axis or 6 axis robot - Vision system for pattern detection - Sensors for obstacle detection - Decision making.	
	TOTAL (L:45) = 45 PERIODS

TEXT BOOKS:
1. Stuart Russell and Peter Norvig, "Artificial Intelligence-A Modern Approach", Pearson Education Series in Artificial Intelligence, London, 3rd Edition, 2016. 2. Robert Schilling and Craig, "Fundamentals of Robotics, Analysis and control", PHI, New Delhi, 3rd Edition, 2015. 3. Kevin M. Lynch and Frank C. Park, "Modern Robotics: Mechanics, Planning, and Control", Cambridge University Press, 2017.
REFERENCES:
1. S K Saha, Introduction To Robotics, 2nd Ed., McGraw-Hill, 2014 2. Forsyth. and Ponce., "Computer Vision, A modern Approach", Pearson Education, London, 2nd Edition, 2011. 3. Mallot., "Computational Vision Information Processing in Perception and Visual Behavior", MIT Press, Cambridge, 2nd Edition, 2000. 4. Duda. Hart. and Stork., "Pattern Recognition", Wiley-Inter science, UK, 2nd Edition, 2000.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3													
2	3													
3	3													
4		3											3	
5				3	2				1			1	1	
CO (W.A)	**3**	**3**		**3**	**2**				**1**			**1**	**2**	

22GEA02 - PRINCIPLES OF MANAGEMENT				
	L	T	P	C
	3	0	0	3
PREREQUISITE : NIL				

Course Objective:	• To provide with a foundational understanding of management concepts and practices. • To equip students with the knowledge and skills necessary to manage and lead organizations effectively, understanding both theoretical frameworks and practical applications in management. • To learn about various planning tools and decision-making processes crucial for organizational success. • To gain insights into human resource management functions. • To study effective communication strategies and the impact of information technology on communication and how effective control can lead to improved productivity and organizational performance.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply key management theories and practices to real-world business scenarios, demonstrating the ability to implement management functions.	Ap	20%
CO2	Analyze human resource management practices, evaluating how recruitment, training, performance appraisal, and employee relations contribute to organizational success.	An	30%
CO3	Evaluate strategic decisions and their impacts on organizational performance, the effectiveness of communication strategies and the use of information technology in facilitating efficient and effective communication within organizations.	E	30%
CO4	Create comprehensive strategic plans and organizational policies and design control systems to ensure continuous improvement in productivity and organizational performance.	C	20%
CO5	Engage in independent study as a member of a team and develop higher-order thinking skills that are crucial for effective management and leadership in complex organizational settings with assignments or case studies.	U	Internal Assessment

UNIT I -INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS	**(9)**
Definition of Management - Science or Art - Manager Vs Entrepreneur - types of managers -managerial roles and skills - Evolution of Management - Scientific, human relations, system and contingency approaches - Types of Business organization-Organization culture and Environment - Current trends and issues in Management.	
UNIT II -PLANNING	**(9)**
Nature and purpose of planning - planning process - types of planning - objectives - setting objectives - policies - Planning premises - Strategic Management - Planning Tools and Techniques - Decision making steps and process.	

UNIT III -ORGANISING	(9)
Nature and purpose - Formal and informal organization - organization chart - organization structure - types - Line and staff authority - departmentalization -delegation of authority - centralization and decentralization - Job Design - Human Resource Management - HR Planning, Recruitment, selection, Training and Development, Performance Management, Career planning and management	
UNIT IV - DIRECTING	**(9)**
Foundations of individual and group behaviour - motivation -motivation theories - motivational techniques - job satisfaction - job enrichment - leadership - types and theories of leadership -communication - process of communication - barrier in communication - effective communication -communication and IT.	
UNIT V - CONTROLLING	**(9)**
System and process of controlling - budgetary and non-budgetary control techniques - use of computers and IT in Management control - Productivity problems and management - control and performance -direct and preventive control -reporting.	
TOTAL(L:45) = 45 PERIODS	

TEXT BOOKS:

