Raisoni Group of Institutes



Scheme and Curriculum
of
B.Tech Electronics and Telecommunication Engineering

Scheme 2020-2021

w.e.f. AY: 2023-2024

Scheme of
B. Tech. in Electronics Engineering and
B. Tech.in Electronics and Telecommunication Engineering

Course Code	Name of Course	Course Category	Teaching Scheme				Credits	Evaluation Scheme					
								Theory			Practical		Total Marks
			L	T	P	Total Hours		TAE	CAE	ESE	INT	EXT	
SEMESTER-VII													
	Elective-II	EL	3			3	3	10	15	50			75
	Elective-III	EL	3			3	3	10	15	50			75
	Elective-IV	EL	3		2	5	4	10	15	50	25		100
	Elective-V	EL	3		2	5	4	10	15	50	25		100
	Elective-VI	EL	3		2	5	4	10	15	50	25		100
UECP401	Project	P			8	8	4				50	50	100
TOTAL			**15**	**0**	**14**	**29**	**22**						**550**

Course Code	Name of Course	Course Category	Teaching Scheme				Credits	Evaluation Scheme					
								Theory			Practical		Total Marks
			L	T	P	Total Hours		TAE	CAE	ESE	INT	EXT	
SEMESTER-VIII													
	MOOCS based open Elective	OE	3			3	3	10	15	50			75
UECP402	Internship	P			24	24	12				200	200	400
TOTAL			**3**	**0**	**24**	**27**	**15**						**475**

UG Scheme-20-21
B. Tech. in Electronics and Telecommunication Engineering
Tracks for Professional Elective Courses

Electives		**Communication, Signal Processing & RF Engineering**		**Embedded Systems & IoT**		**Bio-Medical Engineering**		**VLSI & Quantum**		**Machine Learning**		**Programming**
Track	**Course Code**	**Track-I**	**Course Code**	**Track-II**	**Course Code**	**Track-III**	**Course Code**	**Track-IV**	**Course Code**	**Track -V**	**Course Code**	**Track-VI**
Elective-I (Credits : 3) (Semester-V)	UECL403	Wireless and Mobile Communication	UECL404	Switching Theory and Automata	UISL301	Biomaterials	UECL406	Integrated Circuits & Fabrication	UAIL301	Soft Computing	UCSL206	Operating System
Elective-II (Credits : 3) (Semester-VII)	UECL408	Radar and Satellite Communication	UECL409	Mechatronics	UISL402	Bio-Informatics: Algorithms and Applications	UISL407	Photonics and Nanotubes	UAIL411	Deep Learning	UECL412	Wireless Sensor Network
Elective-III (Credits : 3) (Semester-VII)	UECL413	Audio & Speech Signal Processing	UEEL418	Industrial Automation	UISL401	Biochemistry and Cell Biology	UECL415	MEMS and Applications	UAIL201	AI: Knowledge Representation and Reasoning	UCSL401	Computer System Security
Electives with Laboratory												
Elective-IV (Credits : 4) (Semester-VII)	UECL416, UECP416	Multimedia Processing	UECL417, UECP417	System on Chip	UECL418, UECP418	Brain Machine Interface	UEEL302 UEEP302	Power Electronics	UAIL211, UAIP211	Pattern Recognition	UITL202, UITP202	Computer Networks
Elective-V (Credits : 4) (Semester-VII)	UECL420, UECP420	Digital Image Processing	UECL421, UECP421	Robotics	UISL408, UISP408	Physics & Instrumentation of Medical Imaging	UECL423, UECP423	Analog and Mixed Signal VLSI Design	UECL428, UECP428	Generative Adversarial Network	UCSL412, UCSP412	Blockchain Technology
Elective-VI (Credits : 4) (Semester-VII)	UECL424, UECP424	Optical Communication	UECL425, UECP425	Advanced Embedded Systems	UISL405, UISP405	Neuromorphic Computing	UISL409 UISP409	Quantum & Optical Electronics	UAIL302, UAIP302	Natural Language Processing	UITL305, UITP305	Big Data Computing



Course Title: Radar and Satellite Communication										
Semester	VII	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	TH	TU	PR	Credits	TAE	CAE	ESE	INT	EXT
Course Category	EL	3	-	-	**3**	10	15	50	NA	NA
Course Code	UECL408									
Teaching Mode	Offline	3			TOTAL	75			___	
Duration of ESE	2 Hrs.					75				

Course Objectives	To study the principles of operation of various blocks of Radar systems and Radar Range equation in detail.
	To study the functions of various blocks of CW Radar, FM-CW Radar, MTI and Pulse Doppler Radars
	To understand the basics of orbital mechanics and the look angles from ground stations to the satellite.
	To apply subject understanding in Link Design
Course Outcomes	Upon successful completion of this course, student will be able to:
	CO-1: To understand the basic concepts related with radar technology
	CO-2: Evaluate the radar performance based on pulse width, peak power and beam width
	CO-3 Explain basics of satellite communication, space segment and earth segment
	CO-4: Perform Satellite Link design for Up Link and Down Link.
	CO-5: Demonstrate the knowledge of different application of VSAT

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**--**	**--**	**1**	**1**	**2**
CO2	**2**	**3**	**1**	**1**	**1**	**1**	**1**	**--**	**--**	**1**	**1**	**3**
CO3	**2**	**3**	**1**	**1**	**1**	**1**	**1**	**--**	**--**	**1**	**1**	**2**
CO4	**2**	**3**	**3**	**1**	**1**	**2**	**1**	**--**	**--**	**1**	**1**	**2**
CO5	**3**	**1**	**1**	**1**	**2**	**-**	**1**	**1**	**-**	**2**	**2**	**1**

Course Contents:

Unit	Contents	Hours
I	Radar and Radar Equation: Introduction, Radar block diagram and operation, frequencies, applications, types of displays, derivation of radar equation, minimum detectable signal, probability of false alarm and threshold detection, radar cross-section, system losses.	8
II	CW Radar – Doppler Effect, CW Radar, applications, FM – CW radar, altimeter, Multiple Frequency Radar. Pulse Radar – MTI, Delay Line Canceller, Multiple Frequencies, Range-gated Doppler Filters, Non-coherent MTI, Pulse Doppler Radar	8
III	History of Satellite communication, Orbital mechanics, Look angle determination, Orbital perturbations, Orbital determination, Launchers and launch vehicles, Orbital effects in communication system performance. .	8
IV	Satellite Subsystems, Attitude and Control Systems (AOCS), Telemetry, Tracking, Command and monitoring, Power systems, Communication subsystems, Satellite antennas, Equipment reliability and space qualification. Introduction to Nano-Sat	6
V	Introduction to Link design: , Basic transmission theory, System noise temperature and G/T Ratio, Design of downlinks, Satellite systems using small earth stations, Uplink design, Design of specified C/N: Combining C/N and C/I values in satellite links system design examples. VSAT systems: Advantages, configurations, frequency bands, elements, Applications	8

Text Books	1.	Introduction to Radar Systems – Merrill I. Skolnik, 3rd Edition, Tata McGraw-Hill,
	2.	Timothy Pratt, Charles Bostian, Jeremy Allnutt, —Satellite Communications, John Wiley & Sons
Reference Books	1.	Radar Principles- Peyton Z. Peebles, Jr., Wiley India Pvt. Ltd., 2009
	2.	Dennis Roody, —Satellite Communications‖, McGraw Hill

Course Title: Mechatronics										
Semester	VII	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	TH	TU	PR	Credits	TAE	CAE	ESE	INT	EXT
Course Category	EL	3	-	-	3	10	15	50	-	-
Course Code	**UECL409**									
Teaching Mode	Offline	3			TOTAL	75			___	
Duration of ESE	2 Hrs.					75				

Course Objectives	1. Understand the key elements of mechatronics, 2. Understand the concept of Sensors and Transducers and their characteristics 3. Understand various hydraulic and pneumatic Systems 4. Understand the principle and operation of Electrical and Electromechanical Actuators
Course Outcomes	Upon successful completion of this course, student will be able to:
	CO1. Understand and apply the key elements of mechatronics in automation,
	CO2. Apply the principle of sensor and Transducers and their characteristics in industry applications
	CO3. Understand and analyse the principles of hydraulic Systems in complex engineering applications.
	CO4. Understand and analyse the principles of pneumatic Systems.
	CO5. Apply and evaluate the applications of Electrical Actuators and Electro-Mechanical Actuators.

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**3**	**1**	**1**	**2**	**1**	**1**	--	--	--	**1**	**2**
CO2	**3**	**2**	**1**	**2**	**1**	**2**	**1**	--	--	--	**2**	**3**
CO3	**2**	**3**	**2**	**2**	**1**	**1**	**1**	--	--	--	**1**	**3**
CO4	**2**	**3**	**2**	**1**	**1**	**2**	**1**	--	--	--	**1**	**2**
CO5	**3**	**2**	**1**	**1**	**1**	**-**	**-**	**1**	**-**	**-**	**2**	**2**

Course Contents:

Unit	Contents	Hours
I	**Unit I : Introduction to Mechatronics** Basics of Mechatronics Systems: Definition of Mechatronics, Key elements of Mechatronics Systems, Levels of mechatronics systems, Measurement Characteristics, Mechatronics design process, phases of mechatronics design process, integrated design approach. Mechanical Components and Servo Mechanism: Servomechanism (Concepts and Theory, Problems).	8
II	**Unit II: Signal Conditioning:** Introduction to Data Acquisition system, Sensors, Micro sensors, Transducers, **Signal Conditioning**, Relays, Contactors and Timers, Introduction to PLCs .	8
III	**Unit III : Hydraulic Systems** Introduction to Hydraulic Actuators Fluid Power systems: Concept of Actuators, Classification of Actuators: Pneumatic, Hydraulic and Electrical Actuators, Fluid Power systems Hydraulic Systems: Physical Components of a Hydraulic systems, Hydraulic Pumps (e.g. Gear Pumps, Piston Pumps), Filters and Pressure Regulation, Relief Valve, Accumulator.	8
IV	**Unit IV : Pneumatic Systems** Introduction to Pneumatic a Actuators Physical Components of a Pneumatic Systems, Pneumatic Cylinders, Pneumatic Actuators (e.g. Spring Actuator and Spring Actuator with positioner), Air compressor, Air Receiver, Air Dryer Air Service Treatment: Air Filter, air regulator and Gauge, Air Lubricator and Pressure regulation Intake and Air Filter. Case study of Pick and Place Robot.	8
V	**Unit V : Electrical Actuators and Electro-Mechanical Actuators** Electrical Actuators and Electro-Mechanical Actuators: Selection criteria and specifications of stepper motors, solenoid valves, relay (Solid State relays and Electromechanical relays). Selection Criterion of control valve, Single acting and Double acting Cylinders. Electro-Pneumatic: Pneumatic Motors, Valves: Electro Hydraulic 3/2 Valves, Cables: Power cables, Signal cables	8

Text Books	1.	W. Boltan -Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, 6th Edition, Pearson Education, 2016
	2.	David Alciatore and MaichaelB Histand, -Introduction to Mechatronics and Measurement Systems‖,4th Edition, Tata McGraw Hill 2013.
	3	K.P.Ramachandran, G.K.Vijayaraghavan and M.S. Balasundaram, Mechatronics-Integrated Mechanical Electronic Systems‖, Willey Publication 2008
Reference Books	1.	Nitaigour P. Mahalik ,‖ Mechatronics-Principles, Concepts and Applications‖, Tata McGraw Hill, Eleventh reprint 2011.
	2.	DevdasShetty and Richard A.Kolk, -Mechatronics System Design‖, Thomson India Edition 2007.HMT Limited, - Mechatronics‖, Tata McGraw-Hill Publishing House.

Elective-II

Course Title: **Wireless Sensor Network**										
Semester	VII	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	TH	TU	PR	Credits	TAE	CAE	ESE	INT	EXT
Course Category	EL	3	-	-	3	10	15	50	-	-
Course Code	**UECL412**									
Teaching Mode	Offline	3			TOTAL	75			___	
Duration of ESE	2 Hrs.					75				

Course Objectives	To understand the fundamentals of wireless sensor networks and its application to critical real time scenarios.
	To study the various protocols at various layers and its differences with traditional protocols.
	To understand the issues pertaining to sensor networks and the challenges involved in managing a sensor network.
Course Outcomes	Upon successful completion of this course, student will be able to:
	CO-1: Technical Things on how to building a WSN network.
	CO-2: Understanding the concept of Ad-hoc sensor network.
	CO-3: Understand the concept of MAC Protocol.
	CO-4: Understand the concept of Routing Protocol.
	CO-5: Apply and evaluate the concept of QoS parameter using WSN.

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**3**	**3**	**3**	**3**	**3**	**1**	**3**	**3**	**2**	**2**	**3**
CO2	**3**	**3**	**3**	**3**	**3**	**3**	**1**	**3**	**3**	**2**	**2**	**3**
CO3	**2**	**3**	**2**	**2**	**1**	**1**	**1**	**--**	**--**	**--**	**1**	**3**
CO4	**2**	**3**	**2**	**1**	**1**	**2**	**1**	**--**	**--**	**--**	**1**	**2**
CO5	**2**	**2**	**2**	**1**	**2**	**-**	**2**	**1**	**-**	**2**	**2**	**2**

Course Contents:

Unit	Contents	Hours
I	**Introduction**: Wireless communication technology fundamentals, wireless channels characteristics and multiple access techniques, Bands: Bluetooth, Wi-Fi: performance of noise: S/N ratio Process. G/N Process, wireless LANs, PANs, WANs, MANs.	8
II	**Adhoc sensor networks**: Key definitions of ad-hoc/ sensor networks, unique constraints, and challenges, advantages of ad-hoc/sensor networks, driving applications, Adhoc wireless network issues, issues in the design of the sensor network, architecture of sensor network, data dissemination, and gathering.	8
III	**MAC Protocols** : Issues in designing MAC protocols for adhoc wireless networks, design goals, classification of MAC protocols, MAC protocols for sensor network, location discovery, quality, other issues, S-MAC, IEEE 802.15.4.	8
IV	**Routing Protocols**: Designing routing and power-aware routing protocol issues, classification of routing protocols, table-driven, on-demand, hybrid, flooding, hierarchical.	8
V	**QoS and Energy Management** : Issues and Challenges in providing QoS, classifications, MAC, network layer solutions, QoS frameworks, need for energy management, classification, battery, transmission power, and system power management schemes.	8

Text Books	1.	C. Siva Ram Murthy, and B. S. Manoj, "AdHoc Wireless networks ", Pearson Education - 2008.
Reference Books	1.	Feng Zhao and Leonides Guibas, "Wireless sensor networks ", Elsevier publication - 2004.
	2.	Jochen Schiller, "Mobile Communications", Pearson Education, 2nd Edition, 2003.
	3.	William Stallings, "Wireless Communications and Networks ", Pearson Education - 2004

Course Title: **Audio and Speech Signal Processing**										
Semester	VII	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	TH	TU	PR	Credits	TAE	CAE	ESE	INT	EXT
Course Category	EL	3	-	-	3	10	15	50	-	-
Course Code	UECL413									
Teaching Mode	Offline	3			TOTAL	75			___	
Duration of ESE	2 Hrs.					75				