1. Harold Koontz, Heinz Weihrichand Mark V. Cannice, "Essentials of Management: An International, Innovation, and Leadership Perspective", 11th Edition, Tata McGraw-Hill Education, 2021.
2. J.A.F. Stoner, R.E. Freeman, and Daniel R. Gilbert "Management", 6th Edition, Pearson Education, 2018

REFERENCES:

1. JAF Stoner, Freeman R.E and Daniel R Gilbert "Management", 6th Edition, Pearson Education, 2004.
2. Robert Kreitner & Mamata Mohapatra, "Management", Biztantra, 2008.
3. Stephen A. Robbins & David A. Decenzo & Mary Coulter, "Fundamentals of Management", 7th Edition, Pearson Education, 2011.
4. Tripathy PC & Reddy PN, "Principles of Management", Tata Mcgraw Hill, 1999.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3										3			
2		3									3			
3										3				
4			3							3				
5											3	3		
CO (W.A)	3	3	3							3	3	3		

22GEA03 - TOTAL QUALITY MANAGEMENT				
	L	T	P	C
	3	0	0	3
PREREQUISITE : NIL				

Course Objective:	• To recognize the importance of quality councils and strategic planning in TQM. • To explore the elements and historical development of TQM. • To foster employee involvement through motivation, empowerment, teamwork, and recognition. • To implement continuous process improvement methods like Juran's Trilogy, PDSA Cycle, 5S, and Kaizen. • To Conduct quality audits and understand the introduction to other ISO standards like ISO 14000, IATF 16949, TL 9000, IEC 17025, ISO 18000, ISO 20000, ISO 22000, and ISO 21001.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Describe the elements and principles of Total Quality Management (TQM).	Ap	30%
CO2	Apply continuous process improvement methodologies such as Juran's Trilogy, PDSA Cycle, 5S, and Kaizen.	Ap	20%
CO3	Apply various quality tools and techniques in both manufacturing and service industry.	Ap	20%
CO4	Develop strong supplier partnerships and understand supplier selection, rating, and relationship development.	An	20%
CO5	Choose appropriate quality standards and implement them in the respective industry Applications.	E	10%

UNIT I - QUALITY CONCEPTS AND PRINCIPLES	**(9)**
Definition of Quality - Dimensions of Quality - Quality Planning - Quality Assurance and Control - Quality Costs with Case Studies - Elements / Principles of TQM - Historical Review – Leadership – Qualities / Habits - Quality Council - Quality Statements, Strategic Planning – Importance - Case Studies - Deming Philosophy - Barriers to TQM Implementation – Cases with TQM Success and Failures.	
UNIT II -TQM-PRINCIPLES AND STRATEGIES	**(9)**
Customer Satisfaction - Customer Perception of Quality - Customer Complaints - Customer Retention, Employee Involvement – Motivation - Empowerment - Teams - Recognition and Reward - Performance Appraisal, Continuous Process Improvement - Juran's Trilogy - PDSA Cycle - 5S - Kaizen, Supplier Partnership - Partnering - Sourcing - Supplier Selection - Supplier Rating - Relationship Development, Performance Measures – Purpose – Methods - Cases.	
UNIT III - CONTROL CHARTS FOR PROCESS CONTROL	**(9)**
Basic Seven Tools of Quality and its Role in Quality Control, Statistical Fundamentals - Measures of Central Tendency and Dispersion, Population and Sample - Normal Curve - Control Charts for Variables and Attributes - Process Capability - Case Study- Introduction to Six Sigma.	

UNIT IV - TQM-MODERN TOOLS	(9)
New Seven Tools of Quality, Benchmarking - Need - Types and Process, Quality Function Deployment - House of Quality (HOQ) Construction - Case Studies, Introduction to Taguchi's Robust Design - Quality Loss Function - Design of Experiments (DOE), Total Productive Maintenance (TPM) - Uptime Enhancement, Failure Mode and Effect Analysis (FMEA) - Risk Priority Number (RPN) – Process - Case Studies.	
UNIT V - QUALITY SYSTEMS	**(9)**
Need for ISO 9000 and Other Quality Systems - ISO 9000: 2015 Quality System – Elements - Implementation of Quality System - Documentation - Quality Auditing, Introduction to ISO 14000 - IATF 16949 - TL 9000-IEC 17025 - ISO 18000 - ISO20000 - ISO 22000 - ISO21001. Process of Implementing ISO - Barriers in ISO Implementation.	
TOTAL(L:45) = 45 PERIODS	

TEXT BOOK:

1. Besterfield Dale H., Besterfield Carol, Besterfield Glen H., Besterfield Mary, UrdhwareshеHemant, UrdhwareshеRashmi "Total Quality Management", 5th Edition, Pearson Education, Noida, 2018.