Course Objectives	1. To study the basic concepts of speech and audio. 2. To study the analysis of various M-band filter banks for audio coding 3. To learn various transform coders for audio coding. 4. To study the speech processing methods in time and frequency domain
Course Outcomes	Upon successful completion of this course, student will be able to:
	CO-1: Comprehend the speech production and hearing models.
	CO-2: Design and apply models for speech and audio signal processing.
	CO-3: Understanding different pitch estimation methods.
	CO-4: Understanding the concept of speech coding.
	CO-5: Implement the methods for speech enhancement, speech coding and speech recognition

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**1**	**1**	**3**	**3**	**1**						**1**	**3**
CO2	**2**	**1**	**3**	**3**	**2**						**1**	**3**
CO3	**2**	**1**	**3**	**3**	**1**						**1**	**3**
CO4	**2**	**1**	**3**	**3**	**2**						**1**	**3**
CO5	**1**	**1**	**2**	**3**	**2**						**1**	**3**

Course Contents:

Unit	Contents	Hours
I	**Introduction:** Introduction, Anatomy and physiology of speech production, categorization of speech sounds, Prosody, Parameters of Speech: Pitch and Formants.	8
II	**Analysis and Synthesis of Speech and Audio signals:** Spectral Analysis Models, Linear Predictive Coding Model, Modulation Models, The autocorrelation method, The covariance method, Short-Time Fourier Transform Analysis and Synthesis	8
III	**Pitch Estimation Methods:** A correlation-based Pitch Estimator, Pitch Estimation based on Comb Filter, Pitch Estimation based on a Harmonic Sine wave Model.	6
IV	**Speech Coding:** Vector Quantization, Frequency-Domain Coding, Transform based Approach. Model-based Coding. Audio Compression techniques	8
V	**Enhancement of Speech and Audio Signals:** Spectral subtraction, Cepstral Mean Subtraction, Wiener Filtering, **Speaker Recognition:** Spectral Features required for Speaker Recognition, Minimum Distance classifier, Gaussian Mixture Model. Applications / Case studies,	10

Text Books	1.	T.F. Quartieri, Discrete-Time Speech Signal Processing: Principles and Practice, Prentice Hall.
	2.	L.R.Rabiner, R.W.Schafer, Theory and Applications of Digital Speech Processing, Prentice Hall
Reference Books	1.	B. Gold, N. Morgan, D. Ellis, Speech and Audio Signal Processing: Processing and Perception of Speech and Music, Wiley-Blackwell
	2.	T. Dutoit, F. Marqués, L.R. Rabiner, Applied signal processing: a MATLAB-based Proof of Concept, Springer
	3.	Ian Vince Mcloughlin. Speech and Audio Processing: A MATLAB-based Approach, Cambridge University Press
	4	*A.K.Jain," Fundamentals of Digital Image Processing", PHI,1995*

Elective-III

Course Title: **MEMS and Applications**										
Semester	VII	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	TH	TU	PR	Credits	TAE	CAE	ESE	INT	EXT
Course Category	EL	3	-	-	3	10	15	50	-	-
Course Code	UECL413									
Teaching Mode	Offline	3			TOTAL	75			___	
Duration of ESE	2 Hrs.					75				

Course Objectives	**1.** To teach the students properties of materials, microstructure and MEMS Technology. **2.** To teach the design and modelling of Electrostatic, thermal and piezoelectric principles sensors and actuators. **3.** To give exposure to different MEMS and NEMS devices
Course Outcomes	Upon successful completion of this course, student will be able to:
	CO-1: Understand and Apply the concepts of MEMS technology in complex engineering applications.
	CO-2: Design and Model the various Electrostatic Sensors and Actuators.
	CO-3 Design and Model the various Thermal Sensors and Actuators
	CO-4 Design and Model the various Piezoelectric Sensors and Actuators
	CO-5 :- Analyse and Evaluate case studies and application of Bio-MEMS Technology

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**3**	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**2**	**1**	**1**
CO2	**3**	**2**	**3**	**2**	**1**	**2**	**1**	**1**	**1**	**1**	**1**	**1**
CO3	**3**	**3**	**3**	**3**	**3**	**1**	**1**	**1**	**1**	**1**	**1**	**2**
CO4	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**2**
CO5	**2**	**2**	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**

Course Contents:

Unit	Contents	Hours
I	MEMS: MICRO-FABRICATION, MATERIALS AND ELECTRO-MECHANICAL CONEPTS: Overview of micro fabrication – Silicon and other material-based fabrication processes – Concepts: Conductivity of semiconductors-Crystal planes and orientation-stress and strain- flexural beam bending analysis-torsional deflections-Intrinsic stress-resonant frequency and quality factor.	8
II	ELECTROSTATIC SENSORS AND ACTUATIOS: Principle, material, design and fabrication of parallel plate capacitors as electrostatic sensors and actuators-Applications	8
III	DEVICES: Accelerometer, Gyrometer, Borometer, Magnetometer, Sterometer, Micro gear system	8
IV	PIEZOELECTRIC SENSING AND ACTUATION: Piezoelectric effect-cantilever piezo electric actuator model-properties of piezoelectric materials- Applications.	8
V	CASE STUDIES and Bio Medical Applications: RF MEMS Switches and Applications in Satellite Communications, Piezoresistive sensors Magnetic actuation, Micro fluidics applications, Development of point-of-care disease diagnostic devices and biosensors, drug delivery systems, and surgical tools	8

Text Books	1.	Chang Liu, "Foundations of MEMS", Pearson International Edition, 2006.
	2.	Marc J. Madou"Fundamentals of Microfabrication"The Science of Miniaturization, Second Edition, 2002
	3	Stephen D. Senturia, "Microsystem Design", Springer International Edition, 2011
Reference Books	1.	Boston , "Micromachined Transducers Source Book", WCB McGraw Hill, 1998
	2.	M.H.Bao "Micromechanical transducers :Pressure sensors, accelerometers and gyroscopes", Elsevier, New York, 2000.
	3.	P. Rai Choudhry, "MEMS and MOEMS Technology and Applications", PHI, 2012.
	4	Gabriel M.Rebeiz, "RF MMS: Theory, Design and Technology', 2003, John Wiley & Sons, Inc.

Course Title: **Multimedia Processing**										
Semester	VII	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	TH	TU	PR	Credits	TAE	CAE	ESE	INT	EXT
Course Category	EL	3	-	2	4	10	15	50	25	-
Course Code	UECL416 UECP416									
Teaching Mode	Offline	5			TOTAL	75			25	
Duration of ESE	2 Hrs.					100				

Course Objectives	1. To study the basic concepts of Television, Signal & Speech Processing. 2. To provide an introduction to the fundamental principles of Television techniques in multimedia signal processing and compression. 3. An overview of the current multimedia standards and technologies
Course Outcomes	Upon successful completion of this course, student will be able to:
	CO-1: To understand the concept of colour TV and pattern generator
	CO-2: Design and apply models for Tele signal processing.
	CO-3: Use of Digital filter in multimedia signal processing.
	CO-4: Understanding the concept of model based signal processing.
	CO-5: To know about mobile communication signal processing, music signal processing, explains the anatomy and psychoacoustics of hearing and the design of MP3 music coder

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**1**	**3**					**2**			**2**		**3**
CO2	**2**	**2**					**2**			**2**		**3**
CO3	**2**	**1**					**2**			**2**		**3**
CO4	**1**	**2**					**2**			**2**		**3**
CO5	**1**	**3**					**2**			**2**		**3**

Course Contents:

Unit	Contents	Hours
I	**Fundamentals of Digital Television:** Color TV systems, fundamentals, mixing of colours, colour perception, chromaticity diagram. Digital Television, colour TV transmitter, (high level, low level), colour TV receivers, remote control. Fault finding and servicing equipment like Wobbulo scope, TV Pattern Generator, and Field Strength meter.	8
II	**Digital TV and Display Devices:** Introduction to Digital TV, Digital TV signals and parameters, Digital TV Transmitters, MAC signals, advanced MAC signal transmission, Digital TV receivers, Basic principles of Digital Video compression techniques, MPEG Standards. Digital TV recording techniques, Display devices: LED, LCD, TFT, Plasma,	8
III	**Basic Digital Signal Processing**: introduction of DSP, sampling and quantization, Fourier analysis and synthesis, Z-transform, and digital filters.	8
IV	**Model-based Signal Processing:** Probability and information models, Bayesian inference, Wiener filter, adaptive filters, linear prediction hidden Markov models and independent component analysis.	8
V	**Applications of Signal Processing in Speech:** Speech and music processing, echo cancellation, convolution and channel equalization, and mobile communication signal processing, music signal processing, Speech Modification, anatomy and psychoacoustics of hearing and the design of MP3 music coder, speech processing technology including speech models, speech coding for mobile phones and speech recognition	8

Text Books	1.	Television and video Engineering, A. M. Dhake, TMH Publication.
	2.	Multimedia Signal Coding and Transmission (Signals and Communication Technology)March 17, 2015 by Jens-Rainer Ohm Springer; 2015 edition (March 17, 2015)
Reference Books	1.	Video Demisified, Kelth jack, Penram International Publication.
	2.	Multimedia Signal Processing: Theory and Applications in Speech, Music and CommunicationsNovember 12, 2007 by Saeed V. Vaseghi ,Wiley; 1 edition (November 12, 2007)
	3.	Signal Processing March 8, 2003 by James H. McClellan Ronald W. Schafer(Author), Mark A. Yoder Prentice Hall; 1 edition (March 8, 2003)

List of Experiments

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Sr. No.	Name of Experiments
1	**a.** Obtaining row profile of a given row of an image in MATLAB. **b.** Plotting histogram of an image in MATLAB. **c.** Adjusting the brightness of an image using a constant value in MATLAB. **d.** Calculating mean and variance of an image in MATLAB
2	**a.** Spatial Filtering: Applying low pass, high pass and median filters on an image in MATLAB . **b.** Pseudo Coloring an image using sinusoidal transforms in MATLAB
3	Detection of edges of an image using Canny Edge Detection algorithm in MATLAB.
4	Image Thresholding using OTSU Thresholding algorithm in MATLAB.
5	Region-based Image Segmentation using region growing in MATLAB
6	Apply Discrete Cosine Transform (DCT) on an image in MATLAB.
7	Motion Estimation for video sequence using full search algorithm
8	Tutorial: Presentation of some topics in Digital Image and Video Processing.
9	Open Ended Expertiment:
10	V-Lab Experiment:

Course Title: **System on Chip**										
Semester	VII	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	TH	TU	PR	Credits	TAE	CAE	ESE	INT	EXT
Course Category	EL	3	-	2	4	10	15	50	25	-
Course Code	UECL417 UECP417									
Teaching Mode	Offline	5			TOTAL	75			25	
Duration of ESE	2 Hrs.					100				

Course Objectives	The student will study SOC modelling and interfacing
	The student will learn SOC system design.
	SOC design, SOC prototyping, verification, testing and physical design.
	The student will able to design , implement and test SOC.
Course Outcomes	After successful completion of this course, student will be able to:
	CO-1: Design the SOC prototype for real life applications.
	CO-2: Analyse RTL Simulation and its design flow.
	CO-3 Perform power and timing analysis.
	CO-4 Study of EDA Tools for SOC design
	CO-5 Understand & Apply the concept of Fabrication on MEMS devices

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**1**	**3**	**1**	**3**	**1**	**2**	**2**	**3**	**2**	**3**	**2**
CO2	**1**	**1**	**2**	**2**	**1**	**-**	**-**	**-**	**1**	**-**	**2**	**1**
CO3	**1**	**1**	**2**	**2**	**1**	**-**	**1**	**-**	**1**	**-**	**2**	**1**
CO4	**2**	**2**	**3**	**3**	**3**	**-**	**-**	**2**	**3**	**-**	**2**	**1**
CO5	**3**	**2**	**3**	**1**	**3**	**-**	**2**	**2**	**3**	**2**	**3**	**1**

Course Contents:

Unit	Contents	Hours
I	**Unit I : Introduction to SOC** Design of system on chip, Microsystems technology and applications, core architecture for digital media and the associated compilation techniques.	8
II	**Unit II : RTL Simulation** RTL Designs, RTL based chip design flow, design challenges, Simulation race, and simulation synthesis mismatch.	8
III	**Unit III : Timing Analysis and Clock Domain Crossing** Timing parameters for digital logic, factors affecting delay and slew, sequential arcs, clock domain crossing, bus synchronization, preventing data loss through FIFO.	8
IV	**Unit IV: SOC implementation** Study of processor IP, Memory IP, wrapper Design - Real-time operating system (RTOS), Peripheral interface and components, High-density FPGAs - EDA tools used for SOC design.	8
V	**Unit V : MEMS** Introduction, History, Concepts of MEMS: Principles, application and design, Scaling Properties/Issues, Micromachining Processes: Substrates, lithography, wet/dry etching processes, deposition processes, film stress, biomass application.	8

Text Books	1.	Sanjay Churiwala, Sapan Garg , "Principles of VLSI RTL Design A Practical Guide", Springer
	2.	Youn-Long Steve Lin, "Essential Issues in SOC Design, Designing Complex Systems-onChip", Springer
Reference Books	1.	Reference Books 1. Kamaran Eshraghian, "Principles of CMOS VLSI Design", Pearson Education
	2.	Rabey, Chandrakasan, "Digital IC Design", Preason Publication

List of Experiments.

Sr. No.	Name of Experiments
1	To study FPGA kit.
2	Implement any two logic gates using Data flow and Behavior Model. Implement it on FPGA or CPLD kit.
3	Write a VHDL code for Half Adder and Full Adder. Implement it on FPGA or CPLD kit.
4	Write a VHDL code for 4:1 Multiplexer. Implement it on FPGA or CPLD kit.
5	To study CPLD kit.
6	Design, simulate and implement FSM for detection of either of input sequence X = … 1001..... or …1101… sequence.
7	Design, simulate and implement FSM for detection of either of input sequence X = … 111..... or …110… sequence and set output flags Y='1' or Z='1' respectively. Use Overlapping method for sequence detection.
8	Write a Verilog code for counter.
9	Open Ended Expertiment:
10	V-Lab Experiment:

Course Title: **Brain Machine Interface**										
Semester	VII	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	TH	TU	PR	Credits	TAE	CAE	ESE	INT	EXT
Course Category	EL	3	-	2	4	10	15	50	25	-
Course Code	UECL418 UECP418									
Teaching Mode	Offline	4			TOTAL	75			25	
Duration of ESE	2 Hrs.					100				

Course Objectives	Understand the basic concepts of brain computer interface
	Study the various signal acquisition methods
	Learn about the signal processing methods used in BMI
	Understand the various machine learning methods of BMI
	Learn the various applications of BMI
Course Outcomes	Upon successful completion of this course, student will be able to:
	CO-1: Comprehend and appreciate the significance and role of this course in the present contemporary world.
	CO-2: Evaluate concept of Brain Activation.
	CO-3 Select appropriate feature extraction methods.
	CO-4 Assign functions to the human, to the machine and use machine learning algorithm for translation.
	CO-5 To study applications of BMI