REFERENCES:

1. Subburaj Ramasamy, "Total Quality Management", McGraw Hill Education, New Delhi, 2017.
2. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, Cengage Learning, 2012.
3. David Goetsch & Stanley Davis, "Quality Management for Organizational Excellence: Introduction to Total Quality", 8thEdition, Pearson, 2017.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3													
2	3													
3	3													
4		3												
5	3													
CO (W.A)	3	3												

22GEA04 - PROFESSIONAL ETHICS				
	L	T	P	C
	3	0	0	3
PREREQUISITE : NIL				

Course Objective:	• To develop students' ability to identify, analyse, and resolve ethical dilemmas in engineering contexts, fostering a commitment to professional responsibility, integrity, and ethical decision-making. • To provide engineering students with a comprehensive understanding of ethical principles and practices in the engineering profession. • To familiarize students with key ethical theories, principles, and frameworks that guide ethical decision-making in professional practice. • To foster the ability to communicate ethical concerns and collaborate effectively with diverse stakeholders, including colleagues, clients, and the public. • To encourage students to uphold integrity, honesty, and accountability in their professional activities, fostering a culture of trust and reliability.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply ethical reasoning to evaluate and resolve these issues.	Ap	30%
CO2	Apply ethical principles and reasoning to analyze real-world case studies in engineering.	Ap	30%
CO3	Analyze the importance of ethics in professional practice.	An	20%
CO4	Develop the ability to make informed and ethical decisions in engineering practice.	An	10%
CO5	Recognize the importance of continuous learning and professional development in maintaining ethical standards.	E	10%

UNIT I - INTRODUCTION TO PROFESSIONAL ETHICS	**(9)**
Definition and Importance of Ethics, Ethical Theories and Principles, Ethics vs. Morals vs. Values, Role of Ethics in Engineering.	
UNIT II - PROFESSIONAL RESPONSIBILITY AND CODES OF CONDUCT	**(9)**
Professional Responsibility and Accountability, Codes of Conduct in Engineering (e.g., IEEE, NSPE), Conflicts of Interest and Whistle blowing, Case Studies.	
UNIT III - ETHICAL DECISION-MAKING AND PROBLEM-SOLVING	**(9)**
Ethical Decision-Making Models, Tools and Frameworks for Ethical Analysis, Resolving Ethical Dilemmas, Case Studies	
UNIT IV - LEGAL AND REGULATORY ASPECTS	**(9)**
Legal Frameworks Governing Engineering Practice, Intellectual Property Rights, Health, Safety, and Environmental Regulations, Case Studies.	

UNIT V: SOCIAL AND ENVIRONMENTAL RESPONSIBILITY	(9)
Social Responsibility of Engineers, Sustainable Engineering Practices, Impact of Engineering on Society and Environment,Case Studies.	
TOTAL(L:45) = 45 PERIODS	

TEXT BOOKS:

1. Charles E. Harris Jr., Michael S. Pritchard, and Michael J. Rabins,"Engineering Ethics: Concepts and Cases", 6th edition, 2018.
2. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", 5thEdition 2010.
3. by M. Govindarajan, S. Natarajan, and V. S. SenthilKumar, "Professional Ethics and Human Values", Ist Edition 2006.

REFERENCES:

1. Stephen H. Unger, "Engineering Ethics: Real-World Case Studies"
2. Online Ethics Center for Engineering and Science - www.onlineethics.org
3. National Society of Professional Engineers (NSPE) - www.nspe.org

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3													
2	3													
3		3												
4		3												
5								3						
CO (W.A)	3	3						3						