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**3**	**3**	**3**	**1**	**1**		**2**			**1**	**3**
CO2	**3**	**3**	**2**	**1**	**2**	**3**		**2**			**2**	**3**
CO3	**3**	**3**	**2**	**3**	**3**	**1**		**2**			**3**	**3**
CO4	**3**	**3**	**2**	**3**	**3**	**1**		**2**			**3**	**3**
CO5	**2**	**3**	**3**	**2**	**1**	**3**		**1**			**2**	**3**

Course Contents:

Unit	Contents	Hours
I	**INTRODUCTION TO BMI** Introduction - Brain structure and function, Brain Computer Interface Types - Synchronous and Asynchronous -Invasive BMI -Partially Invasive BMI - Non Invasive BMI, Structure of BMI System, BMI Monitoring Hardware, EEG, ECG, ECoG, MEG, fMRI, Electrophysiological Sensors.	8
II	**BRAIN ACTIVATION** Brain activation patterns - Spikes, Oscillatory potential and ERD, Slow cortical potentials, Movement related potentials-Mu rhythms, motor imagery, Stimulus related potentials - Visual Evoked Potentials – P300 and Auditory Evoked Potentials, Potentials related to cognitive tasks.	8
III	**FEATURE EXTRACTION METHODS** Data Processing – Spike sorting, Frequency domain analysis, Time domain analysis, Time- Frequency domain analysis, Non-linear methods, Spatial filtering -Principal Component Analysis (PCA), Independent Component Analysis (ICA), Artefacts reduction, Feature Extraction - Phase synchronization and coherence	8
IV	**MACHINE LEARNING METHODS FOR BMI** Classification techniques –Binary classification, Ensemble classification, Multiclass Classification, Evaluation of classification performance, Regression - Linear, Polynomial, RBF's, Perceptron's, Multilayer neural networks, Support vector machine, Graph theoretical functional connectivity analysis, CNN, DNN	8
V	**APPLICATIONS OF BMI** Case Studies - Invasive BMIs: decoding and tracking arm (hand) position, controlling prosthetic devices such as orthotic hands, Cursor and robotic control using multi electrode array implant, Cortical control of muscles via functional electrical stimulation. Non-invasive BMIs:P300 Mind Speller, Visual cognitive BMI, Emotion detection. Ethics of BMI. Medical Application,	8

Text Books	1.	Rajesh.P.N.Rao, "Brain-Computer Interfacing: An Introduction", Cambridge University Press, First edition, 2013.
	2.	Jonathan Wolpaw, Elizabeth Winter Wolpaw, "Brain Computer Interfaces: Principles and practice", Oxford University Press, USA, Edition 1, January 2012.
	3.	Chang S. Nam, Anton Nijholt, Fabien Lotte, "Brain – Computer Interfaces Handbook" CRC Press.
Reference Books	1.	Ella Hassianien, A &Azar.A.T (Editors), "Brain-Computer Interfaces Current Trends and Applications", Springer, 2015.
	2.	Bernhard Graimann, Brendan Allison, Gert P furtscheller, "Brain-Computer Interfaces: Revolutionizing Human-Computer Interaction", Springer, 2010
	3	Ali Bashashati, MehrdadFatourechi, Rabab K Ward, Gary E Birch," A survey of signal Processing algorithms in brain–computer interfaces based on electrical brain signals" Journal of Neural Engineering, Vol.4, 2007, PP.32-57
	4	Arnon Kohen, "Biomedical Signal Processing", Vol I and II, CRC Press Inc, Boca Rato, Florida.
	5	Bishop C.M., "Neural networks for Pattern Recognition", Oxford, Clarendon Press, 1995.
	6	Andrew Webb, "Statistical Pattern Recognition", Wiley International, Second Edition, 2002.

List of Experiments

Sr. No.	Name of Experiments
1	To study how to record an EEG and to become familiar with identifying EEG artifacts.
2	To design open-source software for on-line EEG analysis and brain-computer interfaces
3	To test whether a subject's left hemisphere is more active than the right hemisphere, when the subject is engaged in language processes.
4	To identify the presence of Alpha Block that occures when the subject's eyes are closed and subject's mind is focused on problem solving.
5	To design new algorithms for identifying cognitive components in spontaneous EEG related to mental tasks as a basis for new BMI protocols;
6	To design BMI reliability by allowing users to adapt through real-time feedback and by adapting the BCI algorithms using error-related EEG components
	Perform experiment with interaction of two people using BMIs.
7	How to Make a Brain-Computer Interface to Communicate with Google using Keras and Open BMI

Elective-V

Course Title: **Digital Image Processing**										
Semester	VII	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	TH	TU	PR	Credits	TAE	CAE	ESE	INT	EXT
Course Category	EL	3	-	2	4	10	15	50	25	-
Course Code	UECL420 UECP420									
Teaching Mode	Offline	5			TOTAL	75			25	
Duration of ESE	2 Hrs.					100				

Course Objectives	To treat the 2-D systems as an extension of the 1-D systems and discuss the techniques for the 2-D systems.
Course Outcomes	Upon successful completion of this course, student will be able to:
	CO-1: To learn basic concept and image enhancement in spatial domain
	CO-2: To get knowledge of filtering, reconstruction, and restoration of an image.
	CO-3: To study segmentation and morphological image processing.
	CO-4: Understanding the concept of color image processing and compression.
	CO-5: Understanding the concept of image transformation and object recognition.

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**1**	**1**	**1**	**1**							**3**	**3**
CO2	**1**	**1**	**2**	**2**							**3**	**3**
CO3	**2**	**1**	**2**	**2**							**3**	**3**
CO4	**1**	**1**	**2**	**3**							**3**	**3**
CO5	**1**	**1**	**1**	**1**							**3**	**3**

Course Contents:

Unit	Contents	Hours
I	**Introduction and Digital Image Fundamentals:** Digital Image Fundamentals, Human Visual System, Image as a 2-Dimensional (2D) Data, Image Representation Gray Scale and Color Images, Image Acquisition and Camera Model, Image Sampling and Quantization. **Image Enhancement in Spatial Domain:** Basic Grey Level Transformations, Histogram Processing Techniques, Spatial Filtering, Low Pass Filtering, High Pass Filtering	9
II	**Filtering In the Frequency Domain:** Preliminary Concepts, Extension to functions of two variables, Image Smoothing, Image Sharpening, Homomorphic filtering **Image Restoration and Reconstruction:** Noise Models, Noise Reduction, Inverse Filtering, MMSE (Wiener) Filtering	9
III	**Image Segmentation:** Point, Line and Edge Detection, Thresholding, Regions Based Segmentation, Edge Linking and Boundary Detection, Hough Transform Object Recognition and Case Studies **Morphological Image Processing:** Erosion, Dilation, Opening, Closing, Basic Morphological Algorithms: Hole Filling, Connected Components, Thinning, Skeletons	9
IV	**Color Image Processing:** Color Fundamentals, Color Models, Pseudo Color Image Processing **Image Compression:** Fundamentals of Redundancies, Basic Compression Methods: Huffman Coding, Arithmetic Coding, LZW Coding, JPEG Compression Standard	7
V	**Image Transformations:** 2D-DFT, DCT, DST, Hadamard, Walsh, Hotelling transformation, 2D-Wavelet transformation, Wavelet packets. **Object Recognition**- Features, Patterns and Pattern Classes, Recognition Based on Decision – Theoretic Methods, Structural Methods, Application based on AI and CNN	6

Text Books	1.	A.K.Jain," Fundamentals of Digital Image Processing", PHI,1995
	2.	R. C.Gonzalez, R.E.Woods," Digital Image processing", Pearson edition, Inc3/e,2008
Reference Books	1.	J.C. Russ," The Image Processing Handbook", (5/e), CRC, 2006
	2.	R.C.Gonzalez & R.E. Woods; "Digital Image Processing with MATLAB", Prentice Hall, 2003

List of Experiments

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Sr. No.	Name of Experiments
1	(a)To create a program to display grayscale image using read and write operation. (b)To create a vision program to convert a 2D array into a grayscale image. (c)To create a vision program to convert gray images into an array of numbers (d)To create a program to rotate an image.
2	To create a vision program to find histogram value and display histogram of a grayscale and color image.
3	To create a vision program for Non-Linear Filtering technique using edge detection.
4	To create a vision program to determine the edge detection of an image using different operators.
5	To create a program to discretize an image using Fourier transformation.
6	To create a program to perform Discrete cosine transform on an image.
7	To create a program to eliminate the high frequency components of an image.
8	(a)To create a color image and perform read and write operation. (b)To create a vision program to convert a 2D array into a color image. (c)To create a vision program to convert colour images into an array of numbers.
9	To obtain the R, B, G colour values and resolved colour values from a colour box by choosing any colour.
10	To create a program performs discrete wavelet transform on image.
11	Open Ended Expertiment:
12	V-Lab Experiment:

Course Title: **Robotics**										
Semester	VII	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	TH	TU	PR	Credits	TAE	CAE	ESE	INT	EXT
Course Category	EL	3	-	2	4	10	15	50	25	-
Course Code	UECL421 UECP421									
Teaching Mode	Offline	5			TOTAL	75			25	
Duration of ESE	2 Hrs.					100				

Course Objectives	The objective is to impart knowledge about basic theory and mathematics related to robots.
	To study robots and their control, design and application in robotics & automation Industries.
Course Outcomes	Upon successful completion of this course, student will be able to:
	CO-1: Understand the kinematic and dynamic concept of Robots.
	CO-2: Analysis the control laws for a simple robot
	CO-3 Integrate mechanical and electrical hardware for a real prototype of robotic
	CO-4 Select a robotic system for given industrial application.
	CO-5 Design and demonstrate the multidisciplinary Robot

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**2**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**
CO2	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**
CO3	**3**	**3**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**
CO4	**2**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**
CO5	**2**	**2**	**2**	**1**	**2**	**-**	**1**	**1**	**2**	**2**	**1**	**2**

Course Contents:

Unit	Contents	Hours
I	**Introduction to Robotics:** Definition of Robots, Need and purpose of Robots, Introduction to Various Industrial robot Systems, Components of Robots, Types and Classification of robots; Concept of moving robots and arm robots. Classification of robotic systems, anatomy, Specifications and configuration. Basic concepts and terminology. Basic components in a typical robot system, Industrial and other applications of robots.	6
II	**Robot Kinematics and Dynamics** : Orientations and frames, Mappings: Changing descriptions from frame to frame, Operators: Translations, Rotations and Transformations - Transformation Arithmetic - DH Representation - Forward and inverse Kinematics Of Six Degree of Freedom Robot Arm – Robot Arm dynamics, Statics of planer arm robot, Mass and inertia of links,	6
III	**Robot Actuation Systems Actuators**: Electric, Hydraulic and Pneumatic; Transmission: Gears, Timing Belts and Bearings, Robotic sensors/actuators, Selection parameters of actuators.	8
IV	**Basics of Robot Control:** open loop and closed loop system, Transfer functions for both loops, Control laws: P, PI,PD,PI-PD, PID, Linear and Non-linear controls, Arm and body motions, Wrist motions	6
V	**Implementation of Robot:** Hardware and Interfacing of various communication modules , Programming of Robots, Implementation of Line Follower , Obstacle Avoidance intelligent Robot using adequate hardware, Cluster Robot, VISUINO(Visual Development for Arduino) design for Robotic Structure, Types of Robots. Robot System Integration, Robot Vision Systems.	10

Text Books	1.	J. J. Craig, Introduction to Robotics, Addision-Wesley,1989.
	2.	Y. Koren, Robotics for Engineers, MsGraw Hill,1985
	3	Ghosal A. Robotics: Fundamental Concepts and Analysis, Oxford University Press, 2006
	4	Microcontroller and Embedded system by Muhammad Ali Mazidi, Second Edition,2011
Reference Books	1.	Correll N., Introduction to Autonomous Robots, v1.7, Magellan Scientific, 2016. ISBN-13: 978-0692700877.
	2.	Saha. S.K., Introduction to Robotics, McGraw Hill Education (India) Private Limited, 2014.
	3	Spong M.W., Hutchinson S. and Vidyasagar M., Robot Modeling and Control, John Wiley Sons & Inc., 2005

List of Experiments

Sr. No.	Name of Experiments
1	Interface the dc motor with microcontroller board for only one direction rotation
2	Interface the dc motor with microcontroller board for forward and reverse direction
3	Interface the stepper motor with microcontroller board
5	Interface the dc motors with microcontroller board 360 degree rotation robot with clock wise and anitclock wise rotatinos
6	Implement the line follower robot
7	Implement the obstacle detection robot
8	V Lab Experiment
9	Design Visuino Stepper Control Unit For Robotics Arms

10	Design & Interface bitmap Display Unit for Robot Using Visuino
11	Design & Interface Sensor Feedback unit using Visuino.

Elective-V

Course Title: Analog and Mixed Signal VLSI Design:										
Semester	VII	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	TH	TU	PR	Credits	TAE	CAE	ESE	INT	EXT
Course Category	EL	3	-	2	4	10	15	50	25	-
Course Code	UECL423 UECP423									
Teaching Mode	Offline	5			TOTAL	75			25	
Duration of ESE	2 Hrs.					100				

Course Objective	1. To provide in-depth understanding of the analog integrated circuit and building blocks
	2. To provide a basic idea on mixed signal IC design
	To study need of CMOS device and its applications.
	To familiarize the student with the analysis and design of analog circuits.
Course Outcomes	Upon successful completion of this course, student will be able to:
	CO-1: Understand the fundamentals of Single stage amplifiers.
	CO-2: Understand the fundamentals of basic differential amplifier as well as analyze and design the Differential Amplifier.
	CO-3: Understand and analyze the analog circuits such as current mirrors and biasing circuits.
	CO-4: Understand the concepts of frequency response of various Amplifiers like CS amplifier, CG amplifier , differential and multistage amplifiers.
	CO-5: Understand the fundamentals of various CMOS Op-Amps.

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**2**	**2**	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**1**
CO2	**3**	**3**	**3**	**1**	**3**	**1**	**1**	**1**	**2**	**1**	**1**	**2**
CO3	**2**	**3**	**2**	**1**	**3**	**1**	**1**	**2**	**1**	**1**	**1**	**1**
CO4	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**3**	**2**	**3**	**3**
CO5	**2**	**2**	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**1**

Course Contents:

Unit	Contents	Hours
I	**Single stage amplifiers:** Common source amplifier, source degeneration, source follower, common gate amplifier, cascade stage.	8
II	**Differential Amplifiers:** Basic differential pair, common mode response, differential pair with MOS loads, Gilbert Cell, device mismatch effects, input offset voltage.	8
III	**Current Mirrors, Current and Voltage Reference:** Basic current mirrors, cascade current mirrors, active current mirrors, low current biasing, supply insensitive biasing, temperature insensitive biasing, impact of device mismatch.	8
IV	**Frequency Response of Amplifiers**: Miller effect, CS amplifier, source follower, CG amplifier, cascade stage, differential amplifier, Multistage amplifier.	8
V	**High Performance CMOS Op-Amp:** Buffered Op-amps, High speed/Frequency Op-amps, Mixed signal, APMT, High Performance non-silicon technology, GaAs transducer based, Differential output op-amps, low noise and low voltage op-amps.	8

Text Books	1.	Razavi, B., "Design of Analog CMOS Integrated Circuits", 1st Ed., Mc Graw Hill.
	2.	Baker, R. J., Li, H. W. and Boyce, D. E., "CMOS Circuit Design ,Layout and Simulation", Prentice-Hall of India.
	3.	Gray, P.R., Hurst, P. J., Lewis, S.H., Meyer, R.G., "Analysis and Design of Analog Integrated Circuits", 4th Ed., John Wiley and Sons.
Reference Books	1.	P. E. Allen and D. R. Holberg, CMOS Analog Circuit Design, Second Edition, Oxford University Press.
	2.	Thomas Lee, "The Design of CMOS Radio – Frequency Integrated Circuits", Second edition, Cambridge.
	3.	NPTEL LINK:https://nptel.ac.in/courses/117101105/

List of Experiments

Sr. No.	Name of Experiments (New)
1	Design and simulate the schematic of the CMOS inverter, and then to perform the physical verification for the layout of the same.
2	Design and simulate the schematic of Single Stage Cascade Amplifier, and then to perform the physical verification for the layout of the same.
3	To simulate the schematic of the differential amplifier, and then to perform the physical verification for the layout of the same.
4	To simulate the schematic of the Current Mirror, and then to perform the physical verification for the layout of the same Current Mirror.
5	To simulate the schematic of the Cascade Current Mirror Amplifier, and then to perform the physical verification for the layout of the Cascade Current Mirror Amplifier.
6	To simulate the schematic of the common source amplifier, and then to perform the physical verification for the layout of the same.
7	To simulate the schematic of the operational amplifier, and then to perform the physical verification for the layout of the same.
8	To simulate the schematic of the common drain amplifier, and then to perform the physical verification for the layout of the same.
9	Open Ended Expertiment:ADC/DAC Converter

Course Title: Generative Adversarial Network										
Semester	VII	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	TH	TU	PR	Credits	TAE	CAE	ESE	INT	EXT
Course Category	EL	3	-	2	4	10	15	50	25	-
Course Code	UECL 428 UECP428									
Teaching Mode	Offline	5			TOTAL	75			25	
Duration of ESE	2 Hrs.					100				

Course Objectives	Identify problems that GANs can solve.
	Understand the roles of the generator and discriminator in a GAN system.
	Understand the advantages and disadvantages of common GAN loss functions
Course Outcomes	Upon successful completion of this course, student will be able to:
	CO-1:Understand GAN components, build GANs using PYTorch
	CO-2:Compare generative models
	CO-3:Use GANs for data augmentation and privacy preservation
	CO-4: Learn the applications of GANs.
	CO-5 Demonstrate and understand Training techniques of BIG GANs ,BIG GANs model

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**3**	**2**	**1**	**3**	**1**	**1**	**1**	**-**	**1**	**1**	**-**
CO2	**2**	**2**	**2**	**1**	**3**	**-**	**-**	**-**	**1**	**1**	**1**	**1**
CO3	**3**	**3**	**2**	**2**	**3**	**1**	**-**	**-**	**1**	**1**	**1**	**-**
CO4	**3**	**3**	**2**	**2**	**3**	**-**	**1**	**1**	**-**	**-**	**-**	**1**
CO5	**3**	**2**	**1**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**1**	**1**

Course Contents:

Unit	Contents	Hours
I	Introduction to Generative Adversarial Network: Generative models, Real life GANs, Intuition behind GANs, Discriminator and Generator.	8
II	Original Generative Adversarial Networks: Algorithm of training Adversarial Networks.	8
III	Deep convolutional Generative Adversary Networks: Motivation to Convolutions , Convolution operation ,Convolution parameters, Transposed convolutions	8
IV	Applications of Generative Adversarial Networks: Image to image translation with Cycle GANs, Patch based image inpainting, Generation of image from text.	8
V	State of art Generative Adversarial Networks: Progressive growing of GANs, A style based generator Architecture for GANs, Introduction to BIG Generative Adversarial network, Training techniques of BIG GANs ,BIG GANs model	8

Text Books	1.	Generative Adversarial Networks: Next-generation deep learning simplified. Written by Kuntal Ganguly, published in 2017.
	2.	Generative Adversarial Networks Projects: Build next-generation generative models using TensorFlow and Keras. Written by Kailash Ahirwar, published in 2019.
	3	Generative Adversarial Networks Cookbook: Over 100 recipes to build generative models using Python, TensorFlow, and Keras Written by Josh Kalin, published in 2018.
Reference Books	1.	Generative Deep Learning by David Foster
	2.	Advanced Deep learning with Keras by Rowel Atienza
	3.	Deep Generative Modeling by Jakub M. Tomczak

List of Experiments

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Sr. No.	Name of Experiments
1	1-dimentional GANs with pytorch
2	2-dimentional GANs Mode collapse
3	Data Processing And Hyperparameters
4	Build Generator And Discriminator Networks using Pytorch
5	Tracking GAN Training Performance
6	Training GAN On MNIST
7	GAN Generator Input Code Demo - Normally Distributed Random Noise
8	Upsampling Code Demo With Neural Network APIs
9	Transposed Convolution Code Demo With Neural Network APIs
10	Interactive Upsampling Demo
11	Open Ended Expertiment:
12	V-Lab Experiment: Google Colab Environment

Course Title: Optical Communication										
Semester	VII	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	TH	TU	PR	Credits	TAE	CAE	ESE	INT	EXT
Course Category	EL	3	-	2	4	10	15	50	25	-
Course Code	UECL424 UECP424									
Teaching Mode	Offline	5			TOTAL	75			25	
Duration of ESE	2 Hrs.					100				

Course Objectives	To understand the three primary components of a fiber-optic communication system
	To provide an in-depth knowledge on various types of fibers and their transmission characteristics, the construction, working principle and characteristics of transmitters, receivers and various optical amplifiers used in long distance communication
	To apply their subject understanding in Link Design
	To understand the role of WDM components & Optical Amplifier in advanced light wave systems
Course Outcomes	Upon successful completion of this course, student will be able to:
	CO-1: Understand and apply the concept of optical communication
	CO-2: Analyse and Evaluate the characteristics of Sources.
	CO-3: Analyse and Evaluate the characteristics of Detector.
	CO-4: Carry out Link power budget and Rise Time Budget by proper selection of components.
	CO-5: Understand the operational principal of SOA and WDM.

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**1**	**--**	**1**	**1**	**--**	**---**	**--**	**--**	**--**	**1**	**2**
CO2	**3**	**3**	**2**	**1**	**1**	**2**	**1**	**--**	**--**	**--**	**1**	**1**
CO3	**3**	**3**	**2**	**1**	**1**	**1**	**1**	**--**	**--**	**2**	**1**	**1**
CO4	**3**	**1**	**1**	**1**	**2**	**1**	**2**	**-**	**1**	**2**	**1**	**1**
CO5	**3**	**3**	**2**	**1**	**2**	**1**	**2**	**-**	**1**	**2**	**2**	**1**

Course Contents:

Unit	Contents	Hours
I	**Optical Fibre:** Basic concepts of optical communication. The nature of light. Light as an Electromagnetic Wave, Polarisation, Interference. Transmitting light on a Fibre Refractive index, Fibre refractive index profiles, Modes of propagation. Light Propagation in Multimode Fibre, Ray theory transmission: TIR, Acceptance angle, Numerical aperture,	8
II	**Optical Sources:** Light Emitting Diodes, working of LED's , Heterojunctions (Practical LED's) , Characteristics of LED'S, Lasers, Basic Principle of the LASER, Semiconductor Laser Diodes	8
III	**Optical Detectors:** Photoconductors, Photodiodes, P-N Diodes, P-I-N Diodes, Schottky-Barrier Photodiodes, Avalanche Photodiodes (APDS), Hetero interface photo detectors, Travelling Wave Photo detectors, Photo transistors	8
IV	**Optical Communication Systems:** Point-to-point Transmission Systems, Modulation techniques, On-off key, Forward Error correction, Receiving the signal, Timing recovery, Bandwidth Occupancy, Link Power budget, Rise Time budget,	6
V	**Overview of WDM & Optical Amplifiers:** Classification of OAs, Principle of operation of a Semiconductor Optical Amplifier & Gain calculation of Fabry Perot Amplifiers, Principal on Slicing of Fiber. SOA applications: advantages and disadvantages, Principle of operation of Erbium Doped Fiber Amplifiers (EDFA), Gain and Noise in an EDFA.WDM Couplers/ Splitters: Excess loss, Insertion loss Coupling ratio, Isolation and Uniformity properties. State of art: WDM components, Introduction to Free Space Optical communication.	8

Text Books	1.	Gerd Keiser, “Optical fiber Communications”, Tata McGraw Hill, 4th edition.
	2.	John M. Senior, Optical Fiber Communications-Principles and Practice, Prentice Hall of India, second Edition
Reference Books	1.	Govind P. Agrawal, Fiber-Optic Communication Systems, Wiley, 3rd edition
	2.	Djafar K. Mynbaev and Lowell L.Scheiner, “Fiber Optic Communications Technology”, Pearson Education

List of Experiments

Sr. No.	Name of Experiments
1	Estimation of Numerical aperture of fiber
2	Plot the characteristics of various sources
3	Plot the characteristics of various detectors
4	Measure attenuation of MMSI fiber and comment on the result based on attenuation due to increase in length.
5	Measure attenuation of SMSI fiber and comment on the result based on attenuation due to increase in length
6	Measure attenuation of SMSI & SMSI fiber and comment on the result based on attenuation due to bending
7	Set up and analysis of an Analog link.
8	Set up and analysis of Digital link.
9	Tutorial on Power budget analysis of optical fiber system
10	Tutorial on time budget analysis of optical fiber system

11	Open Ended Expertiment:
12	V-Lab Experiment:

Elective-VI

Course Title: Advanced Embedded Systems										
Semester	VII	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	TH	TU	PR	Credits	TAE	CAE	ESE	INT	EXT
Course Category	EL	3	-	2	4	10	15	50	25	-
Course Code	UECL425 UECP425									
Teaching Mode	Offline	5			TOTAL	75			25	
Duration of ESE	2 Hrs.					100				

Course Objectives	To impart the concepts and architecture of Embedded systems and to make the students capable of designing Embedded systems.
	To understand the architecture and programming of Industry popular 32-bit Microcontroller ARM Cortex
	To understand the usage of the development and debugging tools.
	To study programming and interfacing details of building Microcontrollers based Embedded Systems.
Course Outcomes	Upon successful completion of this course, student will be able to:
	CO-1: Understand different options for the realization of embedded systems and single board computers.
	CO-2: Acquire the Knowledge of ARM Architecture and instruction set architecture
	CO-3 Understand and Analyze architecture of ARM Cortex M3 Processor
	CO-4 Analyze and exceptions, Nested Vectored Interrupt Controller and Different behaviour of Interrupts
	CO-5 Demonstrate and analyse architecture of ARM Cortex M3/M4 Processor Core and Its integrated development environment

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**2**	**1**	**2**	**3**	**3**				**2**			**2**
CO2	**2**	**1**	**2**	**3**	**3**				**2**			**2**
CO3	**2**	**1**	**2**	**3**	**3**				**2**			**2**
CO4	**-**	**-**	**1**	**3**	**3**				**2**			**2**
CO5	**2**	**1**	**2**	**3**	**3**				**3**			**2**

Course Contents:

Unit	Contents	Hours
I	**Embedded Systems Concepts:** Introduction to embedded systems, Single Core, multi Core Systems. System In Package (SIP), System On Module (SOM), Package on Package (POP), Computer on Module (COM) based Embedded system, Single Board Computers.	8
II	**ARM Architecture:** Background of ARM Architecture, Architecture Versions, Processor Naming, Instruction Set Development, Thumb-2 and Instruction Set Architecture.	6
III	**Overview of Cortex-M3:** Cortex-M3 Basics: Registers, General Purpose Registers, Stack Pointer, Link Register, Program Counter, Special Registers, Operation Mode, Exceptions and Interrupts, Vector Tables, Stack Memory Operations, Reset Sequence. Instruction Sets: Assembly Basics, Instruction List, Instruction Descriptions. Cortex-M3 Implementation Overview: Pipeline, Block Diagram, Bus Interfaces on Cortex-M3, I-Code Bus, D-Code Bus, System Bus, External PPB and DAP Bus.	10
IV	**Exceptions, NVIC and Interrupt Behavior:** Exception Types Priority, Vector Tables, Interrupt Inputs and Pending Behavior, Fault Exceptions, Supervisor Call and Pendable Service Call. NVIC: Nested Vectored Interrupt Controller Overview, Basic Interrupt Configuration, Software Interrupts and SYSTICK Timer. Interrupt Behavior: Interrupt/Exception Sequences, Exception Exits, Nested Interrupts, Tail-Chaining Interrupts, Late Arrivals and Interrupt Latency	8
V	**Cortex-M3/M4 Microcontroller**: STM32L15xxx ARM Cortex M3/M4 Microcontroller: Memory and Bus Architecture, Power Control, Reset and Clock Control. STM32L15xxx Peripherals: GPIOs, System Configuration Controller, NVIC, ADC, Comparators, GP Timers, USART. Development & Debugging Tools: Software and Hardware tools like Cross Assembler, Compiler, Debugger, Simulator, In-Circuit Emulator (ICE), Logic Analyzer etc .Introduction to Graphics Processor Unit (GPU), Differences and similarities between CPU and GPU. Architecture of GPU.	8

Text Books	1.	The Definitive Guide to the ARM Cortex-M3, Joseph Yiu, Second Edition, Elsevier Inc. 2010.
	2.	Andrew N Sloss, Dominic Symes, Chris Wright, "ARM System Developer's Guide - Designing and Optimizing System Software", 2006, Elsevier.
Reference Books	1.	Steve Furber, "ARM System-on-Chip Architecture", 2nd Edition, Pearson Education
	2.	Cortex-M series-ARM Reference Manual
	3.	Cortex-M3 Technical Reference Manual (TRM)
	4.	Embedded/Real Time Systems Concepts, Design and Programming Black Book, Prasad, KVK.
	5.	David Seal "ARM Architecture Reference Manual", 2001 Addison Wesley, England; Morgan Kaufmann Publishers
	6.	Arnold. S. Berger, "Embedded Systems Design - An introduction to Processes, Tools and Techniques", Easwer Press
	7.	Raj Kamal, "Microcontroller - Architecture Programming Interfacing and System Design" 1st Edition, Pearson Education

List of Experiments

Sr. No.	Name of Experiments
1	Write ARM assembly to perform the following array assignment in C: for (i = 0; i <= 10; i++) {a[i] = b[i] + c;} 34 /97 Assume that r3 contains i, r4 contains c, the starting address of array a is in r1, and the starting address of array b is in r2.
2	Embedded C Programming on ARM Cortex M3/M4 Microcontroller
3	Write a program to read the analog input connected to ADC and compare with threshold so as to control the Digital outputs (LEDs). Use standard peripheral library and interrupt method.
4	Design of a real-time data acquisition & control system using the STM32Lxx ARM Cortex M3 Microcontroller
5	Transmit a string "Programming with ARM Cortex" to PC by using standard peripheral library with the help of USART3. Use polling method.
6	Case Studies: Interfacing TFT display, CAN protocol, ETHERNET to ARM Cortex M3/M4
7	Generation of PWM signal for motor control using LPC1768
8	Open Ended Expertiment:
9	V-Lab Experiment: