K.L.N. COLLEGE OF ENGINEERING

Pottapalayam - 630612, Sivagangai District

(An Autonomous Institution, Affiliated to Anna University, Chennai)

Estd: 1994

FINAL YEAR

CURRICULUM AND SYLLABUS

REGULATIONS 2020

For under Graduate Program

B.E. – ELECTRONICS AND COMMUNICATION ENGINEERING

CHOICE BASED CREDIT SYSTEM

(For the students admitted from the academic year 2021-2022 onwards)

K.L.N. COLLEGE OF ENGINEERING, POTTAPALAYAM
(An Autonomous Institution, Affiliated to Anna University, Chennai)

VISION OF THE INSTITUTION

To become a Centre of Excellence in Technical Education and Research in producing Competent and Ethical professionals to the society

MISSION OF THE INSTITUTION

To impart Value and Need based curriculum to the students with enriched skill development in the field of Engineering, Technology, Management and Entrepreneurship and to nurture their character with social concern and to pursue their career in the areas of Research and Industry**.**

VISION OF THE DEPARTMENT

To promote as a center of excellence in educational and research activities related to electronics and communication engineering and its allied areas.

MISSION OF THE DEPARTMENT

- To create educational and research environment to meet ever changing and ever demanding needs of electronics and communication industry along with IT and other interdisciplinary fields.
- To mould the students to become ethically upright and recognized as responsible engineers

K.L.N. COLLEGE OF ENGINEERING, POTTAPALAYAM
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PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO 1: To prepare graduates with a strong foundation in Engineering science and Technology with more emphasis in Electronics and Communication Engineering and its allied areas.

PEO 2: To prepare the students to pursue successful career in industry and to motivate them for higher education.

PEO 3: To prepare the graduates to sustain as good professional, researcher and to practice them in emerging technologies through lifelong learning.

PEO 4: To impart students with ethical standards, professional excellence through effective communication skills, team work, multi disciplinary projects and social responsibility.

PROGRAM SPECIFIC OUTCOMES (PSOs):

PSO 1: Design and analyse the basic analog and digital electronic circuits.

PSO 2: Design and analyse the spectral components of communication signals and systems.

PSO 3: Develop the modules in VLSI and embedded systems.

PO1: Engineering knowledge

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

PO2: Problem analysis

Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions

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

PO4: Conduct investigations of complex problems

Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage

Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society

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

PO7: Environment and sustainability

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

PO8: Ethics

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

PO9: Individual and team work

Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication

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

PO11: Project management and finance

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

PO12: Life-long learning

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

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REGULATIONS 2020

For Under Graduate Program

B.E. – ELECTRONICS AND COMMUNICATION ENGINEERING

CHOICE BASED CREDIT SYSTEM

CATEGORY OF COURSES

i. **Humanities and Social Sciences (HS) Courses** include Technical English, Environmental Science and Engineering, Engineering Ethics and human values, Communication Skills and Management courses.

ii. **Basic Sciences (BS**) **Courses** include Mathematics, Physics, and Chemistry.

iii. **Engineering Sciences (ES) Courses** include Engineering Practices, Engineering Graphics, Basics of Electrical / Electronics / Mechanical / Computer Engineering / Instrumentation etc.

iv. **Professional Core (PC) Courses** include the core courses relevant to the chosen programme of study.

v. **Professional Elective (PE) Courses** include the elective courses relevant to the chosen programme of study.

vi. **Open Elective (OE) Courses** include courses from other departments which a student can choose from the list specified in the curriculum of the students B.E. / B.Tech. Programmes.

vii. **Employability Enhancement Courses (EEC)** include Project Work and/or Internship, Seminar, Professional Practices, Case Study and Industrial/Practical Training.

viii. **Mandatory (MC) Courses** include Personality and Character development and the courses recommended by the regulatory bodies such as AICTE, UGC, etc

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B.E. – ELECTRONICS AND COMMUNICATION ENGINEERING

SEMESTER VII

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	20EC705	Microwave and Optical Communication	PC	4	3	1	0	4
2.	20EC702	Wireless Communication	PC	3	3	0	0	3
3.		Professional Elective – IV	PE	3	3	0	0	3
4.		Professional Elective – V	PE	3	3	0	0	3
5.		Professional Elective – VI	PE	3	3	0	0	3
6.		Open Elective – II	OE	3	3	0	0	3
PRACTICAL								
7.	20EC7L1	Microwave and Optical Communication Laboratory	PC	4	0	0	4	2
TOTAL				**23**	**18**	**1**	**4**	**21**

SEMESTER VIII

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
PROJECT								
1.	20EC8L1	Project Work	EEC	20	0	0	20	10
TOTAL				**20**	**0**	**0**	**20**	**10**

K.L.N. COLLEGE OF ENGINEERING, POTTAPALAYAM
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HONORS					MINOR
Vertical - 1	**Vertical - 2**	**Vertical - 3**	**Vertical - 4**	**Vertical - 5**	**Vertical - 6**
Semiconductor Chip Design and Testing	**RF & Wireless Communication Technologies**	**Signal Processing & Computer Vision**	**Artificial Intelligence & Machine Learning**	**Embedded & IOT**	**Biomedical and Sensor Technologies**
CAD for VLSI Circuits	Digital Communication Receivers	Speech Processing	Machine Learning and Applications	IoT Enabled Systems Design	Foundations for Nano Engineering
Multicore Programming	Satellite Communication	Advanced Digital Signal Processing	Artificial Intelligence for Everyone	Mixed C and Assembly Language Programming	Sensor Concepts and Techniques
System on Chip Design	RF Integrated Circuit Design	DSP Architecture and Programming	Fundamentals of Soft Computing	Embedded Processors	Human Assist Devices
VLSI Testing and Design for Testability	Wireless Broadband Networks	Text and Speech Analysis	Deep Learning	Robotics and Automation	Wireless Body Area Networks
Low Power IC Design	Advanced Wireless Communication	Digital Imaging and Computer Vision	Data Analytics	Industrial IoT and Industry 4.0	Biomedical Imaging Systems
Network on Chip Design	Radar Technologies	Software Defined Radio	Virtual Reality and Augmented Reality	Communicating Embedded Systems	Wireless Sensor Network Design
IC Fabrication Technology	Massive MIMO Networks	Video Analytics	Text and Speech Analysis	IoT Security	Brain Computer Interface and Applications
		Multimedia Compression Techniques	Ethics & AI		

Registration of Professional Elective Courses from Verticals:

Professional Elective Courses will be registered in Semesters V to VII. These courses are listed in groups called verticals that represent a particular area of specialisation / diversified group. Students are permitted to choose all the Professional Electives from a particular vertical or from different verticals.

Enrolment for B.E. / B. Tech. Minor degree (Optional)

A student can also optionally register for additional courses (18 credits) and become eligible for the award of B.E./B.Tech (Honors) or B.E./B.Tech Minor degree. For minor degree, a student shall register for the additional courses (18 credits) from semester V onwards. All these courses have to be in a particular vertical from any one of the other programmes. For more details on B.E./B.Tech (Honours) or Minor degree refer to the Regulations 2020 (Amendments), Clause 4 & Clause 16.

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PROFESSIONAL ELECTIVES (PE)

Vertical - I
(Semiconductor Chip Design and Testing)

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20ECV11	CAD for VLSI Circuits	PE	4	2	0	2	3
2.	20ECV21	Multicore Programming	PE	4	2	0	2	3
3.	20ECV31	System on Chip Design	PE	4	2	0	2	3
4.	20ECV41	VLSI Testing and Design For Testability	PE	3	3	0	0	3
5.	20ECV51	Low Power IC Design	PE	4	2	0	2	3
6.	20ECV61	Network on Chip Design	PE	3	3	0	0	3
7.	20ECV71	IC Fabrication Technology	PE	3	3	0	0	3

Vertical - II
(RF & Wireless Communication Technologies)

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20ECV12	Digital Communication Receivers	PE	3	3	0	0	3
2.	20ECV22	Satellite Communication	PE	3	3	0	0	3
3.	20ECV32	RF Integrated Circuit Design	PE	3	3	0	0	3
4.	20ECV42	Wireless Broadband Networks	PE	3	3	0	0	3
5.	20ECV52	Advanced Wireless Communication	PE	3	3	0	0	3
6.	20ECV62	Radar Technologies	PE	3	3	0	0	3
7.	20ECV72	Massive MIMO Networks	PE	3	3	0	0	3

Vertical - III
(Signal Processing)

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20ECV13	Speech Processing	PE	3	3	0	0	3
2.	20ECV23	Advanced Digital Signal Processing	PE	4	2	0	2	3
3.	20ECV33	DSP Architecture and Programming	PE	4	2	0	2	3
4.	20ECV43	Text and Speech Analysis	PE	4	2	0	2	3
5.	20ECV53	Digital Imaging and Computer Vision	PE	4	2	0	2	3
6.	20ECV63	Software Defined Radio	PE	3	3	0	0	3
7.	20ECV73	Video Analytics	PE	3	3	0	0	3
8.	20ECV83	Multimedia Compression Techniques	PE	3	3	0	0	3

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Vertical - IV

(Artificial Intelligence & Machine Learning Techniques)

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20ECV14	Machine Learning and Applications	PE	4	2	0	2	3
2.	20ECV24	Artificial Intelligence for Everyone	PE	3	3	0	0	3
3.	20ECV34	Fundamentals of Soft Computing	PE	3	3	0	0	3
4.	20ECV44	Deep Learning	PE	3	3	0	0	3
5.	20ECV54	Data Analytics	PE	3	3	0	0	3
6.	20ECV64	Virtual Reality and Augmented Reality	PE	3	3	0	0	3
7.	20ECV43	Text and Speech Analysis	PE	4	2	0	2	3
8.	20ECV84	Ethics & AI	PE	3	3	0	0	3

Vertical - V

(Embedded & IOT)

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20ECV15	IoT Enabled Systems Design	PE	4	2	0	2	3
2.	20ECV25	Mixed C and Assembly Language Programming	PE	4	2	0	2	3
3.	20ECV35	Embedded Processors	PE	4	2	0	2	3
4.	20ECV45	Robotics and Automation	PE	3	3	0	0	3
5.	20ECV55	Industrial IoT and Industry 4.0	PE	4	2	0	2	3
6.	20ECV65	Communicating Embedded Systems	PE	3	3	0	0	3
7.	20ECV75	IoT Security	PE	3	3	0	0	3

Vertical - VI

(Biomedical and Sensor Technologies)

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20ECV16	Foundations for Nano Engineering	PE	3	3	0	0	3
2.	20ECV26	Sensor Concepts and Techniques	PE	3	3	0	0	3
3.	20ECV36	Human Assist Devices	PE	3	3	0	0	3
4.	20ECV46	Wireless Body Area Networks	PE	3	3	0	0	3
5.	20ECV56	Biomedical Imaging Systems	PE	3	3	0	0	3
6.	20ECV66	Wireless Sensor Network Design	PE	3	3	0	0	3
7.	20ECV76	Brain Computer Interface and Applications	PE	3	3	0	0	3

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SEMESTER – VII

OPEN ELECTIVE – II

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20OE108	Industrial Safety Practices	OE	3	3	0	0	3
2.	20OE205	Industrial Energy Auditing and Management	OE	3	3	0	0	3
3.	20OE406	Java Scripting	OE	3	3	0	0	3
4.	20OE408	Essentials of Data Analytics	OE	3	3	0	0	3
5.	200E505	Essentials of Information Security	OE	3	3	0	0	3
6.	20OE506	Principles of Cyber Physical System	OE	3	3	0	0	3
7.	20OE507	Concepts of Ethical Hacking	OE	3	3	0	0	3
8.	20OE608	Automotive Electrical and Electronics Systems	OE	3	3	0	0	3
9.	20OE708	Instrumentation for Agro food industry	OE	3	3	0	0	3
10.	20OE803	English for Research Paper Writing	OE	3	3	0	0	3

OPEN ELECTIVE II (OE II) offered to other Department

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20OE305	Fundamentals of Image Processing	OE	3	3	0	0	3
2.	20OE306	Consumer Electronics	OE	3	3	0	0	3
3.	20OE307	Fundamentals of Digital Signal Processing	OE	3	3	0	0	3
4.	20OE308	Introduction to VLSI Technology	OE	3	3	0	0	3

20EC705	MICROWAVE AND OPTICAL COMMUNICATIONS	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To deal with the microwave generation techniques.
- To inculcate understanding of the microwave network theory.
- To instill knowledge on the properties of various microwave components.
- To inculcate understanding of the basics required for optical fibers communication.
- To deal with the optical sources and detectors.

PRE-REQUISITE:
Course Code: 20EC502
Course Name: Transmission lines and wave guides

UNIT - I MICROWAVE GENERATION 12

Limitations of conventional Tubes – Klystron: working of Klystron, velocity modulation process and it's derivation, efficiency. Reflex Klystron: working, velocity modulation process, efficiency. Magnetron: working, Hull's cutoff voltage equation, mode jumping, frequency pushing and pulling. TWT: similarities and differences with klystron, working of TWT, Backward wave oscillator.

UNIT - II HIGH FREQUENCY NETWORK THEORY 12

Review of Low frequency parameters; Different types of interconnection of Two port networks, High Frequency parameters, Formulation of S parameters, Properties of S parameters, Reciprocal and lossless Network, Transmission matrix, RF behavior of Resistors, Capacitors and Inductors.

UNIT - III PASSIVE AND ACTIVE MICROWAVE DEVICES 12

Terminations, Attenuators, E-Plane Tee, H-Plane Tee, Magic Tee, Directional Coupler, S matrix for Directional Coupler, Non reciprocal devices: Circulator and Isolator. S matrix for Circulator and Isolator. PIN diode, Gunn Diode, IMPATT, TRAPATT diode.

UNIT - IV OPTICS AND OPTICAL FIBERS 12

Ray theory transmission – Total internal reflection – Acceptance angle – Numerical aperture – Skew rays – Step Index and Graded Index, Single Mode and Multi Mode fibers – Attenuation in a fiber, absorption, linear and non linear scattering losses – Dispersion, Intra model, intermodal dispersion - Fiber to Fiber Joints-Fiber Splicing-Optical Fiber connectors - Fiber in local loop.

UNIT - V OPTICAL SOURCES AND DETECTORS 12

Optical sources: Light Emitting Diodes – LED structures – surface and edge emitters, mono and hetero structures – internal quantum efficiency – injection laser diode structures – comparison of LED and ILD Optical Detectors: PIN Photo detectors, Avalanche photo diodes, construction – Comparison of performance – Photo detector noise – Signal to Noise ratio. Detector response time.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Annapurna Das and Sisir K. Das, "Microwave Engineering", Mc Graw Hill India, Fourth Edition, 2020.
2. John M. Senior, "Optical Fiber Communication: Principles & Practice", Pearson, Third Edition, 2009.

REFERENCES:

1. David M. Pozar, “Microwave Engineering”, Wiley India Pvt. Ltd., New Delhi, 2008.
2. Robert E, Colin, “Foundations for Microwave Engineering”, John Wiley & Sons Inc., 2005.
3. Gerd Keiser, “Optical Fiber Communication”, McGraw Hill International, Fourth Edition, 2010.
4. Samuel Y. Liao, “Microwave devices and Circuits”, Tata McGraw Hill Inc., 2004.
5. John Gowar, “Optical Communication Systems”, Prentice Hall India, 2001.
6. Govinda P. Agarwal, “Fiber-Optic Communication Systems”, John Wiley & Sons, Third Edition, 2004.
7. George Kennedy, Brendan Davis and Srm Prasanna, "Electronic Communication Systems", McGraw Hill Education, 5th Edition, 2011.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Microwave and Optical Communications		**Course Code :** 20EC705			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C401.1	Derive the mathematical parameters of various microwave sources.	1	K3	1,2,3,8,10	2
C401.2	Identify the high frequency parameters for Microwave network.	2	K3	1,2,3,8,10	2
C401.3	Explain the working principle of active microwave devices.	3	K2	1,2,8,10	2
C401.4	Compute S parameters for passive microwave devices.	3	K3	1,2,3,8,10	2
C401.5	Determine the basic parameters and characteristics of optical fiber.	4	K3	1,2,8,10	2
C401.6	Explain the working principle and characteristics of optical sources and detectors.	5	K2	1,2,3,8,10	2

CO-PO Mapping

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C401.1	3	2	1					2		2				2	
C401.2	3	2	1					2		2				2	
C401.3	2	1						2		2				1	
C401.4	3	2	1					2		2				2	
C401.5	3	2	1					2		2				1	
C401.6	2	1						2		2				2	

20EC702	WIRELESS COMMUNICATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the various cellular architectures.
- To know the characteristic of wireless channel.
- To understand the concepts behind various digital signaling schemes for fading channels.
- To familiar the various multipath mitigation techniques.
- To understand the various multiple antenna systems.

PRE-REQUISITE:
Course Code: 20EC503
Course Name: Analog and digital communication techniques

UNIT - I CELLULAR ARCHITECTURE 9

Evolution of wireless communication Standards from 2G to 5G -Multiple Access techniques - FDMA, TDMA, CDMA – Capacity calculations–Cellular concept- Frequency reuse - channel assignment - hand off - interference & system capacity- trunking & grade of service – Coverage and capacity improvement.

UNIT - II WIRELESS CHANNELS 9

Large scale path loss – Path loss models: Free Space and Two-Ray models - Small scale fading- Parameters of mobile multipath channels – Time dispersion parameters-Coherence bandwidth – Doppler spread & Coherence time, Fading due to Multipath time delay spread – flat fading – frequency selective fading – Fading due to Doppler spread – fast fading – slow fading.

UNIT - III DIGITAL SIGNALING FOR FADING CHANNELS 9

Structure of a wireless communication link, Principles of Offset - QPSK, p/4-DQPSK, Minimum Shift Keying, Gaussian Minimum Shift Keying, Error performance in fading channels, OFDM principle – Cyclic prefix, Windowing, PAPR – NOMA.

UNIT - IV MULTIPATH MITIGATION TECHNIQUES 9

Equalisation – Adaptive equalization, Linear and Non-Linear equalization, Zero forcing and LMS Algorithms. Diversity – Micro and Macrodiversity, Diversity combining techniques, Error probability in fading channels with diversity reception, Rake receiver.

UNIT - V MULTIPLE ANTENNA TECHNIQUES 9

MIMO systems – spatial multiplexing - System model - transmitter diversity, receiver diversity - Massive MIMO - Beamforming and MIMO – Cognitive radio - software defined radio - Communication relays - Spectrum sharing.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Theodore S. Rappaport, “Wireless Communications: Principles and Practice”, Pearson Education, Second Edition, 2014.
2. Andreas F. Molisch, “Wireless Communications”, John Wiley India Pvt. Ltd., 2006.

REFERENCES:

1. David Tse and Pramod Viswanath, “Fundamentals of Wireless Communication”, Cambridge University Press, 2005.
2. Upena Dalal, “Wireless Communication”, Oxford University Press, 2009.
3. R.Van Nee and Ramji Prasad, “OFDM for wireless multimedia communications”, Artech House, 2000.
4. Aditya K. Jegannatham, “Principles of Modern Wireless Communication Systems”, Tata McGraw Hill, 2016.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Wireless Communication		**Course Code :** 20EC702			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C402.1	Apply the cellular concept to determine frequency reuse, co-channel interference	1	K3	1,2,3,8,10	2
C402.2	Derive the free space model and two ray model to characterize the wireless channels.	1	K3	1,2,3,8,10	2
C402.3	Determine the channel parameters for various fading channels.	2	K3	1,2,3,8,10	2
C402.4	Apply various signaling schemes for fading channels.	3	K3	1,2,3,8,10	2
C402.5	Apply equalization and diversity techniques to mitigate multipath fading.	4	K3	1,2,3,8,9, 10	2
C402.6	Apply MIMO systems with transmitter and receiver diversity for fading channels.	5	K3	1,2,3,8,9, 10	2

CO-PO Mapping

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C402.1	3	2	1					2		2				2	
C402.2	3	2	1					2		2				2	
C402.3	3	2	1					2		2				2	
C402.4	3	2	1					2		2				2	
C402.5	3	2	1					2	2	2				2	
C402.6	3	2	1					2	2	2				2	

20EC7L1	MICROWAVE AND OPTICAL LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- Understand the working principle of optical sources, detector, fibers and microwave components.
- Develop understanding of simple optical communication link.
- Learn about the characteristics and measurements in optical fiber.
- Know about the behavior of microwave components.
- Practice simulation of wireless experiments.

PRE-REQUISITE:

Course Code: 20EC5L1

Course Name: Communication systems laboratory

LIST OF MICROWAVE EXPERIMENTS:

1. Mode characteristics of Reflex klystron.
2. Characteristics of Gunn diode.
3. Measurement of VSWR, frequency, wavelength.
4. Directional Coupler Characteristics.
5. Radiation Pattern and Gain of Horn Antenna.
6. E plane Tee, H Plane Tee, Magic Tee characteristics.
7. Characteristics of isolator and circulator.

LIST OF OPTICAL EXPERIMENTS:

8. Fiber optic Analog link and its band width.
9. Fiber optic digital Link.
10. Measurement of Attenuation and bending losses.
11. Numerical Aperture determination for Fibers.
12. DC Characteristics of LED.

TOTAL: 60 PERIODS

Note: Microwave test bench comprises of Reflex klystron or Gunn diode with power supply, Gunn oscillator, PIN modulator, Isolator, Fixed and Variable Attenuator, frequency meter, Slotted line section, Wave guides, detector with mount, Termination, Movable short, Slide screw tuner, Horn antenna, Directional coupler and 20 MHz Digital / Analog Oscilloscope.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS: (3 STUDENTS PER EXPERIMENT)

S.NO	NAME OF THE EQUIPMENT REQUIRED	Quantity
1.	Trainer kit for Carrying out characteristics of Analog link and Digital link.	2 Nos
2.	Trainer kit for determining the Attenuation & Bending loss in Optical fiber.	2 Nos
3.	Trainer kit for determining the Numerical aperture.	2 Nos
4.	Trainer kit for carrying out LED and Pin diode Characteristics.	2 Nos
5.	Microwave source with power supply (Klystron, Gunn Oscillator).	5 Nos
6.	Microwave passive components Circulator, Isolator, Directional Coupler, Slotted line Section, Horn Antenna, Tees, Movable short, Fixed and Variable Attenuator.	2 Nos
7.	Pin Modulator, Matched Termination, Diode Detector with Mount, Frequency Meter.	5 Nos
8.	Function Generator (3 MHz).	8 Nos
9.	CRO/DSO (20 MHz).	8 Nos

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Microwave and Optical Laboratory		**Course Code :** 20EC7L1			
CO	**Course Outcomes**	**Experiment No.**	**K-CO**	**POs**	**PSOs**
C403.1	Demonstrate the characteristics of microwave generators.	1.2	K3	1,2,3,8,9, 10	2
C403.2	Determine VSWR, frequency, wavelength and radiation pattern.	3,4,5	K3	1,2,3,8,9, 10	2
C403.3	Experiment with microwave passive devices and obtain its characteristics.	6,7	K3	1,2,3,8,9, 10	2
C403.4	Illustrate the characteristics of analog and digital optical fiber link.	8,9	K3	1,2,3,8,9, 10	2
C403.5	Determine the losses and numerical aperture of the fiber.	10,11	K3	1,2,3,8,9, 10	2
C403.6	Determine the characteristics of LED.	12	K3	1,2,3,8,9, 10	2

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C403.1	3	2	1					2	2	1				2	
C403.2	3	2	1					2	2	1				2	
C403.3	3	2	1					2	2	1				2	
C403.4	3	2	1					2	2	1				2	
C403.5	3	2	1					2	2	1				2	
C403.6	3	2	1					2	2	1				2	

20EC8L1 **PROJECT WORK** **L T P C**
0 0 20 10

OBJECTIVES:

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
- To train the students in preparing project reports and to face reviews and viva voce examination.
- The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor.
- The progress of the project is evaluated based on a minimum of three reviews.
- The review committee may be constituted by the Head of the Department.
- A project report is required at the end of the semester.
- The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

PRE-REQUISITE: Course Code: All core courses & Laboratories

TOTAL: 300 PERIODS

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: Project Work		**Course Code:** 20EC8L1			
CO	**Course Outcomes**	**Exp**	**K-CO**	**POs**	**PSOs**
C404.1	Identify and apply the real world and societal importance problems in the Electronics and Communication Engineering and its allied area.	---	K4	1 to 12	1,2,3
C404.2	Identify, analyze, design, implement and handle prototype projects with a complete and organized solution methodologies.	---	K4	1 to 12	1,2,3
C404.3	Apply modern engineering tools for solution.	---	K4	1 to 12	1,2,3
C404.4	Contribute as an individual or in a team in development of technical projects.	---	K4	1 to 12	1,2,3
C404.5	Develop effective communication skills for presentation of project related activities.	---	K4	1 to 12	1,2,3
C404.6	Prepare reports and examination following professional ethics.	---	K4	1 to 12	1,2,3

CO-PO Mapping

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C404.1	3	3	2	1	1	2	1	2	3	3	3	1	2	2	3
C404.2	3	3	2	1	1	2	1	2	3	3	3	1	2	2	3
C404.3	3	3	2	1	1	2	1	2	3	3	3	1	2	2	3
C404.4	3	3	2	1	1	2	1	2	3	3	3	1	2	2	3
C404.5	3	3	2	1	1	2	1	2	3	3	3	1	2	2	3
C404.6	3	3	2	1	1	2	1	2	3	3	3	1	2	2	3

20ECV11	CAD for VLSI CIRCUITS	L	T	P	C
		2	0	2	3

OBJECTIVE:

- To study various physical design methods in VLSI.
- To understand the concepts behind the VLSI design rules and routing techniques.
- To use the simulation techniques at various levels in VLSI design flow.
- To understand the concepts of various algorithms used for floor planning and routing techniques.

PRE-REQUISITE:

Course Code: 20CS303, 20EC505
Course Name: Object Oriented Programming and Data Structures,
Digital VLSI Design and FPGA Implementation

UNIT - I VLSI DESIGN METHODOLOGIES 6

Introduction to VLSI Design methodologies - Review of Data structures and algorithms - Review of VLSI Design automation tools - Algorithmic Graph Theory and Computational Complexity.

LAB COMPONENT

1. Demonstration of Cadence tools' digital design flow
2. Simulation and synthesis of multiplier circuits. **6**

UNIT - II DESIGN RULES AND FLOOR PLANNING 6

Design rules - algorithms for constraint - graph compaction - placement and partitioning – Placement algorithms - partitioning algorithms - Floorplanning concepts - shape functions and floorplan sizing.

LAB COMPONENT

3. Create the floorplan and power plan for the multiplier circuits. **6**

UNIT - III SIMULATION AND SYNTHESIS IN CAD 6

Classification of pin assignment problems - Types of local routing problems - Area routing - channel routing - global routing - algorithms for global routing.

LAB COMPONENT

4. Create the global and local routing plan for the multiplier circuits. **6**

UNIT - IV PHYSICAL DESIGN IMPLEMENTATION 6

Placement & Placement Optimizations - CTS & CTS Optimizations - Routing & Routing Optimizations - Physical Verification (DRC, LVS, ERC) - DFM Checks - Formal Verification (LEC) - Parasitic Extraction (RC Extraction).

LAB COMPONENT

5. Create the clock tree synthesis for the multiplier circuits.
6. Physical verification for the designed multiplier circuits. **6**

UNIT - V DESIGN ANALYSIS 6

Timing Analysis: Dynamic vs. Static Timing Analysis, Static Timing Analysis (STA) - Congestion Analysis - Power Analysis: Dynamic Power Analysis, Static Power Analysis - IR Drop Analysis: Dynamic IR Drop Analysis, Static IR Drop Analysis.

LAB COMPONENT

7. Parasitic Extraction and Static timing analysis of the designed multiplier circuits. **6**

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Andrew B. Kahng, Jens Lienig, Igor L. Markov and Jin Hu, “VLSI Physical Design: From Graph Partitioning to Timing Closure”, Springer Science, 2011.
2. Niranjan N. Chiplunkar and Manjunath Kotari, “VLSI CAD”, Prentice Hall of India, 2011.

REFERENCES:

1) Wolfgang Fichtner and Martin Morf, “VLSI CAD Tools and Applications”, Springer, 2011.
2) S.H.Gerez, "Algorithms for VLSI Design Automation", John Wiley & Sons, 2002.
3) N.A.Sherwani, "Algorithms for VLSI Physical Design Automation", Kluwer Academic Publishers, 2002.
4) Sadiq M. Sait and Habib Youssef, “VLSI Physical Design automation: Theory and Practice”, World scientific 1999.
5) Steven M. Rubin, “Computer Aids for VLSI Design”, Addison Wesley Publishing 1987.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : CAD for VLSI Circuits		**Course Code : 20ECV11**			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C319.1	Illustrate the fundamental design methodologies of VLSI circuits.	1	K3	1,2,3,8,9	3
C319.2	Summarize the various standard VLSI design automation rules and tools.	2	K3	1,2,3,8,9	3
C319.3	Discuss the concepts floor planning, pin assignment and routing algorithms.	3	K2	1,2,8,9	3
C319.4	Apply the CAD techniques to solve the given circuit design.	3	K3	1,2,3,8,9	3
C319.5	Summarize the logics involved in simulation, synthesis and verification of digital circuits.	4	K3	1,2,3,8,9	3
C319.6	Illustrate the logic synthesis and verification techniques.	5	K3	1,2,3,8,9	3

CO-PO Mapping

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C319.1	3	2	1					2	2						2
C319.2	3	2	1					2	2						2
C319.3	2	1						2	2						1
C319.4	3	2	1					2	2						2
C319.5	3	2	1					2	2						2
C319.6	3	2	1					2	2						2

20ECV12	DIGITAL COMMUNICATION RECEIVERS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basic principles of digital communication techniques.
- To gain knowledge about receivers for AWGN channel and Fading channels.
- To understand the concepts of synchronization and adaptive equalization techniques.

PRE-REQUISITE:

Course Code: 20EC510
Course Name: Analog and Digital Communication Techniques

UNIT - I REVIEW OF DIGITAL COMMUNICATION TECHNIQUES 9

Digital communication system - communication channels and their characteristics - Mathematical model for communication channel.

UNIT - II SIGNAL SPACE REPRESENTATION 9

Representation of Band Pass Signals - Representation of Linear Band-Pass Systems - Response of a Band-Pass System to Band-Pass Signal - Vector Space Concepts - Signal Space Concepts - Orthogonal Expansions of Signals - Memoryless Modulation Methods - Linear Modulation with Memory.

UNIT - III OPTIMUM RECEIVERS FOR AWGN CHANNEL 9

Correlation Demodulator - Matched Filter Demodulator - The Optimum Detector - The Maximum-Likelihood Sequence Detector - A Symbol-by-Symbol MAP Detector for Signal with Memory.

UNIT - IV RECEIVERS FOR FADING CHANNELS 9

Optimum Receiver for Binary Signals - Optimum Receiver for M-ary Orthogonal - Probability of Error for Envelope Detection of M-ary Orthogonal Signals.

UNIT - V CHARACTERIZATION OF BAND LIMITED CHANNEL 9

Characterization of Band-Limited Channels - Signal Design for Band-Limited Channels - Optimum Receiver for Channels with ISI and AWGN - Optimum Maximum-Likelihood Receiver - A Discrete-Time Model for a Channel with ISI - The Viterbi Algorithm for the Discrete-Time White Noise Filter Model - Performance of MLSE for Channels with ISI.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Heinrich Meyer, Mare Moeneclacy and Stefan A. Fechtel, “Digital Communication Receivers: Synchronization, Channel Estimation, and Signal Processing”, John Wiley, New York, 2001.
2. U.Mengali and A.N.D.Andrea, “Synchronization Techniques for Digital Receivers”, Kluwer, 1997.

REFERENCES:

1. John G. Proakis, “Digital communication”, 4th Edition, McGraw-Hill, New York, 2001.
2. E.A.Lee and D.G.Messerschmitt, “Digital communication”, 2nd Edition, Allied Publishers, New Delhi, 1994.
3. Simon Marvin, “Digital communication over fading channel: An unified approach to performance Analysis”, John Wiley, New York, 2000.
4. H.Meyr and G.Ascheid, “Synchronization in Digital Communications”, John Wiley, 1990.
5. R.G.Gallager, “Principles of Digital Communication”, Cambridge University Press, 2008.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Digital Communication Receivers		**Course Code : 20ECV12**			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C320.1	Derive the communication model.	1	K2	1,2,8,9	2
C320.2	Compute the vector space diagram for the given modulation systems.	2	K3	1,2,3,5,8,9	2
C320.3	Explain the correlation receiver and matched filter concepts.	3	K2	1,2,8,9	2
C320.4	Explain ML and MAP detectors.	3	K2	1,2,8,9	2
C320.5	Compute the Probability error for the given modulation systems.	4	K3	1,2,3,8,9	3
C320.6	Explain the performance measure of band limited channel.	5	K2	1,2,8,9	3

CO-PO Mapping

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C320.1	2	1						2	2					2	
C320.2	3	2	1					2	2					2	
C320.3	2	1						2	2					2	
C320.4	2	1						2	2					2	
C320.5	3	2	1					2	2					3	
C320.6	2	1						2	2					3	

20ECV13	SPEECH PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To acquire the fundamentals of the digital signal processing that allows them to assimilate the concepts related to the speech processing.
- To present basic principles of speech analysis.
- To give an overview of speech processing applications including speech enhancement, speech recognition and speaker recognition.
- To give fundamentals of Pattern recognition and application of ANN.

PRE-REQUISITE:

Course Code: 20EC405

Course Name: Principles of Digital Signal Processing

UNIT - I FUNDAMENTALS OF SPEECH PROCESSING 9

Introduction to speech processing – Speech communications – anatomy and physiology of the speech production system – Phonemics and Phonetics – Acoustic theory of speech production – Discrete time modeling Single lossless tube analysis – two tube lossless model of the vocal tract – Fast Discrete time transfer function calculation.

UNIT - II SPEECH ANALYSIS TECHNIQUES 9

Short term processing of speech - Short term measures from long term concepts – Examples of short term features and applications.

Long- term LP analysis by system identification – Short – term LP analysis – Ideal, almost ideal and Non-ideal cases – Alternative representations of the LP coefficients – Applications of LP in Speech analysis.

Cepstral analysis: real cepstrum and complex cepstrum – Critical analysis of the cepstrum.

UNIT - III SPEECH CODING, ENHANCEMENT AND QUALITY ASSESSMENT 9

Speech Coding and Synthesis: Optimum scalar and vector quantization – Waveform coding – Vocoders – Measuring of quality of speech compression.

Speech Enhancement: Classification of Speech Enhancement methods – Short – term spectral amplitude techniques – Speech modeling and wiener filtering – Adaptive noise canceling – systems based on fundamental frequency tracking – performance evaluation.

Speech quality assessment: subjective and objective quality measures.

UNIT - IV SPEECH RECOGNITION AND HIDDEN MARKOV MODELS 9

Dimensions of difficulty in recognition – speaker recognition and verification – Dynamic time warping: dynamic programming (DTW) – DTW applied to isolated word recognition (IWR) – DTW applied to continuous speech recognition (CSR).

Hidden Markov Models: Theoretical developments – practical Issues – IWR without syntax – CSR by the connected-word strategy without syntax – language modeling using HMM.

UNIT - V PATTERN CLASSIFICATION AND ANN 9

Feature extraction – classification methods – support vector machines – unsupervised clustering – Class related probability functions – minimum error classifications – likelihood based MAP classification – Bayes classifier – statistically based linear discriminants – iterative training: EM algorithm.

Network principles and paradigms - Applications of ANNs in speech recognition.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Ben Gold Nelson Morgan and Dan Ellis, “Speech and Audio signal processing”, John Wiley & Sons Inc., Second Edition, 2011.
2. Joh R. Deller, John H.L. Hanse and John G. Proakis, “Discrete Time processing of speech signals”, John Wiley & Sons, Inc., 2000.

REFERENCES:

1. Lawrence Rabiner and Biing – Hwang Juang, “Fundamentals of speech recognition”, Pearson Education, 2003.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : SPEECH PROCESSING		**Course Code :** 20ECV13			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C321.1	Explain the fundamental concept of speech processing.	1	K2	1,2,8,10	2
C321.2	Describe the analysis techniques of speech signal with its applications.	2	K2	1,2,8,10	2
C321.3	Illustrate the coding and enhancement of speech signal with its quality assessment.	3	K3	1,2,3,8,10	2
C321.4	Explain the speech recognition and hidden Markov models.	4	K2	1,2,8,9,10	2
C321.5	Explain the fundamental concept of speech processing.	5	K2	1,2,8,10	2
C321.6	Explain the applications of ANN using speech processing.	5	K2	1,2,8,9,10	2

CO-PO Mapping

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C321.1	2	1						2		2				1	
C321.2	2	1						2		2				1	
C321.3	3	2	1					2		2				2	
C321.4	2	1						2	2	2				1	
C321.5	2	1						2		2				1	
C321.6	2	1						2	2	2				1	

20ECV14	MACHINE LEARNING AND APPLICATIONS	L	T	P	C
		2	0	2	3

OBJECTIVES:

- To understand the need for machine learning for various problem solving.
- To study the various supervised, semi-supervised and unsupervised learning algorithms in machine learning.
- To understand the latest trends in machine learning.
- To design appropriate machine learning algorithms for problem solving.

PRE-REQUISITE: NIL

UNIT - I SUPERVISED LEARNING: REGRESSION **6**

Paradigms of Machine Learning - examples - Types of Learning - Types of supervised learning - Introduction to Regression - Linear regression - Geometrical Interpretation - Iterative solution: Gradient descent - Performance metrics of machine learning.

LAB COMPONENT

1. Installing Anaconda - Jupiter Notebook - Learn Python ML Packages.
2. Implement data loading methods - understanding data with statistics, visualization - Data Preprocessing - Data Labeling. **6**

UNIT - II SUPERVISED LEARNING: CLASSIFICATION **6**

K-Nearest Neighbour Classification - Distance metric and Cross-Validation - Computational efficiency of KNN - Introduction to Decision Trees - Entropy and Information Gain - Naive Bayes classifier - Perceptron and its learning algorithm.

LAB COMPONENT

3. Logistic Regression Implementation: Implement the standard Logistic Regression model generally used for classifying data into binary classes such as pass/fail, win/lose, alive/dead or healthy/sick.
4. Decision Tree Implementation: Implement the standard Decision Tree Class used for classifying data into various classes using a tree-like model of decisions and their possible consequences. **6**

UNIT - III UNSUPERVISED LEARNING **6**

K-means Clustering – Llyod's Algorithms - Convergence and Initialization - Covariance Matrix and Eigen direction.

LAB COMPONENT

5. Tumor Prediction: Detect Brain tumor images from the given data set.
6. Heart disease Prediction- Detect heart blockage images from the given data set. **6**

UNIT - IV RECOMMENDER SYSTEMS **6**

Recommender Systems - Introduction - Non-Personalized Recommender Systems - Content-Based Recommender Systems - Recommender System Evaluation.

LAB COMPONENT

7. Movie/Book/Any Product recommendation by using content-based filtering. **6**

UNIT - V OPTIMIZATION FOR WIRELESS COMMUNICATION **6**

Introduction to Applied Optimization - Least Squares problem - Geometric Intuition for Least Squares - Multi Antenna Channel Estimation - Image Deblurring - Regularization - Spectrum sensing - Linear classification.

LAB COMPONENT

8. Spectrum sensing by using linear classification. **6**

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Marc Peter Deisenroth, A. Aldo Faisal and Cheng Soon Ong, “Mathematics for Machine Learning”, Cambridge University Press, 2020.
2. Gopal sakarkar, gaurav patil and prateek dutta, “Machine Learning Algorithms using Python Programming”, Nova Science Publishers, New York, 2021.

REFERENCES:

1. Tom M. Mitchell, “Machine Learning”, McGraw-Hill Education (India) Private Limited, 2013.
2. Stephen Marsland, “Machine Learning: An Algorithmic Perspective”, CRC Press, 2009.
3. Mehryar Mohri, Afshin Rostamizadeh and Ameet Talwalkar, “Foundations of Machine Learning”, MIT Press, 2012.
4. Ethem Alpaydin, “Introduction to Machine Learning (Adaptive Computation and Machine Learning)”, The MIT Press, 2004.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : MACHINE LEARNING AND APPLICATIONS		**Course Code :** 20ECV14			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C322.1	Identify the category of the learning problem, and measure it’s performance like recall, precision etc.	1	K3	1,2,3,5,8,9, 10	2
C322.2	Apply the classification algorithms like K-NN, Decision Tree, Naive Bayes, Logistic Regression to classify the dataset.	2	K3	1,2,3,5,8,9, 10	2
C322.3	Apply unsupervised algorithms namely K-means and PCA to cluster the given dataset.	3	K3	1,2,3,5,8,9, 10	2
C322.4	Apply Content-based recommender systems and Collaborative Filtering to implement recommender systems.	4	K3	1,2,3,5,6,8,9, 10,11,12	2
C322.5	Identify and analyze the problem and apply machine learning techniques to solve real world applications.	5	K4	1,2,3,4,5,6,8, 9,10,11,12	2
C322.6	Formulate a classification model using suitable machine learning techniques.	5	K4	1,2,3,4,5,6,8, 9,10,11,12	2

CO-PO Mapping

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C322.1	3	2	1		3			2	2	2				2	
C322.2	3	2	1		3			2	2	2				2	
C322.3	3	2	1		3			2	2	2				2	
C322.4	3	2	1		3	3		2	2	2	2	2		2	
C322.5	3	3	2	1	3	3		2	2	2	2	2		3	
C322.6	3	3	2	1	3	3		2	2	2	2	2		3	

20ECV15	IOT ENABLED SYSTEM DESIGN	L	T	P	C
		2	0	2	3

OBJECTIVE:

- To appraise students with basic knowledge of IoT that paves a platform to understand physical and logical design of IOT.
- To teach a student how to analyse requirements of various communication models and protocols for cost-effective design of IoT applications on different IoT platforms.
- To introduce the technologies behind Internet of Things (IoT).
- To explain the students how to code for an IoT application using Raspberry Pi open platform.
- To understand the various applications in IoT.

PRE-REQUISITE:

Course Code: 20EC511
Course Name: Microprocessor and Microcontroller based systems

UNIT - I INTRODUCTION TO INTERNET OF THINGS 6

Evolution of Internet of Things – Enabling Technologies – IoT Architectures: oneM2M, IoT World Forum (IoTWF) and Alternative IoT Models – Simplified IoT Architecture and Core IoT Functional Stack – Fog, Edge and Cloud in IoT.

LAB COMPONENT

1. Study of different operating systems and installation for Raspberry Pi. **6**

UNIT - II COMMUNICATION TECHNOLOGIES OF IoT 6

Functional Blocks of an IoT Ecosystem – Sensors, Actuators, and Smart Objects – Communication modules (Bluetooth, Zigbee, Wi-Fi, GPS, GSM Modules)

LAB COMPONENT

2. Interface various sensors and communication modules with Raspberry Pi. **6**

UNIT - III PROTOCOLS AND TECHNOLOGIES BEHIND IoT 6

IoT Protocols - IPv6, 6LoWPAN, MQTT, CoAP - RFID, Wireless Sensor Networks, Big Data Analytics, Cloud Computing.

LAB COMPONENT

3. Develop a server application by using suitable IoT protocol **6**

UNIT - IV OPEN PLATFORMS AND PROGRAMMING 6

IOT deployment for Raspberry Pi platform - Architecture - Programming - Interfacing - Accessing GPIO Pins - Sending and Receiving Signals Using GPIO Pins - Connecting to the Cloud.

LAB COMPONENT

4. Interface the Raspberry Pi with cloud to trans-receive data from sensors and actuators. **6**

UNIT - V APPLICATIONS AND CASE STUDIES 6

Business models for the internet of things - Smart city - Smart mobility and transport - Industrial IoT - Smart health - Environment monitoring and surveillance - Home Automation - Smart Agriculture.

LAB COMPONENT

5. Design business model and deploy Home Automation using Raspberry Pi **6**

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", CISCO Press, 2017.
2. Samuel Greengard, The Internet of Things, The MIT Press, 2015.

REFERENCES:

1. Perry Lea, "Internet of things for architects", Packt, 2018.
2. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things – Key applications and Protocols", Wiley, 2012.
3. Arshdeep Bahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 2015.
4. Peter Waher, "Mastering Internet of Things: Design and create your own IoT applications using Raspberry Pi 3", First Edition, Packt Publishing, 2018.
5. John C. Shovic, "Raspberry Pi IoT Projects: Prototyping Experiments for Makers", Packt Publishing, 2016.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : IoT Enabled System Design		**Course Code : 20ECV15**			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C324.1	Explain IoT architecture, fog, edge and cloud computing.	1	K2	1,2,8,10	3
C324.2	Build an IoT ecosystem that interfaces with various hardwares and wireless communication modules.	2	K3	1,2,3,5,8,9,10	3
C324.3	Make use of data analytics and cloud computing to develop an application with suitable IoT protocol.	3	K3	1,2,3,5,8,9,10	3
C324.4	Demonstrate the use of GPIO pins to interface raspberry pi with cloud.	4	K3	1,2,3,5,8,9,10	3
C324.5	Discuss different business models for IoT.	5	K2	1,2,8,10	3
C324.6	Identify any societal problem and solve by applying acquired knowledge of IoT enabled system design.	5	K3	1,2,3,5,6,7,8,9,10	3

CO-PO Mapping

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C324.1	2	1						2	-	2					1
C324.2	3	2	1		2			2	2	2					2
C324.3	3	2	1		2			2	2	2					2
C324.4	3	2	1		2			2	2	2					2
C324.5	2	1						2	-	2					1
C324.6	3	2	1		2	1	1	2	2	2					2

20ECV16	FOUNDATIONS FOR NANO ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues.
- To introduce quantum mechanics concepts, approximations and statistical mechanics for understanding nano systems.

PRE-REQUISITE: NIL

UNIT - I INTRODUCTION TO QUANTUM MECHANICS 9

Particles – waves – probability amplitudes – Schrodinger equation – wave packets solutions – operators – expectation values – eigen functions – piecewise constant potentials.

UNIT - II SIMPLE HARMONIC OSCILLATORS AND APPROXIMATIONS 9

SHM Operators – SHM wave packet solutions – Quantum LC circuit – WKB approximations – variational methods.

UNIT - III SYSTEMS WITH TWO AND MANY DEGREES OF FREEDOM 9

Two level systems with static and dynamic coupling – problems in more than one dimensions – electromagnetic field quantization – density of states.

UNIT - IV STATISTICAL MECHANICS 9

Basic concepts – microscopic – quantum systems in equilibrium – statistical models applied to metals and semiconductors.

UNIT - V APPLICATIONS 9

Hydrogen and Helium atoms – electronic states – Atomic force microscope – Nuclear Magnetic Resonance – Carbon nanotube properties and applications.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Rainer Waser, “Nanoelectronics and Information Technology”, Wiley, Third Edition, 2012.
2. Hagelstein L. Peter, Stephen D. Senturia and Terry P. Orlando, “Introduction to Applied Quantum and Statistical Physics”, Wiley, New York, 2004.

REFERENCES:

1. Michael A. Nielsen and Isaac L. Chuang, “Quantum Computation and Quantum Information”, Cambridge University Press, 2000.
2. Neil Gershenfeld, “The Physics of Information Technology”, Cambridge University Press, 2000.
3. Adrian Ionesu and Kaustav Banerjee, “Emerging Nanoelectronics Life with and after CMOS”, Vol I, II, and III, Kluwer Academic, 2005.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Foundations For Nano Engineering		**Course Code : 20ECV16**			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C325.1	Apply mathematical tools to solve the problems of quantum mechanics.	1	K3	1,2,3,8,10	1
C325.2	Comprehend the significance of simple harmonic oscillators.	2	K2	1,2,8,10	1
C325.3	Apply the fundamentals of quantum mechanics to solve the one or two dimensional problems.	3	K3	1,2,3,8,10	1
C325.4	Explain the fundamentals of statistical mechanics.	4	K2	1,2,8,10	1
C325.5	Apply the fundamental knowledge of statistical mechanics to develop statistical models in metals and semiconductors.	4	K3	1,2,3,8,10	1
C325.6	Explain the application of Nano Electronics in the area of Helium & Hydrogen atoms, atomic force microscope, Nuclear magnetic resonance and Carbon nano tube.	5	K2	1,2,8,9,10	1

CO-PO Mapping

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C325.1	3	2	1					2		2			2		
C325.2	2	1						2		2			2		
C325.3	3	2	1					2		2			2		
C325.4	2	1						2		2			2		
C325.5	3	2	1					2		2			2		
C325.6	2	1						2	2	2			2		

20ECV21	MULTICORE PROGRAMMING	L	T	P	C
		2	0	2	3

OBJECTIVES:

- To understand the need for multi-core processors, and their architecture.
- To understand the challenges in parallel and multi-threaded programming.
- To learn about the various parallel programming paradigms.
- To develop multicore programs and design parallel solutions.

PRE-REQUISITE:

Course Code: 20EC402, 20EC511, 20EC505

Course Name: Computer Architecture and Organization, Microprocessor and Microcontroller based systems, Digital VLSI Design and FPGA Implementation

UNIT - I MULTI-CORE PROCESSORS **6**

Single core to multi-core architectures – SIMD and MIMD systems – Interconnection networks – Symmetric and Distributed Shared Memory Architectures – Cache coherence – Performance Issues – Parallel program design.

LAB COMPONENT

1. Controlling the Number of Threads on Multiple Nesting Levels. **6**

UNIT - II PARALLEL PROGRAM CHALLENGES **6**

Performance – Scalability – Synchronization and data sharing – Data races – Synchronization primitives (mutexes, locks, semaphores, barriers) – deadlocks and livelocks – communication between threads (condition variables, signals, message queues and pipes).

LAB COMPONENT

2. Create a program that computes a simple matrix vector multiplication b=Ax, in C/C++. Use OpenMP directives to make it run in parallel. **6**

UNIT - III SHARED MEMORY PROGRAMMING WITH OPENMP **6**

OpenMP Execution Model – Memory Model – OpenMP Directives – Work-sharing Constructs – Library functions – Handling Data and Functional Parallelism – Handling Loops – Performance Considerations.

LAB COMPONENT

3. Create a program that computes the sum of all the elements in an array A in C/C. Use OpenMP directives to make it run in parallel. **6**

UNIT - IV DISTRIBUTED MEMORY PROGRAMMING WITH MPI **6**

MPI program execution – MPI constructs – libraries – MPI send and receive – Point-to-point and Collective communication – MPI derived datatypes – Performance evaluation.

LAB COMPONENT

4. Implement a parallel version of the Jacobi algorithm using OpenMP. **6**

UNIT - V PARALLEL PROGRAM DEVELOPMENT **6**

Case studies: n-Body solvers – Tree Search – OpenMP and MPI implementations and comparison.

LAB COMPONENT **6**

Create a program that computes the adjusted prefix sum below for 4 different arrays and after that adds all of them up. Use OpenMP directives to make it run in parallel.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Thomas Rauber and Gudula Rünger, "Parallel Programming", Springer Berlin, Heidelberg, 2013.
2. Darryl Gove, "Multicore Application Programming for Windows, Linux, and Oracle Solaris", Pearson, 2011.

REFERENCES:

1. Michael Quinn, "Parallel programming in C with MPI and OpenMP", McGraw-Hill Education, 2003.
2. Victor Alessandrini, "Shared Memory Application Programming: Concepts and Strategies in Multicore Application Programming", Morgan Kaufmann, First Edition, 2015.
3. Yan Solihin, "Fundamentals of Parallel Multicore Architecture", Chapman and Hall/CRC, First Edition, 2015.
4. Peter S. Pacheco, "An Introduction to Parallel Programming", Morgan-Kauffman/Elsevier, 2011.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Multicore Programming		**Course Code :** 20ECV21			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C326.1	Describe multicore architectures and identify their characteristics and challenges.	1	K2	1,2,8,10	3
C326.2	Compare and contrast programming for serial processors and programming for parallel processors.	1	K2	1,2,8,9,10	3
C326.3	Determine the issues in programming Parallel Processors.	2	K3	1,2,3,8,10	3
C326.4	Develop the programs using OpenMP.	3	K3	1,2,3,8,10	3
C326.5	Develop the programs for data-level parallelism and thread-level parallelism.	4	K3	1,2,3,8,10	3
C326.6	Design the parallel programming solutions to common problems.	5	K3	1,2,3,8,10	3

CO-PO Mapping

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C326.1	2	1						2		2					1
C326.2	2	1						2	2	2					1
C326.3	3	2	1					2		2					2
C326.4	3	2	1					2		2					2
C326.5	3	2	1					2		2					2
C326.6	3	2	1					2		2					2

20ECV22	SATELLITE COMMUNICATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basics of satellite orbits.
- To analyze the geo stationary and non geo-stationary orbits.
- To acquire the knowledge about launching procedures.
- To study satellite system engineering, orbital mechanism, orbital effects on communication etc.
- To study and analysis of multiplexing and multiple access techniques.
- To study and analysis of earth station antenna and equipment.

PRE-REQUISITE: NIL

UNIT - I SATELLITE ORBITS 9

Kepler's Laws - Newton's law - orbital parameters - orbital perturbations - station keeping - geo stationary and non geo-stationary orbits - Look Angle Determination- Limits of visibility - eclipse- Sub satellite point - Sun transit outage-Launching Procedures - launch vehicles and propulsion.

UNIT - II SPACE SEGMENT 9

Spacecraft Technology: Structure, Primary power, Attitude and Orbit control - Thermal control and Propulsion - communication Payload and supporting subsystems - Telemetry - Tracking and command-Transponders-The Antenna Subsystem.

UNIT - III SATELLITE LINK DESIGN 9

Basic link analysis - Link budget calculations -Uplink and Downlink of a satellite link - Atmospheric Losses-Interference analysis - Rain induced attenuation and interference - Ionospheric characteristics -Ionospheric Effects - Link Design with and without frequency reuse.

UNIT - IV SATELLITE ACCESS AND CODING METHODS 9

Modulation and Multiplexing: Voice, Data, Video - Analog and digital transmission system - Digital video Broadcast. Multiple accesses: FDMA, TDMA, CDMA, DAMA Assignment Methods - compression - encryption - Coding Schemes.

UNIT - V SATELLITE APPLICATIONS 9

INTELSAT Series - INSAT - VSAT - Mobile satellite services: GSM, GPS, INMARSAT, LEO, MEO, Satellite Navigational System. GPS Position Location Principles - Differential GPS - Direct Broadcast satellites (DBS/DTH) -Indian Regional Navigation Satellite System (IRNSS).

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Louis J. Ippolito Jr., "Satellite Communications Systems Engineering: Atmospheric Effects, Satellite Link Design and System Performance", Wiley, Second Edition, 2017.
2. Gerard Maral, Michel Bousquet and Zhili Sun, "Satellite Communications Systems: Systems, Techniques and Technology", Wiley, Fifth Edition, 2010.

REFERENCES:

1. Wilbur L. Pritchard, Hendri G. Suyderhoud and Robert A. Nelson, "Satellite Communication Systems Engineering", Prentice Hall/Pearson, 2007.
2. Dennis Roddy, "Satellite Communication", Mc Graw Hill International, Fourth Edition, 2006.
3. Timothy Pratt, Charles W. Bostain and Jeremy E. Allnutt, "Satellite Communication", John Wiley & Sons, Second Edition, 2003.
4. M.Richharia, "Satellite Communication Systems: Design Principles", Mac Millan, 2003.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Satellite Communication		**Course Code :** 20ECV22			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C327.1	Describe the Extended and reusable satellite launching vehicles and launching procedures of satellite systems.	1	K3	1,2,3,8,10	2
C327.2	Explain about the satellite space segment with various satellite subsystems.	2	K2	1,2,8,10	2
C327.3	Derive the satellite Link design with uplink, downlink, rain effects and Ionospheric characteristics.	3	K3	1,2,3,8,10	2
C327.4	Apply accessing schemes such as TDMA, FDMA and CDMA for satellite communication.	4	K3	1,2,3	2
C327.5	Illustrate various satellite applications such as Intelsat series and Mobile satellite services.	5	K3	1,2,3,9,10	2
C327.6	Discuss about Satellite Navigational System - Direct Broadcast satellites (DBS/DTH), Indian Regional Navigation Satellite System (IRNSS).	5	K3	1,2,3,8,10	2

CO-PO Mapping

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C327.1	3	2	1					2		2				2	
C327.2	2	1						2		2				1	
C327.3	3	2	1					2		2				2	
C327.4	3	2	1											2	
C327.5	3	2	1						2	2				2	
C327.6	3	2	1					2		2				2	

20ECV23 ADVANCED DIGITAL SIGNAL PROCESSING

L	T	P	C
2	0	2	3

OBJECTIVES:

- To learn the concepts of stationary and non-stationary random signals and characterization of discrete time random process.
- To estimate power spectral density of random process.
- To derive adaptive filter algorithm.
- To analyze multi rate signal processing.

PRE-REQUISITE:

Course Code: 20EC405
Course Name: Principles of Digital Signal Processing

UNIT - I DISCRETE TIME RANDOM PROCESS **6**

Review of Random Variables: Definitions - Ensemble averages - Jointly distributed random variables - Joint moments - Independent, uncorrelated and orthogonal random variables. Review of Random Process: Definitions - Ensemble averages - Gaussian Processes - Stationary processes - Auto covariance and auto correlation matrices - ergodicity - white noise. Power spectrum. Filtering of random process - Spectral factorization.

LAB COMPONENT

1. Estimation of statistical parameters for a given random signal. **6**
2. Estimation of Auto correlation matrix, Power spectral density, and cross power spectral density using MATLAB.

UNIT - II SPECTRUM ESTIMATION – NON-PARAMETRIC METHODS **6**

Non parametric methods: The periodogram - performance of the periodogram - The modified periodogram - Bartlett's method - Welch's method - Blackman-Tukey approach - Performance comparisons.

LAB COMPONENT

3. Finding PSD using various Methods (periodogram, modified periodogram) using MATLAB. **6**

UNIT - III SPECTRUM ESTIMATION – PARAMETRIC METHODS **6**

Parametric methods: Auto regressive spectrum estimation - BURG method - moving average spectrum estimation - ARMA spectrum estimation. Frequency estimation: Eigen decomposition of the auto correlation matrix.

LAB COMPONENT

4. Finding PSD-BURG method for AR model using MATLAB. **6**
5. Estimation of frequency using Eigen decomposition.

UNIT - IV OPTIMUM LINEAR FILTERS **6**

Wiener filters for filtering and prediction: FIR Wiener filter - Orthogonality principle in Linear mean square estimation - IIR Wiener filter - Non causal wiener filter

LAB COMPONENT

6. Simulation of Weiner filtering FIR using MATLAB. **6**
7. Simulation of Weiner filtering IIR using MATLAB.

UNIT - V ADAPTIVE FILTERS **6**

Adaptive Direct Form FIR filter: Minimum Mean square error Criterion - LMS algorithm - Applications of adaptive filters: adaptive channel equalization - Adaptive noise cancelling.

LAB COMPONENT

8. Adaptive noise cancellation using MATLAB. **6**
9. Adaptive channel equalization of LMS adaptive filter using MATLAB.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Monson H. Hayes, “Statistical Digital signal Processing and Modeling”, Wiley, 2012.
2. John G. Proakis and Dimitris G. Manolakis, “Digital Signal Processing – Principles, Algorithms and Applications”, Pearson Education, Fourth Edition, 2016.

REFERENCES:

1. Vinay K. Ingle and John G. Proakis, “Digital signal Processing using MATLAB” Cengage Learning, Third Edition, 2012.
2. Simon Haykin, “Adaptive Filter Theory”, Pearson Education, Fifth Edition, 2014.
3. Emmanuel C. Ifeacher and Barrie W. Jervis, “DSP-A Practical approach”, Pearson Education, Second Edition, 2002.
4. Jian Wang and Barmak Honarvar Shakibaei Asli, “Advanced Digital Signal Processing**”,** Scitus Academics, 2019.
5. Dr. Shaila D Apte, “Advanced Digital Signal Processing”, Wiley, 2021.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Advanced Digital Signal Processing		**Course Code : 20ECV23**			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C328.1	Apply the fundamental concept of random process and random variable to derive the statistical parameters while filtering the random process.	1	K3	1,2,3,8,10	2
C328.2	Compute spectrum estimation using parametric	2	K3	1,2,3,8,10	2
C328.3	Compute spectrum estimation using non parametric methods.	3	K3	1,2,3,8,10	2
C328.4	Compute prediction error using Wiener filters	3	K3	1,2,3,8,10	2
C328.5	Explain the LMS algorithm for optimum linear filtering applications	4	K2	1,2,8,9,10	2
C328.6	Apply adaptive filter algorithms to compute the filter coefficients for the given applications	5	K4	1,2,3,8,10	2

CO-PO Mapping

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C328.1	3	2	1					2		2				2	
C328.2	3	2	1					2		2				2	
C328.3	3	2	1					2		2				2	
C328.4	3	2	1					2		2				2	
C328.5	2	1						2	2	2				2	
C328.6	3	2	1					2		2				2	

20ECV24 ARTIFICIAL INTELLIGENCE FOR EVERYONE

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the various characteristics of Intelligent agents.
- To study the different search strategies in AI.
- To learn techniques in solving AI problems.
- To understand the different ways of designing software agents.
- To learn the various applications of AI.

PRE-REQUISITE: NIL

UNIT - I INTRODUCTION **9**

Introduction to AI - Definition - Compare with human intelligence and traditional information processing - strengths and limitations - Future of AI - Characteristics of Intelligent Agents - Typical Intelligent Agents - Problem Solving Approach to Typical AI problems.

UNIT - II PROBLEM SOLVING METHODS **9**

Problem solving Methods - Search Strategies - Uninformed - Informed - Heuristics - Local Search Algorithms and Optimization Problems - Searching with Partial Observations - Constraint Satisfaction Problems - Constraint Propagation - Backtracking Search - Game Playing - Optimal Decisions in Games - Alpha - Beta Pruning - Stochastic Games.

UNIT - III KNOWLEDGE REPRESENTATION **9**

First Order Predicate Logic - Prolog Programming - Unification - Forward Chaining-Backward Chaining - Resolution - Knowledge Representation - Ontological Engineering - Categories and Objects - Events - Mental Events and Mental Objects - Reasoning Systems for Categories - Reasoning with Default Information.

UNIT - IV BUILDING AI PROJECTS **9**

Workflow of a machine learning project - Workflow of a data science project - how to use data - Technical tools for AI - Case study: Smart speaker, Self-driving car, AI Transformation Playbook, Population Scale Healthcare.

UNIT - V ARTIFICIAL INTELLIGENCE ON THE CLOUD **9**

Cloud migration - Cloud providers - Conversational agents - Natural language processing - Image and video processing - Translation - Machine learning platform -Transcription - Document analysis.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. S.Russell and P.Norvig, “Artificial Intelligence: A Modern Approach”, Pearson Publishers, Fourth Edition, 2021.
2. Alberto Artasanchez and Prateek Joshi, “Artificial Intelligence with Python”, Packt Publishing, Second Edition, 2020.

REFERENCES:

1. Ivan Bratko, “Prolog Programming for Artificial Intelligence”, Addison-Wesley, Fourth Edition, 2011.
2. M.Tim Jones, “Artificial Intelligence: A Systems Approach”, Jones & Bartlett Learning, First Edition, 2009.
3. Nils J. Nilsson, “The Quest for Artificial Intelligence: A History of Ideas and Achievements”, Cambridge University Press, 2009.
4. Zoltán Somogyi, “The Application of Artificial Intelligence”, Springer Nature, 2021.
5. S.Kanimozhi Suguna, M.Dhivya and Sara Paiva, “Artificial Intelligence (AI): Recent Trends and Applications”, CRC Press, 2021.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Artificial Intelligence for Everyone		**Course Code :20ECV24**			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C329.1	Explain AI concepts and the characteristics and applications of intelligent agents.	1	K2	1,2,8,9,10	2
C329.2	Apply search strategies to solve AI problems.	2	K3	1,2,3,8,9, 10	2
C329.3	Apply knowledge representation techniques to categorize and reason with objects.	3	K3	1,2,3,8,9, 10	2
C329.4	Explain the workflow of machine learning projects and the use of data and tools in AI case studies.	4	K2	1,2,8,9,10	2
C329.5	Describe the process of cloud migration and the role of cloud providers in AI.	5	K2	1,2,8,9,10	2
C329.6	Explain how AI technologies like natural language processing and machine learning platforms are integrated into cloud environments.	5	K2	1,2,8,9,10	2

CO-PO Mapping

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C329.1	2	1						2	2	2				2	
C329.2	3	2	1					2	2	2				2	
C329.3	3	2	1					2	2	2				2	
C329.4	2	1						2	2	2				2	
C329.5	2	1						2	2	2				2	
C329.6	2	1						2	2	2				2	

20ECV25	MIXED C AND ASSEMBLY LANGUAGE PROGRAMMING	L	T	P	C
		2	0	2	3

OBJECTIVE:

- To understand link between the Microprocessors and C programming
- To realize how a C program is translated into assembly language and how it eventually gets executed on a microprocessor
- To research what happens in the stack, data and code segment, of the microprocessor when a C program is executed
- To describe how to write a mixture of C, C++, and assembly language code for the ARM architecture.

PRE-REQUISITE:

Course Code: 20CS304, 20EC511
Course Name: Object Oriented Programming and Data Structures, Microprocessor and Microcontroller based systems

UNIT - I OVERVIEW OF MICROPROCESSOR PROGRAMMING (8086) 6

Overview of Microprocessors and Assembly language Programming - Microprocessor Architecture - Machine Language - Execution Sequence in a Microprocessor - Memory in a Microprocessor - Instruction Set - Addressing Schemes - Flags - Registers - Stacks.

LAB COMPONENT

1. Write a program for instructions call and ret hardware loops. **6**

UNIT - II C PROGRAMMING 6

Overview of C - Inline Assembly Data types and their sizes - String length - Multiplication using repeated addition - Swap two variables in C - Swap two variables in inline Assembly Function - Swap two variable in C Inline code - swap the two variables using a function.

LAB COMPONENT

2. Write the simple example programs for inline assembly ALU operations. **6**

UNIT - III COMPILATION OF C, C++ AND ASSEMBLY 6

Compiling C to Assembly Language - Compiling a simple program to Assembly - First order Passing parameters - Prologue Epilogue Local variables - C++ and Some special Functions of C and C++ at assembly language level - Special functions using memcpy and strlen.

LAB COMPONENT

3. Give examples for recursion vs. loops with factorial. **6**

UNIT - IV MIXTURE OF C, C++ AND ASSEMBLY LANGUAGE CODE 6

Instruction intrinsic - Inline and embedded assembler - Access to C global variables from assembly code - Mixed-language programming - Rules for calling between C, C++, and assembly language - Rules for calling C++ functions from C and assembly language - Information specific to C++.

LAB COMPONENT

4. Write a program for including system C header files from C++.
5. Write a program for including your own C header files from C++. **6**

UNIT - V MIXED-LANGUAGE PROGRAMMING 6

Calls to assembly language from C - Calls to C from assembly language - Calls to C++ from C - Calls to C++ from assembly language - Passing a reference between C and C++ - Calls to C++ from C or assembly language.

LAB COMPONENT

6. Write the program for calls to C from C++.
7. Write the program for calls to assembly language from C++. **6**

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Brian W. Kernighan and Dennis Ritchie, “The C Programming Language”, Pearson Education India, Second Edition, 2015.
2. Yifeng Zhu, “Embedded Systems with Arm Cortex-M Microcontrollers in Assembly Language and C”, E-Man Press LLC, Third Edition, 2017.

REFERENCES:

1. Stanley Lippman, Josée Lajoie and Barbara Moo, “C++ Primer”, Addison-Wesley Professional, Fifth Edition, 2012.
2. Mike Hendrickson, Andrew Koenig and Barbara Moo, “Accelerated C++: Practical Programming by Example (C++ In-Depth Series)”, Addison-Wesley, First Edition, 2000.
3. Randall Hyde, “The Art of Assembly Language”, No Starch Press, Second Edition, 2010.
4. Barry B. Brey, “The Intel Microprocessors - Architecture, Programming, and Interfacing”, Pearson Education India, Eight Edition, 2008.
5. Igor Zhirkov, “Low-Level Programming: C, Assembly, and Program Execution on Intel 64 Architecture”, Apress, First Edition, 2017.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Mixed C and Assembly Language Programming		**Course Code :** 20ECV25			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C330.1	Describe the architecture and organization of microprocessor along with instruction set format.	1	K2	1,2,5,8,9	3
C330.2	Recollect various programming constructs to develop C programs.	2	K2	1,2,5,8,9	3
C330.3	Develop the C and assembly language programs using various programming tools.	3	K3	1,2,3,5,8,9	3
C330.4	Describe the object-oriented programming approach in connection with C++.	4	K3	1,2,3,5,8,9	3
C330.5	Apply the programming knowledge of C, C++ and assembly language in the development of mixed programming concept.	4	K3	1,2,3,5,8,9	3
C330.6	Implement simple programs using mixed programming language.	5	K3	1,2,3,5,8,9	3

CO-PO Mapping

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C330.1	2	1			3			2	2						1
C330.2	2	1			3			2	2						1
C330.3	3	2	1		3			2	2						2
C330.4	3	2	1		3			2	2						2
C330.5	3	2	1		3			2	2						2
C330.6	3	2	1		3			2	2						2

20ECV26	SENSOR CONCEPTS AND TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide in depth knowledge in physical principles applied in sensing and measurement.
- To give a fundamental knowledge on the basic laws and phenomena on which operation of sensor transformation of energy is based.
- To impart a reasonable level of competence in the design, construction, and execution of mechanical measurements strain, force, torque and pressure.
- To familiarize with different sensors and transducers.
- To explain smart sensors and biosensors.

PRE-REQUISITE: NIL

UNIT - I SENSORS AND TRANSDUCERS 9

Principles - Classification - Parameters - Characteristics - Environmental Parameters (EP) - Characterization. Inductive Sensors: Sensitivity and Linearity of the Sensor, Types-Capacitive Sensors: Electrostatic Transducer - Force/Stress Sensors using Quartz Resonators - Ultrasonic Sensors.

UNIT - II THERMAL AND MAGNETIC SENSORS 9

Introduction - Gas thermometric Sensors - Thermal Expansion Type - Thermometric Sensors - Acoustic Temperature Sensor - Dielectric Constant and Refractive Index thermo sensors - Magnetic Thermometer - Resistance Change Sensors and the Principles Behind - Magneto-resistive Sensors - Semiconductor Magneto resistors - Hall Effect and Sensors - Inductance and Eddy Current Sensors.

UNIT - III RADIATION AND ELECTRO ANALYTICAL SENSORS 9

Introduction - Basic Characteristics - Types of Photosensistors/Photo detectors – X ray and Nuclear Radiation Sensors – Fiber Optic Sensors, the Electrochemical Cell- The Cell Potential - Standard Hydrogen Electrode (SHE) - Liquid Junction and Other Potentials - Polarization – Concentration Polarization - Reference Electrodes - Sensor Electrodes - Electro ceramics in Gas Media.

UNIT - IV SMART SENSORS 9

Introduction - Primary Sensors - humidity sensors - proximity sensors - fluid velocity sensors - Excitation - Amplification - Filters - Converters - Compensation - Information Coding Process - Data Communication - Standards for Smart Sensor Interface - The Automation.

UNIT - V ACTUATORS 9

Pneumatic and Hydraulic Actuation Systems- Actuation systems - Pneumatic and hydraulic systems - Directional Control valves - Pressure control valves - Cylinders - Servo and proportional control valves - Process control valves - Rotary actuators.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. D.Patranabis, “Sensors and Transducers”, Prentice Hall India Learning Private Limited, Second Edition, 2003.
2. W.Bolton, “Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering”, Pearson Education, Sixth Edition, 2015.

REFERENCES:

1. Ernest O. Doebelin and Dhanesh N. Manik, “Measurement Systems: Application and Design”, McGraw Hill, Sixth Edition, 2007.
2. R.Sinclair, “Sensors and Transducers”, Newnes Publishers, Third Edition, 2001.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Sensor Concepts and Techniques		**Course Code : 20ECV26**			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C331.1	Classify the transducers used for measurement of temperature, strain, motion, position and light.	1	K3	1,2,3,9,10	1
C331.2	Explain the construction and working of various industrial parameters and devices used to measure temperature	2	K2	1,2,8,9	1
C331.3	Explain the construction and working of semiconductor magneto resistors and synchro resolvers	3	K2	1,2,9,10	1
C331.4	Analyze the characteristics of photo resistors, fiber optic sensors and polarization of sensor electrodes	4	K4	1,2,3,4,8,9	1
C331.5	Explain the function of primary sensors and standards for smart sensor interface.	4	K2	1,2,9,10	1
C331.6	Explain the Pneumatic and hydraulic actuation systems and functions of control valves	5	K2	1,2,9,10	1

CO-PO Mapping

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C331.1	3	2	1						1	1			2		
C331.2	2	1						1	1				1		
C331.3	2	1							1	1			1		
C331.4	3	3	2	1				1	1				3		
C331.5	2	1							1	1			1		
C331.6	2	1							1	1			1		

20ECV31	SYSTEM ON CHIP DESIGN	L	T	P	C
		2	0	2	3

OBJECTIVES:

- To design, optimize, and program a modern System-on-a-Chip.
- To decompose the task into parallel components that cooperate to solve the problem.
- To characterize and develop real-time solutions.
- To implement both hardware and software solutions, and perform hardware/software co-design.
- To understand and estimate key design metrics and requirements.

PRE-REQUISITE :

Course Code: 20EC402, 20EC511, 20EC505

Course Name: Computer Architecture and Organization, Microprocessor and Microcontroller based systems, Digital VLSI Design and FPGA Implementation

UNIT - I INTRODUCTION TO THE SYSTEM APPROACH **6**

System Architecture – Components of the system – Hardware and Software – Processor Architectures – Memory and Addressing – System level interconnection – An approach for SOC Design – System Architecture and Complexity.

LAB COMPONENT

1. Installation of GEM 5 software.
2. Demonstration of GEM 5 software. **6**

UNIT - II PROCESSORS **6**

Introduction – Processor Selection for SOC – Basic concepts in Processor Architecture – Basic concepts in Processor Micro Architecture – Basic elements in Instruction handling – Buffers – minimizing Pipeline Delays – Branches – More Robust Processors – Vector Processors and Vector Instructions extensions – VLIW Processors – Superscalar Processors.

LAB COMPONENT

3. Design of a data processing system architecture. **6**

UNIT - III MEMORY DESIGN FOR SOC **6**

Overview of SOC external memory – Internal Memory – Size – Scratchpads and Cache memory – Cache Organization – Cache data – Write Policies – Strategies for line replacement at miss time – Types of Cache – Split – I, and D – Caches – Multilevel Caches – Virtual to real translation – SOC Memory System – Models of Simple Processor – memory interaction.

LAB COMPONENT

4. Design of a SOC memory system and pipelining set-up. **6**

UNIT - IV INTERCONNECT CUSTOMIZATION AND CONFIGURATION **6**

Inter Connect Architectures – Basic Bus Architectures – SOC Standard Buses – Analytic Bus Models – Using the Bus model – Effects of Bus transactions and contention time – Overview of SOC Customization – Customizing Instruction Processor – Reconfiguration Technologies – Mapping design onto Reconfigurable devices – Instance Specific design – Customizable Soft Processor – Overhead analysis on Reconfiguration – trade-off analysis on reconfigurable Parallelism.

LAB COMPONENT

5. Design of a SOC bus system and pipelining set-up. **6**

UNIT - V **APPLICATION STUDIES / CASE STUDIES** **6**

SOC Design approach – AES algorithms: Design and evaluation - Image compression: JPEG compression.

LAB COMPONENT

6. Implementation of AES algorithm in the SOC. **6**

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Michael J. Flynn and Wayne Luk, “Computer System Design: System-on-Chip”, Wiley India Pvt. Ltd., First Edition, 2011.
2. Steve Furber, “ARM System on Chip Architecture”, Addison-Wesley, Second Edition, 2000.

REFERENCES:

1. Ricardo Reis and Jochen A.G. Jess, “Design of System on a Chip: Devices and Components”, Springer, First Edition, 2004.
2. Jason Andrews, “Co-Verification of Hardware and Software for ARM SoC Design”, Newnes, Pap/Cdr Edition, 2004.
3. Peter Marwedel, “Embedded System Design: Embedded Systems Foundations of Cyber-Physical Systems”, Springer, Second Edition, 2011.
4. Michael Keating, “The Simple Art of SoC Design: Closing the Gap between RTL and ESL”, Springer, 2011.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : SYSTEM ON CHIP DESIGN		**Course Code : 20ECV31**			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C332.1	Install and demonstrate GEM 5 software required.	1	K2	1,2,5,8,9	3
C332.2	Explain the Processor needed for SoC.	2	K2	1,2,8,9,10	3
C332.3	Design SoC memory system.	3	K3	1,2,3,5,8,9,10	3
C332.4	Explain Interconnect architecture bus models.	4	K2	1,2,8,9	3
C332.5	Design pipelining setup.	4	K3	1,2,3,5	3
C332.6	Implement AES algorithm in SoC.	5	K4	1,2,3,4,5	3

CO-PO Mapping

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C332.1	2	1			2			2	2					1	
C332.2	2	1						2	2	2				2	
C332.3	3	2	1		2			2	2	2				2	
C332.4	2	1						2	2					2	
C332.5	3	2	1		2									1	
C332.6	3	3	2	1	2									2	

20ECV32	RF INTEGRATED CIRCUIT DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the Integrated circuit design for Amplifiers at radio frequency.
- To have exposure to microwave oscillator design.
- To imparts the concepts of RF IC.
- To analyze and focus on circuits for radio frontends for mobile phone handsets.
- To understand noise amplifiers, mixers, power amplifiers, frequency synthesizers (phase locked loops) and modern radio architectures.

PRE-REQUISITE:

Course Code: 20EC404
Course Name: Analog Electronics and Integrated Circuits

UNIT - I HIGH POWER RF TRANSISTOR AMPLIFIER DESIGN 9

FET and bipolar transistor models - Two port power gains - stability - Amplifier design using S parameters - LNA - Differential amplifiers - DC biasing - Power amplifiers - general issues: efficiency, linearity, load pull - Design: class A, class AB, class C - Higher class power amplifiers - linearization - distributed power amplifier.

UNIT - II RF OSCILLATORS 7

Microwave oscillators - LC - Colpitts - negative resistance - differential oscillators - frequency synthesis methods - phase locked loop analysis - oscillator phase noise.

UNIT - III RADIO FREQUENCY IC DESIGN 10

Introduction to RFIC basics - Historical aspects - From Maxwells to current wireless standards - the bridge between communication system designer and RFIC designer - System level parameters - circuit level parameters -Analog and microwave design versus RFIC design - noise performance estimate - RF technology - receiver with single IF stage metallization - sheet resistance - skin effect - parasitic capacitance and inductance quality factor.

UNIT - IV MICROWAVE POINT TO POINT SYSTEM DESIGN 10

Microwave transmission - link design - theoretical and practical aspects - fading design - protected and non-protected microwave systems - link design - path calculation - spread spectrum microwave system - compatibility - safety coordinate systems - Datum's and GPS - Receiver design - receiver architecture - dynamic range - frequency conversion and filtering - examples of practical receivers.

UNIT - V TRANSMISSION LINE EQUIPMENT 9

Digital microwave radio - fiber optic equipment - wire line equipment - cabling - grounding - Power battery backup - GPS antenna - reliability issues - cell site selection - microwave repeater site selection - microwave site and path survey - microwave antenna mounting - measurement of RF fields - source emissions - power level and radiation pattern - microwave installation measurements and testing.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. David Pozar, "Microwave and RF Design of Wireless Systems", John Wiley, Second Edition, 2012.
2. Hooman Darabi, "Radio Frequency Integrated Circuits and Systems", Cambridge University Press, First Edition, 2015.

REFERENCES:

1. John Rogers and Calvin Plett, “Radio Frequency Integrated Circuit Design”, Artech House, Second Edition, 2002.
2. John Kraus and Daniel Fleisch, “Electromagnetics with Applications”, McGraw Hill Education, Fifth Edition, 2017.
3. Thomas H. Lee, “The Design of CMOS Radio Frequency Integrated Circuits”, Cambridge University Press, Second Edition, 2003.
4. Sorin Voinigescu, “High Frequency Integrated Circuits”, Cambridge University press, First Edition, 2013.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : RF Integrated Circuit Design		**Course Code : 20ECV32**			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C333.1	Design Low noise amplifier, power amplifier for portable applications.	1	K3	1,2,3,9	2
C333.2	Develop RF oscillator for high frequency applications.	2	K3	1,2,3,9	2
C333.3	Recognize the fundamentals of RF integrated circuits operating at radio frequencies.	3	K2	1,2,3,9	2
C333.4	Apply RF technology in the high frequency IC design.	3	K3	1,2,3,9	2
C333.5	Choose the theoretical and practical design aspects in the microwave point to point system.	4	K3	1,2,3,9	2
C333.6	Apply IC design techniques in the transmission line equipment.	5	K3	1,2,3,9,10	2

CO-PO Mapping

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C333.1	3	2	1						3					2	
C333.2	3	2	1						3					2	
C333.3	3	2	1						3					2	
C333.4	3	2	1						3					2	
C333.5	3	2	1						3					2	
C333.6	3	2	1						3	1				2	

20ECV33	DSP ARCHITECTURE AND PROGRAMMING	L	T	P	C
		2	0	2	3

OBJECTIVES:

- To understand the basics on digital signal processors.
- To learn the programmable DSP's architecture, on-chip peripherals and instruction set.
- To learn the programming for signal processing applications.
- To learn the advanced programmable DSP processors.

PRE-REQUISITE:

Course Code: 20EC302, 20EC405
Course Name: Signals and Systems, Principles of Digital Signal Processing

UNIT - I FUNDAMENTALS OF PROGRAMMABLE DSPs **6**

Introduction to Programmable DSPs - Architectural Features of PDSPs - Multiplier and Multiplier accumulator - Modified Bus Structures and Memory access - Multiple access memory - Multi-port memory - VLIW architecture - Pipelining - Special Addressing modes in P-DSPs - On chip Peripherals - Applications of Programmable DSPs.

LAB COMPONENT

1. Demonstration of TMS320C5X processor.
2. Exploration of code composer studio. **6**

UNIT - II TMS320C5X PROCESSOR **6**

Architecture of C5X Processor - Addressing modes - Assembly language Instructions - Pipeline structure -on-chip Peripherals - Block Diagram of DSP starter kit (DSK) - Software Tools – DSK on-board peripherals.

LAB COMPONENT

3. Study the addressing modes of TMS320c5x processors.
4. Perform Linear convolution using TMS 320 c5x **6**

UNIT - III TMS320C6X PROCESSOR **6**

Architecture of the C6x Processor - Addressing modes - Assembler directives - on-chip peripherals - DSP Development System - DSP Starter Kit - Code Composer Studio (CCS) - Support Files. Real-Time Programming Examples for Signals and Noise generation, Frequency analysis

LAB COMPONENT

5. Real-Time Programming Examples for Signals and Noise generation, Frequency analysis **6**

UNIT - IV ADSP PROCESSORS **6**

Architecture of ADSP-21XX series of DSP processors- Addressing modes and assembly language instructions - Application programs - Fast Fourier Transform (FFT) calculation.

LAB COMPONENT

6. Implementation FFT algorithm (DIT & DIF) using ADSP processor. **6**

UNIT - V ADVANCED PROCESSORS **6**

Study of TI's advanced processor - TMS320C674x DSPs - ADSP's Blackfin and Sigma DSP Processors - NXP's DSP56Fxx Family of DSP Processors - Comparison of the features of TI, ADSP, NXP DSPs.

LAB COMPONENT

7. Implementation of simple linear and circular convolution using TMS320C674x DSPs. **6**

TOTAL: 60 PERIODS

TEXT BOOKS:

1. B.Venkataramani and M.Bhaskar, “Digital Signal Processors: Architecture, Programming and Applications”, Tata McGraw-Hill Publishing Company Limited, 2011.
2. Avtar Singh and S. Srinivasan, “Digital Signal Processing: Implementations using DSP Microprocessors with Examples from TMS320C54xx”, Cengage Learning India Private Limited, Delhi, 2012.

REFERENCES:

1. V. Udayashankara, “Modern Digital Signal Processing includes Signals and Systems, MATLAB programs, DSP architecture with Assembly and C programs”, PHI Publications, Third Edition, 2015.
2. Rulph Chassaing and Donald Reay, “Digital Signal Processing and Applications with the C6713 and C6416 DSK”, John Wiley & Sons, Inc. Publication, 2012 (Reprint).
3. User guides from Texas Instruments, Analog Devices and NXP.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : DSP Architecture and Programming		**Course Code :** 20ECV33			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C334.1	Discuss the fundamental concepts of Digital signal processors.	1	K2	1,2,8,9	2
C334.2	Develop Assembly language program using TMS320C5X processor.	2	K3	1,2,8,9,10	2
C334.3	Use TMS320C6X processor and its instructions in the generation of signals and noise	3	K3	1,2,8,9,10	2
C334.4	Develop C Program using Code Composer Studio of DSP for the real time applications	4	K3	1,2,8,9	2
C334.5	Discuss the architecture, addressing modes and assembly language instructions of ADSP processors.	5	K2	1,2,3,4,5	2
C334.6	Analyze the suitable Advanced DSP Processors for real-time signal processing applications.	5	K3	1,2,3,5	2

CO-PO Mapping

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C334.1	2	1						2	2					1	
C334.2	3	2	1					2	2	2				2	
C334.3	3	2	1					2	2	2				2	
C334.4	3	2	1					2	2					2	
C334.5	2	1			2									1	
C334.6	3	2	1		2									2	

20ECV34	FUNDAMENTALS OF SOFT COMPUTING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn about soft computing techniques and their applications.
- To analyze various neural network architectures.
- To understand perceptron and counter propagation networks.
- To understand the fuzzy systems.
- To analyze the genetic algorithms and their applications.

PRE-REQUISITE: NIL

UNIT - I INTRODUCTION TO SOFT COMPUTING 9

Introduction of soft computing and characteristics - learning methods - taxonomy - Evolution of neural networks - basic models - important technologies - applications. Fuzzy logic: Introduction, crisp sets, fuzzy sets. Crisp relations and fuzzy 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 reparability - 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 auto associative memory network - iterative associative memory network - unsupervised learning networks - Kohonen self-organizing feature maps - LVQ - CP networks - ART network.

UNIT - III FUZZY LOGIC 9

Fuzzy Sets - Properties - Membership functions - Fuzzy operations - Applications - Classification and Regression tree - Data clustering algorithms - Rule-based structure identification and Regression trees - neuro fuzzy systems.

UNIT - IV GENETIC ALGORITHM 9

Genetic algorithm- Introduction - biological background - traditional optimization and search techniques - Genetic basic concepts - operators - Encoding scheme - Fitness evaluation - crossover - mutation - 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: 45 PERIODS

TEXT BOOKS:

1. S.N. Sivanandam and S.N. Deepa, “Principles of Soft Computing”, Wiley India Pvt., Ltd., 2011.
2. J.S.R. Jang, C.T. Sun and E. Mizutani, “Neuro-Fuzzy and Soft Computing”, PHI/Pearson Education, 2004.

REFERENCES:

1. S. Rajasekaran and G.A. Vijayalakshmi Pai, “Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis & Applications”, Prentice-Hall of India Pvt. Ltd., 2006.
2. George J. Klir, Ute St. Clair and Bo Yuan, “Fuzzy Set Theory: Foundations and Applications”, Prentice Hall, 1997.
3. David E. Goldberg, “Genetic Algorithm in Search Optimization and Machine Learning”, Pearson Education India, 2013.
4. James A. Freeman and David M. Skapura, “Neural Networks Algorithms, Applications, and Programming Techniques”, Pearson Education India, 1991.
5. Simon Haykin, “Neural Networks Comprehensive Foundation” Second Edition, Pearson Education, 2005.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Fundamentals of Soft Computing		**Course Code :** 20ECV34			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C335.1	Apply various soft computing concepts for practical applications.	1	K3	1,2,3,8,9	3
C335.2	Choose and design suitable neural networks for real time problems.	2	K3	1,2,3,8,9	3
C335.3	Use fuzzy rules and reasoning to develop decision making and expert system.	3	K3	1,2,3,8,9	3
C335.4	Explain the importance of optimization techniques and genetic programming.	4	K2	1,2,5,8,9	3
C335.5	Apply Genetic algorithms in multimedia application processing.	5	K3	1,2,3,5,8,9	3
C335.6	Summarize the various hybrid soft computing techniques and apply in real time problems.	5	K2	1,2,8,9	3

CO-PO Mapping

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C335.1	3	2	1					2	2						2
C335.2	3	2	1					2	2						2
C335.3	3	2	1					2	2						2
C335.4	2	1			1			2	2						1
C335.5	3	2	1		1			2	2						2
C335.6	2	1						2	2						1

20ECV35	EMBEDDED PROCESSORS	L	T	P	C
		2	0	2	3

OBJECTIVES:

- Provide understanding of architecture of MSP430 microcontroller
- Develop ability to write and Interpret C language programs for MSP430
- Use advance features in PWM for MSP430
- Interface various devices with MSP430
- Understand use of MSP 430 for IoT applications

PRE-REQUISITE:
Course Code: 20EC511
Course Name: Microprocessor and Microcontroller based systems

UNIT - I MSP430 ARCHITECTURE & PROGRAMMING **6**

Introduction to MSP430, RISC Architecture / Functional Block Diagram of MSP430, Pin Diagram, Memory Organization, CPU, On-Chip Peripherals. Overview of MSP430 Launch pad and its Features, GPIO programming and I/O multiplexing; Interrupts and interrupt programming

LAB COMPONENT

1. Study of functional Unit of MSP430 Launch pad.
2. Demonstration of Code Composer Studio and sample GPIO programming **6**

UNIT - II TIMERS, PWM CONTROL AND RTC **6**

Watchdog timer, Timers, Measurement in Capture Mode, PWM control – Edge-Aligned PWM, Centred PWM and Sine-PWM, Real Time Clock (RTC)

LAB COMPONENT

3. PWM generation using Timer on MSP430 GPIO.
4. PWM based Speed Control of Motor controlled by MSP430 GPIO. **6**

UNIT - III ADC AND OPERATING MODES **6**

Analog-to-Digital Conversion: General Issues, Successive Approximation. Basic Operation of ADC10, Advanced Operation of ADC10, ADC10 Successive Approximation, Digital to Analog Conversion, Low Power aspects of MSP430: Operating Modes, low power modes.

LAB COMPONENT

5. Interfacing ADC using MSP430
6. Interfacing DAC using MSP430 **6**

UNIT - IV COMMUNICATION PROTOCOLS **6**

Serial communication basics, USCI, Synchronous/Asynchronous interfaces (like UART, USB, SPI, and I2C), UART protocol, I2C protocol, SPI protocol, Implementing and programming UART, I2C, SPI interface using MSP430, Interfacing external devices.

LAB COMPONENT

7. I2C communication using MSP430.
8. UART communication using MSP430. **6**

UNIT - V IOT BASICS AND APPLICATIONS OF MSP430 **6**

IoT overview and architecture, Overview of wireless sensor networks and design examples. Various wireless connectivity: NFC, ZigBee and Bluetooth

LAB COMPONENT

9. Real world application: MSP430 based Embedded Networking Application: “Implementing Wi-Fi or Bluetooth Connectivity in a Smart Electric Meter” **6**

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Getting Started with the MSP430 Launchpad by Adrian Fernandez, Dung Dang, Newnes, 2013.
2. MSP430 microcontroller basics 1st Edition by John H. Davies, Newnes - Elseveir, 2008.

REFERENCES:

1. MSP430 Microcontrollers in Embedded System Projects, C P RaviKumar, 1st Edition, Elite Publishing House, 2012.
2. Analog and Digital Circuits for Electronic Control System Applications: Using the TI MSP430 Microcontroller, Jerry Luecke, 1st Edition, Elsevier, 2005.
3. User Manual MSP430 from TI.com.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Embedded Processor		**Course Code : 20ECV35**			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C336.1	Explain architecture of MSP430 microcontroller, its instructions and the addressing modes	1	K2	1,2,8,9	3
C336.2	Develop and debug program in C language for specific applications.	2	K3	1,2,3,5,8,9, 10	3
C336.3	Use the CCS software to operate the MSP430 GPIO using basic I/O operation.	3	K3	1,2,3,5,8,9, 10	3
C336.4	Demonstrate the PWM techniques for control the external device using MSP430	4	K3	1,2,3,5,8,9	3
C336.5	Demonstrate the serial &wireless communication techniques using MSP430	5	K3	1,2,3,5,8,9	3
C336.6	Develop IoT based application using MSP430.	5	K3	1,2,3,5,8,9	3

CO-PO Mapping

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C336.1	2	1						2	2					1	
C336.2	3	2	1		2			2	2	2				2	
C336.3	2	1	1		2			2	2	2				2	
C336.4	3	2	1		2			2	2					2	
C336.5	2	1	1		2			2	2					1	
C336.6	3	2	1		2			2	2					2	

20ECV36	HUMAN ASSIST DEVICES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the role and importance of machines that takes over the functions of the heart and lungs.
- To study various mechanical techniques that helps a non-functioning heart.
- To learn the functioning of the unit which does the clearance of urea from the blood.
- To understand the tests to assess the hearing loss and development of electronic devices to compensate for the loss.
- To study about recent techniques used in modern clinical applications.

PRE-REQUISITE: NIL

UNIT - I HEART LUNG MACHINE AND ARTIFICIAL HEART 9

Condition to be satisfied by the H/L System. Different types of Oxygenators, Pumps, Pulsatile and Continuous Types, Monitoring Process, Shunting, The Indication for Cardiac Transplant, Driving Mechanism, Blood Handling System, Functioning and different types of Artificial Heart, Schematic for temporary bypass of left ventricle.

UNIT - II CARDIAC ASSIST DEVICES 9

Assisted through Respiration, Right and left Ventricular Bypass Pump, Auxiliary ventricle, Open Chest and Closed Chest type, Intra Aortic Balloon Pumping, Prosthetic Cardiac valves, Principle of External Counter pulsation techniques.

UNIT - III ARTIFICIAL KIDNEY 9

Indication and Principle of Haemodialysis, Membrane, Dialysate, types of filter and membranes, Different types of hemodialyzers, Monitoring Systems, Wearable Artificial Kidney, Implanting Type.

UNIT - IV RESPIRATORY AND HEARING AIDS 9

Ventilator and its types-Intermittent positive pressure, Breathing Apparatus Operating Sequence, Electronic IPPB unit with monitoring for all respiratory parameters. Types of Deafness, Hearing Aids, SISI, masking techniques, wearable devices for hearing correction.

UNIT - V RECENT TRENDS 9

Transcutaneous electrical nerve stimulator, bio-feedback, Diagnostic and point-of-care platforms.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. R.S.Khandpur, “Handbook of Bio Medical Instrumentation”, Second Edition, Tata Mc Graw Hill, 2003.
2. Dr.M.Arumugam, “Bio Medical Instrumentation”, Anuradha Agencies, 2003.
3. Gray E. Wnek and Gray L. Browlin, “Encyclopedia of Biomaterials and Biomedical Engineering”, Marcel Dekker Inc., New York, 2004.

REFERENCES:

1. Andreas F. Von Recum, “Hand book of bio material evaluation”, McGraw-Hill Professional, 1986.
2. Gray E. Wnek and Gray L. Browlin, “Encyclopedia of Biomaterials and Biomedical Engineering”, Marcel Dekker Inc., New York, 2004.
3. D.S.Sunder, “Rehabilitation Medicine”, Third Edition, Jaypee Medical Publication, 2010.
4. Joseph D. Bronzino, “The Biomedical Engineering Handbook”, Third Edition: Three Volume Set, CRC Press, 2006.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Human Assist Devices		**Course Code : 20ECV36**			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C337.1	Explain the principle and construction of artificial heart.	1	K2	1,2,6,8,9	3
C337.2	Discuss the various mechanical techniques that improve therapeutic technology.	2	K2	1,2,6,8,9	3
C337.3	Explain the functioning of the membrane or filter that cleanses the blood.	3	K2	1,2,6,8,9	3
C337.4	Categorize the methodologies in the respiratory measurement systems and conditions.	4	K2	1,2,6,8,9	3
C337.5	Describe the tests to access the hearing loss and development of wearable devices for the same.	4	K2	1,2,6,8,9	3
C337.6	Discuss the latest research on electrical stimulation and bio feedback techniques in rehabilitation and physiotherapy.	5	K2	1,2,6,8,10	3

CO-PO Mapping

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C337.1	2	1				1		1	1						1
C337.2	2	1				1		1	1						1
C337.3	2	1				1		1	1						1
C337.4	2	1				1		1	1						1
C337.5	2	1				1		1	1						1
C337.6	2	1				1		1		1					1

20ECV41	VLSI TESTING AND DESIGN FOR TESTABILITY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To involve the students in the theory and practice of VLSI test and validations.
- To introduce advanced techniques for efficiently testing and validating the VLSI design.
- To introduce the concept of Design for Test and the technique of automated test pattern generation.
- To define a methodology to test the combinational and sequential circuits.
- To construct a Design for Testability (DFT) algorithm for VLSI Circuits.

PRE-REQUISITE: NIL

UNIT - I INTRODUCTION TO TESTING 9

Introduction - VLSI Testing Process and Test Equipment – Challenges in VLSI Testing - Test Economics and Product Quality - Fault Modeling - Relationship among Fault Models.

UNIT - II LOGIC & FAULT SIMULATION & TESTABILITY MEASURES 9

Simulation for Design Verification and Test Evaluation - Modeling Circuits for Simulation - Algorithms for True Value and Fault Simulation - SCOAP Controllability and Observability.

UNIT - III TEST GENERATION FOR COMBINATIONAL AND SEQUENTIAL CIRCUITS 9

Algorithms and Representations - Redundancy Identification - Combinational ATPG Algorithms - Sequential ATPG Algorithms - Simulation Based ATPG - Genetic Algorithm Based ATPG.

UNIT - IV DESIGN FOR TESTABILITY 9

Design for Testability Basics - Testability Analysis - Scan Cell Designs - Scan Architecture – Built-in Self-Test - Random Logic BIST - DFT for other Test Objectives.

UNIT - V FAULT DIAGNOSIS 9

Introduction and Basic Definitions - Fault Models for Diagnosis - Generation for Vectors for Diagnosis - Combinational Logic Diagnosis - Scan Chain Diagnosis - Logic BIST Diagnosis.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Laung-Terng Wang, Cheng-Wen Wu and Xiaoqing Wen, “VLSI Test Principles and Architectures”, Elsevier, 2017.

REFERENCES:

1. Michael L. Bushnell and Vishwani D. Agrawal, “Essentials of Electronic Testing for Digital, Memory & Mixed-Signal VLSI Circuits”, Kluwer Academic Publishers, 2017.
2. Niraj K. Jha and Sandeep Gupta, “Testing of Digital Systems”, Cambridge University Press, 2017.
3. Vishwani Agrawal and Michael Bushnell, “Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits”, Springer, 2002.
4. Jan M. Rabaey, Anantha Chandrakasan and Borivoje Nikolic, “Digital Integrated Circuits: A Design perspective”, Pearson, Second Edition, 2016.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : VLSI TESTING AND DESIGN FOR TESTABILITY		Course Code : 20ECV41			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C338.1	Explain the various VLSI Testing Process and challenges with fault modeling.	1	K2	1,2,8,10	3
C338.2	Construct Logic Simulation for modeling circuits.	2	K3	1,2,3,8,10	3
C338.3	Construct various Fault Simulation process with testability measures.	2	K3	1,2,3,8,10	3
C338.4	Develop Test generation for Combinational and Sequential circuits.	3	K3	1,2,3,8,10	3
C338.5	Apply the Design for Testability with scan cell designs and Built In Self-Test.	4	K3	1,2,3,8,10	3
C338.6	Explain various Fault Diagnosis methods.	5	K2	1,2,8,10	3

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C338.1	2	1						2		2					1
C338.2	3	2	1					2		2					2
C338.3	3	2	1					2		2					2
C338.4	3	2	1					2		2					2
C338.5	3	2	1					2		2					2
C338.6	2	1						2		2					1

20ECV42	WIRELESS BROADBAND NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the various network layer and transport layer protocols for wireless networks.
- To study the architecture in 3G standards.
- To learn about 4G technologies and LTE-A in mobile cellular network.
- To learn about the layer level functionalities in interconnecting networks.
- To study the emerging techniques in 5G network.

PRE-REQUISITE: NIL

UNIT - I WIRELESS PROTOCOLS 9

Mobile Network Layer **-** Fundamentals of Mobile IP - IP packet Delivery - IPv6 - IP Micro Mobility - IP Addressing - DHCP-Mobile Transport Layer - Traditional TCP - Congestion Control, Slow Start, Fast recovery/Fast retransmit - classical TCP improvements - Indirect TCP - snooping TCP, Mobile TCP.

UNIT - II 3G EVOLUTION 9

IMT-2000 - W-CDMA, CDMA 2000 - radio & network components, network structure, packet-data transport process flow, core network, UMTS-services, air interface, network architecture of 3GPP, UTRAN - architecture, High Speed Packet Data-High Speed Downlink packet access (HSDPA) High Speed Uplink packet access (HSUPA).

UNIT - III 4G EVOLUTION 9

Introduction to LTE-A - Requirements and Challenges, network architectures - EPC, E-UTRAN architecture - mobility management, resource management, services, downlink/uplink data transfer, PDU packet formats, scheduling services, random access procedure.

UNIT - IV LAYER-LEVEL FUNCTIONS 9

Characteristics of wireless channels - downlink physical layer, uplink physical layer, MAC scheme - frame structure, resource structure, mapping, SC-FDMA, interference cancellation - CoMP, Carrier aggregation, Services - multimedia broadcast/multicast, location-based services.

UNIT - V 5G EVOLUTION 9

5G Roadmap - Pillars of 5G - 5G Architecture, The 5G internet - IoT and context awareness - Networking reconfiguration and virtualization support - Mobility QoS control - Small cells for 5G mobile networks- capacity limits and achievable gains with densification - Mobile data demand, Demand Vs Capacity, Small cell challenges, conclusion and future directions.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Jochen Schiller, “Mobile Communication”, Second Edition, Pearson Edition, 2008.
2. P.E.Clint Smith and Dannel Collins, “3G Wireless Networks”, Second Edition, Tata McGraw-Hill, 2011.

REFERENCES:

1. Vijay K.Garg, “Wireless Network Evolution - 2G & 3G”,. Prentice Hall, 2008.
2. Sassan Ahmadi, “LTE-Advanced – A practical systems approach to understanding the 3GPP LTE Releases 10 and 11 radio access technologies”, Elsevier, 2014.
3. Jonathan Rodriguez, "Fundamentals of 5G Mobile networks", John Wiley, 2015.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : WIRELESS BROAD BAND NETWORKS		Course Code : 20ECV42			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C339.1	Explain the various protocols in wireless networks.	1	K2	1,2,8,10	2
C339.2	Determine the architecture of 3G network standards.	2	K3	1,2,3,8,10	2
C339.3	Determine the LTE-A network design from 4G standard.	3	K3	1,2,3,8,10	2
C339.4	Explain the interconnecting network functionalities by layer level functions.	4	K2	1,2,8,10	2
C339.5	Examine the current generation (5G) network architecture.	5	K3	1,2,3,8,10	2
C339.6	Examine the QOS requirement of 5 G networks under the massive wireless data traffic from different application scenarios.	5	K3	1,2,3,8,10	2

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C339.1	2	1						2		2				2	
C339.2	3	2	1					2		2				2	
C339.3	3	2	1					2		2				2	
C339.4	2	1						2		2				2	
C339.5	3	2	1					2		2				2	
C339.6	3	2	1					2		2				2	

20ECV43	TEXT AND SPEECH ANALYSIS	L	T	P	C
		2	0	2	3

OBJECTIVES:

- Understand natural language processing basics
- Apply classification algorithms to text documents
- Build question-answering and dialogue systems
- Develop a speech recognition system
- Develop a speech synthesizer

PRE-REQUISITE:

Course Code: 20GE101
Course Name: Problem Solving using Python Programming

UNIT - I NATURAL LANGUAGE BASICS **6**

Foundations of natural language processing – Language Syntax and Structure- Text Preprocessing and Wrangling – Text tokenization – Stemming – Lemmatization – Removing stop-words – Feature Engineering for Text representation – Bag of Words model- Bag of N-Grams model – TF-IDF model.

LAB COMPONENT

1. Create Regular expressions in Python for detecting word patterns and tokenizing text. **6**
2. Getting started with Python and NLTK - Searching Text, Counting Vocabulary, FrequencyDistribution, Collocations, Bigrams.

UNIT - II TEXT CLASSIFICATION **6**

Vector Semantics and Embeddings -Word Embeddings - Word2Vec model – Glove model – FastText model – Overview of Deep Learning models – RNN – Transformers – Overview of Text summarization and Topic Models.

LAB COMPONENT

3. Accessing Text Corpora using NLTK in Python. **6**
4. Write a function that finds the 50 most frequently occurring words of a text that are not stopwords.
5. Implement the Word2Vec model.
6. Use a transformer for implementing classification.

UNIT - III QUESTION ANSWERING AND DIALOGUE SYSTEMS **6**

Information retrieval – IR-based question answering – knowledge-based question answering - language models for QA – classic QA models – chatbots – Design of dialogue systems - evaluating dialogue systems.

LAB COMPONENT

7. Design a chatbot with a simple dialogue system. **6**

UNIT - IV TEXT-TO-SPEECH SYNTHESIS **6**

Overview – Text normalization - Letter-to-sound - Prosody, Evaluation, Signal processing - Concatenative and parametric approaches, WaveNet and other deep learning-based TTS systems.

LAB COMPONENT

8. Convert text to speech and find accuracy. **6**

UNIT - V AUTOMATIC SPEECH RECOGNITION **6**

Speech recognition: Acoustic modelling – Feature Extraction - HMM, HMM-DNN systems.

LAB COMPONENT

9. Design a speech recognition system and find the error rate. **6**

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Daniel Jurafsky and James H. Martin, “Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition”, Third Edition, 2022.
2. Christopher Manning and Hinrich Schutze, “Foundations of Statistical Natural Language Processing”, MIT Press, 1999.

REFERENCES:

1. Dipanjan Sarkar, “Text Analytics with Python: A Practical Real-World approach to Gaining Actionable insights from your data”, APress, 2018.
2. Tanveer Siddiqui, Tiwary U S, “Natural Language Processing and Information Retrieval”, Oxford University Press, 2008.
3. Lawrence Rabiner, Biing-Hwang Juang, B. Yegnanarayana, “Fundamentals of Speech Recognition” 1st Edition, Pearson, 2009.
4. Steven Bird, Ewan Klein, and Edward Loper, “Natural language processing with Python”, O’REILLY.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : TEXT AND SPEECH ANALYSIS		**Course Code : 20ECV43**			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C340.1	Model Language using Text preprocessing, tokenization and representation using N-Gram.	1	K3	1,2,3,5,8,10	2
C340.2	Apply deep learning techniques for NLP tasks, language modelling and machine translation	2	K3	1,2,3,5,8,10	2
C340.3	Make use of word2vec and transformers for text classification.	2	K3	1,2,3,5,8,9,10	2
C340.4	Build question-answering systems, chatbots and dialogue systems	3	K3	1,2,3,5,8,10	2
C340.5	Design a chatbot with a simple dialogue system.	3	K3	1,2,3,5,8,9,10	2
C340.6	Apply deep learning models for building speech recognition and text-to-speech systems	4	K3	1,2,3,5,8,10	2
C340.7	Use HMM and HMM-DNN systems for feature extraction in Acoustic model.	5	K3	1,2,3,5,8,10	2
C340.8	Design a speech recognition system.	5	K3	1,2,3,5,8,9,10	2

CO-PO Mapping

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C340.1	3	2	1		2			2		2				2	
C340.2	3	2	1		2			2		2				2	
C340.3	3	2	1		2			2	2	2				2	
C340.4	3	2	1		2			2		2				2	
C340.5	3	2	1		2			2	2	2				2	
C340.6	3	2	1		2			2		2				2	
C340.7	3	2	1		2			2		2				2	
C340.8	3	2	1		2			2	2	2				2	

20ECV44	DEEP LEARNING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basic ideas and principles of neural networks.
- To understand the basic concepts of big data and statistical data analysis.
- To familiarize the student with the image processing facilities like tensorflow and keras.
- To learn to use deep learning tools and framework for solving real-life problems.
- To use Python for deep learning.

Pre-requisite: - NIL -

UNIT - I INTRODUCTION TO NEURAL NETWORKS 9

Basic concept of Neurons – Perceptron Algorithm – Feed Forward and Back Propagation Networks.

UNIT - II INTRODUCTION TO DEEP LEARNING 9

Feed Forward Neural Networks – Gradient Descent – Back Propagation Algorithm – Vanishing Gradient problem – Mitigation – RelU Heuristics for Avoiding Bad Local Minima – Heuristics for Faster Training – Nestors Accelerated Gradient Descent – Regularization – Dropout.

UNIT - III CONVOLUTIONAL NETWORKS 9

Convolution operation – Motivation – Pooling – Convolution and Pooling as strong prior – Efficient convolution algorithms – Unsupervised features – Sequence Modeling: Recurrent and Recursive Nets – LSTM Networks – Applications – Computer Vision – Speech Recognition – Natural Language Processing.

UNIT - IV DEEP LEARNING ARCHITECTURES 9

LSTM, GRU, Encoder/Decoder Architectures – Autoencoders – Standard- Sparse – Denoising – Contractive - Variational Autoencoders – Adversarial Generative Networks – Autoencoder and DBM.

UNIT - V DEEP LEARNING WITH PYTHON 9

Introduction to Keras and Tensorflow – Deep Learning for computer vision – convnets – Deep Learning for Text and Sequences – Generative Deep Learning – Text Generation with LSTM – Deep Dream – Neural Style Transfer – Generating images with variational autoencoders – Generative Adversarial Networks (GAN).

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Ian Goodfellow, Yoshua Bengio and Aaron Courville, “Deep Learning”, The MIT Press, 2016.
2. Nikhil Buduma and Nicholas Lacascio, “Fundamentals of Deep Learning”, O.Reilly, First Edition, 2017.

REFERENCES:

1. Josh Patterson and Adam Gibson, “Deep Learning: A Practitioner's Approach”, O'Reilly Media, 2017.
2. Laura Graesser and Wah Loon Keng, “Foundations of Deep Reinforcement Learning: Theory and Practice in Python”, Addison-Wesley Professional, 2020.
3. Francois Chollet, “Deep Learning with Python”, Manning Publications, 2018.
4. Jon Krohn, Grant Beyleveld and Aglaé Bassens, “Deep Learning Illustrated: A Visual, Interactive Guide to Artificial Intelligence”, Addison-Wesley Professional, First Edition, 2019.
5. Navin Kumar Manaswi, “Deep Learning with Applications Using Python”, Apress, 2018.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Deep Learning		**Course Code :** 20ECV44			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C341.1	Explain the basic concepts of neural network.	1	K2	1,2,8,10	3
C341.2	Identify the deep learning algorithms for various domains.	2	K2	1,2,8,10	3
C341.3	Explain about basics of Convolutional Neural Networks.	3	K3	1,2,3,8,10	3
C341.4	Apply appropriate deep learning models for analyzing the data.	4	K3	1,2,3,8,10	3
C341.5	Illustrate the concept of Tensor Flow/Keras in deep learning.	5	K2	1,2,8,10	3
C341.6	Develop an application using deep learning techniques.	5	K3	1,2,3,5,8, 10,12	3

CO-PO Mapping

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C341.1	2	1						2		2					1
C341.2	2	1						2		2					1
C341.3	3	2	1					2		2					2
C341.4	3	2	1					2		2					2
C341.5	2	1						2		2					1
C341.6	3	2	1		1			2		2		2			2

20ECV45 ROBOTICS AND AUTOMATION

L	T	P	C
3	0	0	3

OBJECTIVES:

- To study the various parts of robots and fields of robotics.
- To study the various kinematics and inverse kinematics of robots.
- To study the various kinematics and robot dynamics.
- To study the trajectory planning and control for robot.
- To study the control of robots for some specific applications.

PRE-REQUISITE: NIL

UNIT - I BASIC CONCEPTS OF ROBOTS 9

Introduction of robots – Classification of robots – Present status and future trends – Basic components of robotic system – Mechanisms and transmission – End effectors – Grippers – different methods of gripping – Specifications of robot.

UNIT - II DRIVE SYSTEMS AND SENSORS 9

Drive system – hydraulic, pneumatic and electric systems – Sensors in robot: Touch sensors, Tactile sensor, Proximity and range sensors, Robotic vision sensor, Force sensor, Light sensors, Pressure sensors.

UNIT - III KINEMATICS AND DYNAMICS OF ROBOTS 9

2D & 3D Transformation – Scaling – Rotation – Translation – Homogeneous coordinates – multiple transformation – Simple problems – Matrix representation – Forward and Reverse Kinematics of Three Degree of Freedom – Homogeneous Transformations – Inverse kinematics of Robot – Robot Arm dynamics – Basics of Trajectory Planning.

UNIT - IV ROBOT CONTROL 9

Robot controls – Point to point control – Continuous path control – Intelligent robot – Control system for robot joint – Control actions – Feedback devices – Encoder – Resolver – LVDT – Motion Interpolations – Adaptive control.

UNIT - V ARTIFICIAL INTELLIGENCE IN ROBOTICS 9

Application of Machine learning – Artificial Intelligence – Expert systems – Tele-robotics and Virtual Reality – Micro and Nanorobots – Unmanned vehicles – Cognitive robotics – Evolutionary robotics – Humanoids.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Mikell P. Groover, Nicholas G. Odrey, Mitchel Weiss, Roger N. Nagel and Ashish Dutta, “Industrial Robotics, Technology programming and Applications”, McGraw Hill, 2017.
2. J.J.Craig, “Introduction to Robotics - mechanics and control”, Addison-Wesley, Fourth Edition, 2008.

REFERENCES:

1. S.R.Deb, “Robotics Technology and flexible automation”, Tata McGraw-Hill Education, 2009.
2. Richard D. Klafter, A.Thomas, Chri Elewski and Michael Negin, “Robotics Engineering an Integrated Approach”, PHI Learning, 2009.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Robotics and Automation		**Course Code :** 20ECV45			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C342.1	Explain the basic concepts of robotics.	1	K2	1,2,8,10	3
C342.2	Classify the various sensors used in robotics.	2	K3	1,2,3,8,10	3
C342.3	Explain about the differential kinematic in robotics.	3	K2	1,2,8,9,10	3
C342.4	Classify the various dynamics in robotics.	3	K3	1,2,3,8,10	3
C342.5	Discuss the different controls of robot.	4	K2	1,2,8,9,10	3
C342.6	Apply Artificial Intelligence in the field of robotics.	5	K3	1,2,3,8,10	3

CO-PO Mapping

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C342.1	2	1						2		2					1
C342.2	3	2	1					2		2					2
C342.3	2	1						2	2	2					1
C342.4	3	2	1					2		2					2
C342.5	2	1						2	2	2					1
C342.6	3	2	1					2		2					2

20ECV46 WIRELESS BODY AREA NETWORKS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the support system of WBAN.
- To get knowledge about the various protocol design.
- To understand the power management of WBAN.
- To know the application of WBAN in medical field.
- To understand the various wearable applications of WBAN.

PRE-REQUISITE: NIL

UNIT - I OVERVIEW AND SUPPORT SYSTEMS OF WBAN 9

Introduction – WBAN – Hardware: Wireless body sensors – Sensor nodes and hardware designs – Wireless systems and platforms – Wireless transceivers and microcontrollers – Existing sensor boards – Design of implanted sensor nodes for WBAN – WBAN Systems – Software programs and monitoring.

UNIT - II PROTOCOL DESIGN FOR WBAN 9

Network topologies and configuration – Basics of MAC protocol – Traffic characteristics – Scheduled protocol – Random access protocol – Hybrid MAC protocol – Energy management in WBAN – Patient Monitoring Network Design – Performance analysis of WBAN.

UNIT - III POWER MANAGEMENT 9

The Case for Transmit Power Control in Body Area Networks: Normal Walk, Slow Walk, Resting, Optimal Off-Line Transmit Power Control, Practical On-Line. Transmit Power Control: A Simple and Flexible Class of Schemes. Example: Adaptations of the General Scheme, Tuning the Parameters.

UNIT - IV APPLICATIONS OF WBAN IN MEDICAL 9

Monitoring patients with chronic disease – Hospital patients – Elderly patients – Cardiac arrhymias monitoring – Multi patient monitoring systems – Multichannel Neural recording – Gait analysis – Sports Medicine – Electronic pill.

UNIT - V WEARABLE SYSTEMS 9

Need for Wearable Systems – Applications of Wearable Systems – Recent developments – Global and Indian Scenario – Types of Wearable Systems – Components of wearable Systems – Physiological Parameters commonly monitored in wearable applications – Smart textiles & textiles sensors – Wearable Systems for Disaster management.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Huan-Bang Li and Kamya Yekeh Yazdandoost Bin-Zhen, “Wireless Body Area Networks”, River Publishers, 2010.
2. Mehmet R. Yuce and Jamil Y. Khan, “Wireless Body Area Networks Technology, Implementation, and Applications”, Pan Stanford Publishing Pte. Ltd, Singapore, 2012.

REFERENCES:

1. Annalisa Bonfiglio and Danilo De Rossi, “Wearable Monitoring Systems”, Springer, 2011.
2. Terrance J. Dishongh and Michael Mcgrath, “Wireless Sensor Networks for Healthcare Applications”, Artech House, First Edition, 2009.
3. Guang-Zhong Yang and M.Yacoub, “Body Sensor Networks”, Springer, First Edition, 2006.
4. Huan-Bang Li, Kamya Yekeh Yazdandoost and Bin Zhen, “Wireless Body Area Network”, River Publishers’ Series in Information Science and Technology, 2010.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Wireless Body Area Networks		**Course Code :** 20ECV46			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C343.1	Explain the support system of wireless body area network.	1	K2	1,2,8,10	2
C343.2	Develop network protocols for wireless body area network.	2	K3	1,2,3,8,10	2
C343.3	Explain the power management systems in wireless body area networks.	3	K2	1,2,8,10	2
C343.4	Apply the concepts of Wireless body area network in medical field.	4	K3	1,2,3,8,10	2
C343.5	Explain the fundamentals of wearable systems.	5	K2	1,2,8,10	2
C343.6	Classify different types of Wearable systems.	5	K3	1,2,3,8,10	2

CO-PO Mapping

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C343.1	2	1						2		2				1	
C343.2	3	2	1					2		2				2	
C343.3	2	1						2		2				1	
C343.4	3	2	1					2		2				2	
C343.5	2	1						2		2				1	
C343.6	3	2	1					2		2				2	

20ECV51	LOW POWER IC DESIGN	L	T	P	C
		2	0	2	3

OBJECTIVES:

- To learn the fundamentals of low power low voltage VLSI design.
- To understand the impact of power on system performances.
- To understand the different design approaches.
- To develop the low power low voltage memories

PRE-REQUISITE:

Course Code: 20EC505

Course Name: Digital VLSI Design and FPGA Implementation

UNIT I FUNDAMENTALS OF LOW POWER CIRCUITS 6

Need for Low Power Circuit Design, Sources of Power Dissipation – Switching Power Dissipation, Short Circuit Power Dissipation, Leakage Power Dissipation, Glitching Power Dissipation, Short Channel Effects – Drain Induced Barrier Lowering and Punch Through, Surface Scattering, Velocity Saturation, Impact Ionization, Hot Electron Effect.

LAB COMPONENT 1. Modeling and sources of power consumption **6**

UNIT II LOW-POWER DESIGN APPROACHES 6

Low-Power Design through Voltage Scaling: VTCMOS circuits, MTCMOS circuits, Architectural Level Approach –Pipelining and Parallel Processing Approaches. Switched Capacitance Minimization Approaches: System Level Measures, Circuit Level Measures, Mask level Measures.

LAB COMPONENT 2. Power estimation at different design levels (mainly circuit, transistor, and gate) **6**

UNITIII LOW-VOLTAGE LOW-POWER ADDERS 6

Introduction, Standard Adder Cells, CMOS Adder's Architectures – Ripple Carry Adders, Carry Look-Ahead Adders, Carry Select Adders, Carry Save Adders, Low Voltage Low Power Design Techniques –Trends of Technology and Power Supply Voltage, Low Voltage Low-Power Logic Styles.

LAB COMPONENT 3. Power optimization for combinational circuits **6**

UNIT IV LOW-VOLTAGE LOW-POWER MULTIPLIERS 6

Introduction, Overview of Multiplication, Types of Multiplier Architectures, Braun Multiplier, Baugh Wooley Multiplier, Booth Multiplier, Introduction to Wallace Tree Multiplier

LAB COMPONENT 4. Power optimization for sequential circuits **6**

UNIT V LOW-VOLTAGE LOW-POWER MEMORIES 6

Basics of ROM, Low-Power ROM Technology, Future Trend and Development of ROMs, Basics of SRAM, Memory Cell, Pre-charge and Equalization Circuit, Low Power SRAM Technologies, Basics of DRAM, Self-Refresh Circuit, Future Trend and Development of DRAM.

LAB COMPONENT 5. Power optimization for RT and algorithmic levels **6**

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Sung-Mo Kang, Yusuf Leblebici, "CMOS Digital Integrated Circuits – Analysis and Design", TMH, 2011.
2. 2. Kiat-Seng Yeo, Kaushik Roy, "Low-Voltage, Low-Power VLSI Subsystems", TMH Professional Engineering, 2004.

REFERENCES:

1. Ming-BO Lin, “Introduction to VLSI Systems: A Logic, Circuit and System Perspective”, CRC Press, 2012.
2. Anantha Chandrakasan, “Low Power CMOS Design”, IEEE Press, /Wiley International, 1998.
3. Kaushik Roy, Sharat C. Prasad, “Low Power CMOS VLSI Circuit Design”, John Wiley, & Sons, 2000.
4. Gary K. Yeap, “Practical Low Power Digital VLSI Design”, Kluwer Academic Press, 2002.
5. Bellamour, M. I. Elamasri, “Low Power CMOS VLSI Circuit Design”, A Kluwer Academic Press, 1995.
6. Siva G. Narendran, Anatha Chandrakasan, “Leakage in Nanometer CMOS Technologies”, Springer, 2005.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : LOW POWER IC DESIGN		**Course Code :** 20ECV51			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C344.1	Summarize the sources of power dissipation.	1	K2	1,2	3
C344.2	Discuss different low-power design approaches.	2	K2	1,2	3
C344.3	Design low-voltage low-power adder logic circuits.	3	K3	1,2,3,5,6,8,9, 10	3
C344.4	Design low-voltage low-power multiplier logic circuits.	4	K3	1,2,3,5,6,8,9, 10	3
C344.5	Design low-voltage low-power memory logic circuits.	5	K3	1,2,3,5,6,8,9, 10	3
C344.6	Design and develop low power, low voltage circuits.	5	K3	1,2,3,5,6,8,9, 10	3

CO-PO Mapping

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C344.1	2	1													1
C344.2	2	1													2
C344.3	3	2	1		3	2		2	2	2					1
C344.4	3	2	1		3	2		2	2	2					2
C344.5	3	2	1		3	2		2	2	2					1
C344.6	3	2	1		3	2		2	2	2					2

20ECV52 ADVANCED WIRELESS COMMUNICATION

L	T	P	C
3	0	0	3

OBJECTIVES:

- To learn the various channel models.
- To know the channel capacity of fading channels.
- To understand the concepts of diversity combining techniques for transmit and receive diversity.
- To understand the MIMO communication architecture and beamforming.
- To understand the various multiple access techniques for multiuser.

PRE-REQUISITE: NIL

UNIT - I WIRELESS CHANNEL PROPAGATION AND MODEL 9

Propagation of EM signals in wireless channel – Reflection, diffraction and Scattering- free space, two ray. Small scale fading - channel classification - channel models – COST - 231 Hata model, Longley-Rice Model, NLOS Multipath Fading Models: Rayleigh, Rician, Nakagami, Composite Fading – shadowing Distributions, Link power budget Analysis.

UNIT - II CAPACITY OF WIRELESS CHANNELS 9

Capacity in AWGN, capacity of flat fading channel, capacity of frequency selective fading channels.

UNIT - III DIVERSITY 9

Realization of independent fading paths, Receiver Diversity: Selection combining, Threshold Combining, Maximum-ratio Combining, Equal Gain Combining. Transmitter Diversity: Channel known at transmitter, Channel unknown at the transmitter.

UNIT - IV MIMO COMMUNICATIONS 9

Narrowband MIMO model, Parallel decomposition of the MIMO channel, MIMO channel capacity, MIMO Diversity Gain: Beam forming, Diversity-Multiplexing trade-offs, Space time Modulation and coding: STBC, STTC, Spatial Multiplexing and BLAST Architectures.

UNIT - V MULTIUSER SYSTEMS 9

Review of Multiple Access Techniques, Scheduling, power control, Uplink and Downlink.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Andrea Goldsmith, “Wireless Communications”, Cambridge University Press, 2007.
2. Harry R. Anderson, “Fixed Broadband Wireless System Design”, John Wiley, India, 2003.

REFERENCES:

1. Andreas F. Molisch, “Wireless Communications”, John Wiley, India, 2006.
2. Simon Haykin and Michael Moher, “Modern Wireless Communications”, Pearson Education, 2007.
3. T.S.Rappaport, “Wireless Communications”, Pearson Education, 2003.
4. Gordon L. Stuber, “Principles of Mobile Communication”, Springer International Ltd., 2001.
5. Upena Dalal, “Wireless Communication”, Oxford Higher Education, 2009.
6. David Tse and Pramod Viswanath, “Fundamentals of Wireless Communication”, Cambridge University Press, 2005.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : ADVANCED WIRELESS COMMUNICATION		**Course Code :** 20ECV52			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C345.1	Identify appropriate wireless channel models using the wireless channel characteristics.	1	K3	1,2,3,8,10	2
C345.2	Apply the mathematics behind the capacity calculation under different channel conditions.	2	K3	1,2,3,8,10	2
C345.3	Selection of minimum fading path using diversity combining methods and the knowledge of channel.	3	K3	1,2,3,8,10	2
C345.4	Apply the diversity and beam forming concepts in MIMO Communications.	4	K3	1,2,3,8,10	2
C345.5	Classification of multiple access techniques.	5	K3	1,2,3,8,9,10	2
C345.6	Make use of multiple access techniques in different multi-user scenarios.	5	K3	1,2,3,8,9,10	2

CO-PO Mapping

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C345.1	3	2	1					2		2				2	
C345.2	3	2	1					2		2				2	
C345.3	3	2	1					2		2				2	
C345.4	3	2	1					2		2				2	
C345.5	3	2	1					2	2	2				2	
C345.6	3	2	1					2	2	2				2	

20ECV53	DIGITAL IMAGING AND COMPUTER VISION	L	T	P	C
		2	0	2	3

OBJECTIVES:

- To become familiar with digital image fundamentals.
- To get exposed to simple image enhancement techniques in spatial and frequency domain.
- To learn concepts of degradation function and Image compression techniques.
- To study the image segmentation and morphological image processing.
- To become familiar with computer vision techniques.

PRE-REQUISITE: NIL

UNIT - I INTRODUCTION **6**

Components of Image Processing System - Image Sampling and Quantization - Some basic relationships - Neighbors - Connectivity - Distance Measures between pixels.

LAB COMPONENT

1. Write a MATLAB program for sampling and quantization.
2. Write a MATLAB program for relation between neighboring pixels and distance measurement. **6**

UNIT - II IMAGE ENHANCEMENT IN THE SPATIAL AND FREQUENCY DOMAIN **6**

Image enhancement by point processing and neighbourhood processing - Basic Gray Level Transformations - Histogram Processing - Basics of Spatial Filters - Smoothening and Sharpening - Spatial Filters Enhancement - Frequency Domain Filtering: Smoothing and Sharpening, Homomorphic Filtering.

LAB COMPONENT

3. Write a MATLAB program for basic gray level transformations.
4. Write a MATLAB program for filtering operations **6**

UNIT - III IMAGE RESTORATION AND IMAGE COMPRESSION **6**

Image Restoration: Model of the Image Degradation - Noise Models - Restoration in the presence of Noise Only Spatial Filtering - Inverse filtering - Wiener filtering.

Image Compression: Data Redundancies - Image Compression models - Lossless and Lossy compression - Huffman Coding - Shanon-Fano Coding

LAB COMPONENT

5. Write a MATLAB program for removing various noise in degraded images.
6. Implement MATLAB program for any one of the image compression techniques. **6**

UNIT - IV IMAGE SEGMENTATION AND MORPHOLOGICAL IMAGE PROCESSING **6**

Image Segmentation: Discontinuity based segmentation - similarity based segmentation - Edge linking and boundary detection - Threshold - Region based Segmentation.

Morphological Image Processing: Dilation - Erosion - Some basic Morphological Algorithms.

LAB COMPONENT

7. Write a MATLAB program for region-based image segmentation algorithm.
8. Implement MATLAB program for basic morphological operations. **6**

UNIT - V COMPUTER VISION TECHNIQUES **6**

Introduction to Computer vision - Image Formation: Geometric image formation - Feature extraction and detection - Matching - Object detection and tracking - Motion estimation - Object Modeling - video processing.

LAB COMPONENT

9. Write a MATLAB program for object tracking in videos.
10. Implement MATLAB program for feature extraction and detection in images. **6**

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing", Pearson Education, Fourth Edition, 2018.
2. David A. Forsyth and Jean Ponce, "Computer Vision: A Modern Approach", Prentice Hall, 2015.

REFERENCES:

1. Anil K. Jain, "Fundamental of Digital Image Processing", Prentice-Hall of India Pvt. Ltd., 2015.
2. W.K. Pratt, "Digital Image Processing", A John Wiley & Sons Inc., 2007.
3. John C. Russ and F. Brent Neal, "The Image processing Handbook", CRC Press, Seventh Edition, 2017.
4. Wesley E. Snyder and Hairong Qi, "Fundamentals of Computer Vision", Cambridge University Press, First Edition, 2017.
5. Chris Solomon and Toy Breckon, "Fundamentals of Digital Image Processing: A practical approach with examples in Matlab", Wiley Publication, First Edition, 2010.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Digital Imaging and Computer Vision		**Course Code :** 20ECV53			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C346.1	Discuss how digital images are acquired, stored and relationship between pixels.	1	K2	1,2,5,8,9,10	2
C346.2	Illustrate image enhancement techniques in spatial and frequency domain.	2	K3	1,2,3,5,8,9, 10	2
C346.3	Elaborate the mathematical modelling of image restoration and compression.	3	K4	1,2,3,4,5,8,9, 10	2
C346.4	Describe the various image segmentation techniques.	4	K2	1,2,5,8,9,10	2
C346.5	Illustrate the morphological image processing and algorithms.	4	K3	1,2,3,5,8,9, 10	2
C346.6	Discuss the fundamental concepts of Computer vision methods.	5	K2	1,2,5,8,9,10	2

CO-PO Mapping

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C346.1	2	1			3			2	2	2				1	
C346.2	3	2	1		3			2	2	2				2	
C346.3	3	3	2	1	3			2	2	2				3	
C346.4	2	1			3			2	2	2				1	
C346.5	3	2	1		3			2	2	2				2	
C346.6	2	1			3			2	2	2				1	

20ECV54	DATA ANALYTICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basic concepts of data analytic.
- To handle missing data in the real world data sets by choosing appropriate methods.
- To learn data analysis methods.
- To learn stream computing.
- To understand and apply data analysis techniques.
- To gain knowledge on Hadoop related tools.

PRE-REQUISITE:
Course Code: 20ECV14
Course Name: Machine Learning and Applications

UNIT - I INTRODUCTION **9**

Knowledge domains of Data Analysis – Understanding structured and unstructured data – data analytic tools – applications of data analytics – various phases of data analytics lifecycle: discovery, data preparation, model planning, model building, communicating results, operationalization.

UNIT - II DATA PREPROCESSING **9**

Data Preprocessing: Data Cleaning – Data Integration – Data Reduction – Data Transformation. Handling Missing Data: Introduction to Missing data – Traditional methods for dealing with missing data. Maximum Likelihood Estimation – Basics, Missing data handling, improving the accuracy of analysis.

UNIT - III CLASSIFICATION AND CLUSTERING **9**

Statistical Methods: Regression modelling – Multivariate Analysis – Classification: SVM & Kernel Methods – Rule Mining – Cluster Analysis – Types of Data in Cluster Analysis – Partitioning Methods – Hierarchical Methods – Density Based Methods – Grid Based Methods – Model Based Clustering Methods – Clustering High Dimensional Data – Predictive Analytics.

UNIT - IV INTELLIGENT DATA ANALYSIS **9**

Analysis of Time Series: Linear and Non Linear Systems Analysis, Neural Networks : Fundamentals – Back Propagation Neural Network – Fuzzy Logic : Basics of Fuzzy Sets and Fuzzy Logic - Genetic Algorithms

UNIT - V HADOOP FRAMEWORKS **9**

HADOOP: HDFS concepts, Algorithms using MapReduce. Introduction to NoSQL, Cassandra, Pig – Hive.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. EMC Education Services (Editor), “Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data”, John Wiley & Sons, 2015.
2. Craig K. Enders, “Applied Missing Data Analysis”, The Guilford Press, 2010.
3. Michael Berthold and David J. Hand, “Intelligent Data Analysis”, Springer, Second Edition, 2007.

REFERENCES:

1. Bill Franks, “Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics”, Wiley, 2012.
2. Michael Minelli, Michelle Chambers and Ambiga Dhiraj, “Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses”, Wiley, 2013.
3. P.J. Sadalage and M. Fowler, “NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence”, Addison-Wesley Professional, 2012.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Data Analytics		**Course Code :** 20ECV54			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C347.1	Explain the basic concepts of Data Analytic	1	K2	1,2,8,9	2
C347.2	Describe the Data Analysis preprocessing Techniques.	2	K2	1,2,8,9	2
C347.3	Explain about how missing data will be handled during preprocessing	2	K2	1,2,8,9	2
C347.4	Apply the Classification and Clustering algorithms for real time applications	3	K3	1,2,3,8,9	2
C347.5	Apply intelligent analytics techniques like neural networks, fuzzy and genetic algorithms for real time analytics applications	4	K3	1,2,3,8,9	2
C347.6	Explain the Hadoop related tools such as HBase, Cassandra, Pig, and Hive for big data analytics	5	K2	1,2,8,9	2

CO-PO Mapping

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C347.1	2	1						1	1					1	
C347.2	2	1						1	1	1				1	
C347.3	2	1						1	1	1				1	
C347.4	3	2	1					1	1			1		2	
C347.5	3	2	1					1	1			1		2	
C347.6	2	1			1			1	1			1		1	

20ECV55	INDUSTRIAL IOT AND INDUSTRY 4.0	L	T	P	C
		2	0	2	3

OBJECTIVES:

- To know about IoT Nodes & Sensors, IoT Gateways, IoT Cloud Systems and IoT Cloud Dashboards
- To study the challenges in IoT system Design – Hardware & Software

PRE-REQUISITE: - NIL

UNIT - I UNDERSTANDING IOT CONCEPT AND DEVELOPMENT PLATFORM 6

IOT Definition, Importance of IoT, Applications of IOT, IoT architecture, Understanding working of Sensors, Actuators, Sensor calibration, Study of Different sensors and their characteristics.

LAB COMPONENT

1. Interfacing LDR sensor, IR sensor.
2. Interfacing Temperature sensor, Gas sensor. **6**

UNIT - II ANALYZING & DECODING OF COMMUNICATION PROTOCOL USED IN IOT DEVELOPMENT PLATFORM 6

UART Communication Protocol, I2C Protocol device interfacing and decoding of signal, SPI Protocol device interfacing and decoding of signal, WIFI and Router interfacing, Ethernet Configuration, Bluetooth study and analysis of data flow, Zigbee Interfacing and study of signal flow.

LAB COMPONENT

3. Interfacing UART, I2C.
4. Interfacing Bluetooth, Zigbee. **6**

UNIT - III RSAPBERRY PI - IOT DEVELOPMENT PLATFORM 6

Raspberry Pi: Introduction to Raspberry Pi, About the Raspberry Pi Board: Hardware Layout and Pinouts, Operating Systems on Raspberry Pi, Configuring Raspberry Pi, Connecting Raspberry Pi via SSH, Remote access tools, Programming Raspberry Pi - Python program with Raspberry PI with focus on interfacing external gadgets, controlling output, reading input from pins. Pi as Webserver, Pi Camera, Image & Video Processing using Pi.

LAB COMPONENT

5. Write a program using sensors for car parking assist.
6. Write a program using sensors for water level indicator and overflow detection. **6**

UNIT - IV IOT PHYSICAL DEVICES AND ENDPOINTS AND CONTROLLING HARDWARE AND SENSORS 6

Controlling Hardware - Connecting LED, Buzzer, Switching High Power devices with transistors, Controlling AC Power devices with Relays, Controlling servo motor, speed control of DC Motor, unipolar and bipolar Stepper motors;

Sensors - Light sensor, temperature sensor with thermistor, voltage sensor, ADC and DAC, Temperature and Humidity Sensor DHT11, Motion Detection Sensors, Wireless Bluetooth Sensors, Level Sensors, USB Sensors, Embedded Sensors, Distance Measurement with ultrasound sensor.

LAB COMPONENT

7. Write a program to control LEDs using Alexa Echo Dot.
8. Write a program to control Buzzer using Alexa Echo Dot. **6**

UNIT - V CLOUD SERVICES USED IN IOT DEVELOPMENT PLATFORM 6

Configuration of the cloud platform, Sending data from the IOT nodes to the gateways using different communication options; Transferring data from gateway to the cloud; Exploring the web services like mail, Messaging (SMS) and Twitter etc.; Tracking of cloud data as per the requirement; Google Cloud service architect; AWS cloud Services architect; Microsoft Azure cloud services Architect; OEN source Cloud Services; Initial State Iot Dashboard & Cloud Services.

LAB COMPONENT

9. Write a program to control Stepper motor using Google Assistance.
10. Write a program to control DC motor using Google Assistance. **6**

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Arshdeep Bahga and Vijay Madisetti, “Internet of Things – A Hands-on Approach”, Universities Press, 2015.
2. Matt Richardson and Shawn Wallace, “Getting Started with Raspberry Pi”, O’Reilly (SPD), 2014.

REFERENCES:

1. Simon Monk, “Raspberry Pi Cookbook: Software and Hardware Problems and solutions”, O’Reilly (SPD), 2016.
2. N.Ida, “Sensors, Actuators and Their Interfaces”, SciTech Publishers, 2014.
3. Peter Waher, “Learning Internet of Things”, Packt Publishing, 2015.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : INDUSTRIAL IOT AND INDUSTRY 4.0		**Course Code :** 20ECV55			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C348.1	Explain the building blocks of IoT technology and explore the vast spectrum of IoT applications.	1	K2	1,2,8,10	2
C348.2	Illustrate the processors and peripherals to design and build IoT hardware.	2	K3	1,2,3,8,10	2
C348.3	Illustrate the assess, select and customize technologies for IoT applications.	3	K3	1,2,3,8,10	2
C348.4	Apply connect numerous IOT applications with the physical world of humans and real life problem solving.	4	K3	1,2,3,5,8,9, 10	2
C348.5	Design and implement IOT applications that manage big data.	5	K3	1,2,3,5,8,10	2
C348.6	Identify any societal problem and solve by applying the acquired knowledge in Industrial IoT and Industry 4.0.	5	K3	1,2,3,5,8,9, 10	2

CO-PO Mapping

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C348.1	2	1						1		1				2	
C348.2	3	2	1					2		2				2	
C348.3	3	2	1					2		2				2	
C348.4	3	2	1		2			2	2	2				2	
C348.5	3	2	1		2			1		1				2	
C348.6	3	2	1		2			2	2	2				2	

20ECV56	BIOMEDICAL IMAGING SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- A study of the principles and design of medical imaging systems such as X-ray, ultrasound, nuclear medicine, and nuclear magnetic resonance.
- The rapidly growing field of biomedical imaging enables one to visualize physiological structures.
- Provide an overview of physical processes of imaging biological tissues.
- Provide the students with mathematical and computational tools to analyse and interpret a range of biomedical images.

Pre-requisite:
Course Code: 20ECV53
Course Name: Digital Imaging and Computer Vision

UNIT - I FUNDAMENTALS OF MEDICAL IMAGING SYSTEMS 9

Medical imaging with x-rays: CT, MRI and ultrasound – X-ray radiography – ultrasound – radionuclide imaging – magnetic resonance imaging (MRI) – Biological effects of each modality – Topographical reconstruction principles – including X-ray computed tomography (CT) – position emission tomography (PET) – single-photon emission computed tomography (SPECT).

UNIT - II X-RAY IMAGING 9

The EM spectrum – interactions of EM radiation with tissue – ionizing radiation – x-ray production – photo electric effect – Compton scatter – X-ray imaging – Planar imaging: characterizing x-ray beams, Beer's law, linear attenuation coefficients, radiation dose, filtering and collimation, projection radiography, blurring and resolution, SNR. Basic concepts, evolution of x-ray CT scanners, hardware. CT measurement, CT numbers, line integrals and Radon transform. Projection slice theorem. Image reconstruction by filtered backprXojection for parallel and fan beam data. Conbeam CT. Sampling issues; resolution and noise in CT, beam hardening and scatter.

UNIT - III NUCLEAR MEDICINE 9

Radioactive decay and radioisotopes. Types of radioactive decay, gamma rays and positrons. Common sources in nuclear medicine. Radio pharmacy and kinetic modeling. The Anger camera and planar imaging. Collimators and imaging equations. Resolution and SNR. SPECT imaging basics, imaging equation, reconstruction. Resolution and noise properties. Quantitation: scatter, background, sensitivity. PET imaging basics, imaging equation, reconstruction. Resolution and noise properties.

UNIT - IV ULTRASOUND IMAGING 9

Wave equation, reflections and refractions, attenuation and absorption. Ultrasound transducer design, A, M and B mode display. Imaging signal model for pulse echo imaging, Image formation, and resolution and noise characteristics.

UNIT - V MAGNETIC RESONANCE IMAGING 9

MR hardware, spin physics, Bloch equations, Signal detection, spectroscopy, noise, RF excitation, Spin echoes, relaxation, contrast. Spatial encoding, image reconstruction, resolution, Artefacts, fMRI, diffusion MRI.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Thomas Martin Deserno, "Biomedical Image Processing", Springer, 2011.
2. G.R.Sinha and B.C.Patel, "Medical Image Processing: Concepts and Applications", Prentice Hall, 2014.

REFERENCES:

1. Karen M. Mudry, Robert Plonsey and Joseph D. Bronzino, “Biomedical Imaging”, CRC Press, 2003.
2. Z.H. Cho, J.P. Jones and M. Singh, “Foundations of Medical Imaging”, Wiley, 1993.
3. R.M.Rangayyan, “Biomedical Image Analysis”, CRC Press, Fifth Edition, 2005.
4. Kayvan Najarian and Robert Splinter, “Biomedical Signal and Image Processing”, CRC Press, Second Edition, 2014.
5. T.M.Deserno, “Biomedical Image Processing”, Springer, 2011.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : BIOMEDICAL IMAGING SYSTEMS		**Course Code :** 20ECV56			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C349.1	Describe how biomedical imaging systems are used in biological and medical research.	1	K2	1,2,8,10	2
C349.2	Analyze the x ray imaging systems used for needed biomedical applications.	2	K4	1,2,3,4,8,10	2
C349.3	Explain about Nuclear medicine used in SPECT and PET imaging basics.	3	K2	1,2,8,10	2
C349.4	Discuss the concept of the Anger camera and planar imaging.	3	K2	1,2,8,9,10	2
C349.5	Explain the fundamentals of ultrasound imaging and also ultrasound transducer design.	4	K2	1,2,8,9,10	2
C349.6	Illustrate the types and basis of MRI systems.	5	K3	1,2,3,8,10	2

CO-PO Mapping

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C349.1	2	1						2		2				1	
C349.2	3	3	2	1				2		2				3	
C349.3	2	1						2		2				1	
C349.4	2	1						2	2	2				1	
C349.5	2	1						2	2	2				1	
C349.6	3	2	1					2		2				2	

20ECV61	NETWORK ON CHIP DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the relationship between semiconductor technology, computer architecture and computer networking in the design of the communication network for a MPSoC or a many-core design.
- To learn the basic concepts of Network-on-Chip design by studying the topologies, router design and MPSoC styles.
- To learn sample routing algorithms on a NoC with deadlock and livelock avoidance.
- To understand the role of system-level design and performance metrics in choosing a NoC design.

PRE-REQUISITE:

Course Code: 20EC505, 20EC602

Course Name: Digital VLSI Design and FPGA Implementation, Communication Networks

UNIT - I INTRODUCTION TO NOC **9**

Introduction to NOC - OSI layer rules in NOC - Interconnection networks in Network-on-Chip Network topologies - Switching techniques - Routing strategies - Flow control protocol quality-of-service support.

UNIT - II ARCHITECTURE DESIGN **9**

Switching techniques and packet format - Asynchronous FIFO design - GALS style of communication - Wormhole router architecture design - VC router architecture design - Adaptive router architecture design.

UNIT - III ROUTING ALGORITHM **9**

Packet routing - QOS - Congestion control and flow control - Router design - Network link design - Efficient and deadlock-free tree-based multicast routing methods - Path-based multicast routing for 2D and 3D mesh networks - Fault-tolerant routing algorithms - Reliable and adaptive routing algorithms.

UNIT - IV FAULT TOLERANCE OF NOC **9**

Design-security in Networks-on-Chips - Formal verification of communications in Networks-on Chips - Test and fault tolerance for Networks-on-Chip infrastructures - Monitoring services for Networks-on-Chips.

UNIT - V THREE-DIMENSIONAL INTEGRATION OF NETWORK-ON-CHIP **9**

Three-dimensional Networks-on-Chips architectures - A novel dimensionally-decomposed router for on-Chip communication in 3D architectures - Resource allocation for QoS on-Chip communication - Networks-on-Chip protocols - on-Chip processor traffic modeling for Networks-on-Chip.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Santanu Chattopadhyay and Santanu Kundu, "Network-on-Chip: The Next Generation of System-on-Chip Integration", CRC Press, First Edition, 2014.
2. Maurizio Palesi and Masoud Daneshtalab, "Routing Algorithms in Networks-on-Chip", Springer Nature, 2014.

REFERENCES:

1. Chita R. Das, Chrysostomos Nicopoulos and Vijaykrishnan Narayanan, "Network-on-Chip Architectures: A Holistic Design Exploration", Springer, 2010.
2. Fayez Gebali, Haytham Elmiligi and Mohamed Watheq El-Kharashi, "Networks-on-Chips: Theory and Practice", CRC Press, First Edition, 2017.
3. Konstantinos Tatas, Kostas Siozios, Dimitrios Soudris and Axel Jantsch, "Designing 2D and 3D Network-on-Chip Architectures", Springer, 2016.
4. Sheng Ma, Libo Huang, Mingche Lai, Wei Shi and Zhiying Wang, "Networks-on-Chip: From Implementations to Programming Paradigms", Morgan Kaufmann, 2014.
5. Fayez Gebali, Haytham Elmiligi and Mohamed Watheq El-Kharashi, "Networks-on-Chips: Theory and Practice", CRC Press, First Edition, 2009.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : NETWORK ON CHIP DESIGN		**Course Code :** 20ECV61			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C350.1	Explain the various concepts of network-on-chip.	1	K2	1,2,8,9	3
C350.2	Discuss the relationship between semiconductor technology, computer architecture and computer networking in the design of the on-chip communication network.	1	K2	1,2,8,9	3
C350.3	Compare the different architecture designs.	2	K2	1,2,8,9	3
C350.4	Discuss the different routing algorithms.	3	K2	1,2,8,9	3
C350.5	Describe the fault tolerant NOC design.	4	K2	1,2,8,9	3
C350.6	Explain the three-dimensional architectures of NOC.	5	K2	1,2,8,9	3

CO-PO Mapping

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C350.1	2	1						1	1						1
C350.2	2	1						1	1						1
C350.3	2	1						1	1						1
C350.4	2	1						1	1						1
C350.5	2	1						1	1						1
C350.6	2	1						1	1						1

20ECV62	RADAR TECHNOLOGIES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basics of Radar and Radar equation.
- To understand the types of Radar.
- To understand tracking Radar.
- To understand the various signal processing in Radar.
- To understand the subsystems in Radar.

PRE-REQUISITE: - NIL

UNIT - I INTRODUCTION TO RADAR EQUATION **9**

The Origins of Radar, Radar principles, Basic Block Diagram, Radar classifications based on Frequencies, Wave form and application, Radar Fundamentals: Detection, Range, velocity, The simple form of the Radar Equation, Pulsed Radar equation, Detection of Signals in Noise- Receiver Noise, Signal-to-Noise Ratio, Probabilities of Detection and False Alarm, Integration of Radar Pulses, Radar Cross Section of Targets, Transmitter Power, Pulse Repetition Frequency, Antenna Parameters, System losses.

UNIT - II CW, MTI AND PULSE DOPPLER RADAR **9**

CW and Frequency Modulated Radar, Doppler and MTI Radar - Delay Line Cancellers, Staggered Pulse Repetition Frequencies, Doppler Filter Banks, Digital MTI Processing, Moving Target Detector, Limitations to MTI Performance, MTI from a Moving Platform (AMIT), Pulse Doppler Radar.

UNIT - III TRACKING RADAR **9**

Tracking with Radar, Monopulse Tracking, Conical Scan, Sequential Lobing, Limitations to Tracking Accuracy, Low-Angle Tracking - Comparison of Trackers, Track while Scan (TWS) Radar- Target prediction, state estimation, Measurement models, alpha - beta tracker, Kalman Filtering, Extended-Kalman filtering.

UNIT - IV RADAR SIGNAL PROCESSING **9**

Radar Signal Processing Fundamentals, Detection strategies, Optimal detection, Threshold detection, Constant False alarm rate detectors, Adaptive CFAR, pulse compression waveforms, compression gain, LFM waveforms matched filtering, radar ambiguity functions, radar resolution, Detection of radar signals in Noise and clutter, detection of non-fluctuating target in noise, Doppler spectrum of fluctuating targets, Range Doppler spectrum of stationary and moving radar.

UNIT - V RADAR TRANSMITTERS AND RECEIVERS **9**

Radar Transmitter, Linear Beam Power Tubes, Solid State RF Power Sources, Magnetron, Crossed Field Amplifiers, Other RF Power Sources. The Radar Receiver, Receiver noise power, Super heterodyne Receiver, Duplexers and Receiver Protectors - Radar Displays. Radar Antenna - Reflector Antennas - Electronically Steered Phased Array Antennas - Phase Shifters.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Habibur Rahman, “Fundamental Principles of Radar”, CRC press, Taylor and Francis, 2019.
2. M.R.Richards, J.A.Scheer and W.A.Holm, “Principles of Modern Radar: Basic Principles”, SciTech Publishing, 2012.

REFERENCES:

1. Nathansan, “Radar design principles, Signal processing and environment”, PHI, Second Edition, 2007.
2. M.I.Skolnik , “Introduction to Radar Systems”, Tata McGraw Hill, 2006.
3. Mark A. Richards, “Fundamentals of Radar Signal Processing”, McGraw-Hill, 2005.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : RADAR TECHNOLOGIES		**Course Code :** 20ECV62			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C351.1	Identify the different Radar parameters and derive the Radar equation.	1	K2	1,2,8,10	2
C351.2	Differentiate various Radar types.	2	K2	1,2,9,10	2
C351.3	Explain different tracking and filtering schemes.	3	K2	1,2,9,10	2
C351.4	Apply Signal Processing in target detection.	4	K3	1,2,3,8,10	2
C351.5	Apply the detection of radar signal in noise and demonstrate noise figure.	4	K3	1,2,3,8,10	2
C351.6	Develop Radar transmitters and Receiver blocks.	5	K3	1,2,3,8,10	2

CO-PO Mapping

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C351.1	2	1						1		1				2	
C351.2	2	1							1	1				2	
C351.3	2	1							1	1				2	
C351.4	3	2	1					1		1				2	
C351.5	3	2	1					1		1				2	
C351.6	3	2	1					1		1				2	

20ECV63	SOFTWARE DEFINED RADIO	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the concepts of software radios.
- To know about RF implementation challenges for software defined radios.
- To understand the digital generation of signals.
- To know about Smart antennas for SDR.
- To learn the software and hardware requirements for software defined radios.

PRE-REQUISITE: - NIL -

UNIT - I INTRODUCTION TO SOFTWARE RADIO AND RF FRONT END 9

The Need for Software Radios. what is a software radio, Characteristics and Benefits of a Software Radio. Design Principles of a Software Radio. Purpose of RF front-end, Dynamic range, RF receiver front-end topologies.

UNIT - II RADIO FREQUENCY IMPLEMENTATION ISSUES 9

Enhanced flexibility of the RF chain with software radios, Importance of the components to overall performance, Transmitter architectures and their issues, Noise and distortion in the RF chain, ADC and DAC distortion, Predistortion, flexible RF systems using micro electro mechanical systems.

UNIT - III DIGITAL GENERATION OF SIGNALS 9

Hybrid DDS – PLL systems, Applications of Direct Digital Synthesis. Comparison of direct digital synthesis with analog signal synthesis, Approaches to direct digital synthesis, Analysis of spurious signals, Performance of direct digital synthesis systems, Applications of direct digital synthesis.

UNIT - IV SMART ANTENNAS 9

Introduction, vector channel modeling, benefits of smart antennas, structure for Beam forming systems, smart antenna algorithms, diversity and space-time adaptive signal processing. Algorithms for transmit STAP, hardware implementation of smart antennas. Digital Hardware Choices-Key hardware elements.

UNIT - V HARDWARE AND SOFTWARE FOR SDR & CASE STUDIES 9

DSP Processors, FPGA, ASICs. Trade-offs, Object oriented programming, Object Brokers, GNU Radio-USRP. Case Studies: SPEAK easy, JRTS, SDR-3000. Digital transceiver subsystem, spectrum ware.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Jeffrey Hugh Reed, “Software Radio: A Modern Approach to Radio Engineering”, Prentice Hall Professional, 2002.
2. Tony J. Rouphael, “RF and DSP for SDR”, Elsevier Newnes Press, 2008.

REFERENCES:

1. P. Kenington, “RF and Baseband Techniques for Software Defined Radio”, Artech House, 2005.
2. Paul Burns, “Software Defined Radio for 3G”, Artech House, 2002.
3. Behrouz. F. Bourjney, “Signal Processing for Software defined Radios”, Lulu, 2008.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : SOFTWARE DEFINED RADIO		**Course Code :** 20ECV63			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C352.1	Demonstrate an understanding in the evolving paradigm of Software defined radio and technologies for its implementation.	1	K3	1,2,3,8,10	2
C352.2	Explain about RF front end.	2	K2	1,2,8,10	2
C352.3	Identify radio frequency implementation issues.	3	K3	1,2,3,8,10	2
C352.4	Identify various digital synthesis procedures.	4	K3	1,2,3,8,10	2
C352.5	Illustrate smart antenna techniques for software defined radio.	5	K3	1,2,3,8,10	2
C352.6	Classify various hardware and software requirements for software defined radios.	5	K3	1,2,3,8,10	2

CO-PO Mapping

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C352.1	3	2	1					2		2				2	
C352.2	2	1						2		2				1	
C352.3	3	2	1					2		2				2	
C352.4	3	2	1					2		2				2	
C352.5	3	2	1					2		2				2	
C352.6	3	2	1					2		2				2	

20ECV64	VIRTUAL REALITY AND AUGMENTED REALITY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn rapidly evolving and commercially viable field of computer science.
- To become familiar with geometric modeling and computer graphics.
- To learn various types of Hardware and Software in virtual Reality systems.

PRE-REQUISITE: - NIL

UNIT - I INTRODUCTION TO VIRTUAL REALITY **9**

Virtual Reality and Virtual Environment: Introduction – Computer graphics – Real time computer graphics – Flight Simulation – Virtual environment requirement – benefits of virtual reality – Historical development of VR – Scientific Landmark.

UNIT - II AUGMENTED REALITY **9**

Taxonomy – technology and features of augmented reality – difference between AR and VR – Challenges with AR – AR systems and functionality – Augmented reality method – visualization techniques for augmented reality – enhancing interactivity in AR environments – evaluating AR systems.

UNIT - III COMPUTER GRAPHICS AND GEOMETRIC MODELING **9**

Introduction – The Virtual world space – positioning the virtual observer – The perspective projection – Human vision – Stereo perspective projection – Colour theory. Geometrical Transformations: Introduction – frames of reference – Modeling transformations – scaling the VE – Collision detection.

UNIT - IV DEVELOPMENT TOOLS AND FRAMEWORK **9**

Human factors – Hardware – Software – The somatic senses – Sensor hardware – Head coupled displays – Acoustic hardware – Integrated VR systems – Modeling virtual world – Physical simulation.

UNIT - V AUGMENTED AND VIRTUAL REALITY APPLICATION **9**

Virtual Reality Applications: Introduction – Engineering – Entertainment – Education. The Future: Introduction – Virtual environments – modes of interaction. Case study on Oculus Rift – Head mounted display.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Jernej Barbic, Mirabelle D'Cruz, Marc Erich Latoschik, Mel Slater and Patrick Bourdot, “Virtual Reality and Augmented Reality”, 14th EuroVR International Conference, EuroVR 2017, Laval, France, December 12–14, 2017, Proceedings: 10700 (Lecture Notes in Computer Science).
2. Timothy Jung and M.Claudia tom Diek, “Augmented Reality and Virtual Reality”, Progress in IS (PROIS), 2018.

REFERENCES:

1. Grigore C. Burdea and Philippe Coiffet, “Virtual Reality Technology”, Wiley-IEEE Press, Second Edition, 2017.
2. Alan B. Craig, “Understanding Augmented Reality, Concepts and Applications”, Morgan Kaufmann, First Edition, 2013.
3. Alan B. Craig Dr., William R. Sherman Dr. and Jeffrey D. Will, “Developing Virtual Reality Applications: Foundations of Effective Design”, Morgan Kaufmann, 2009.
4. John Vince, “Virtual Reality Systems”, Pearson Education Asia, 2007.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Virtual Reality and Augmented Reality		**Course Code :** 20ECV64			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C353.1	Explain the virtual reality and environment, virtual reality requirements and benefits.	1	K2	1,2,8,9	3
C353.2	Illustrate the visualization techniques for augmented reality.	2	K2	1,2,8,9,10	3
C353.3	Discuss the concept of computer graphics and geometric modeling.	3	K2	1,2,8,9	3
C353.4	Use various types of hardware and software in virtual reality systems.	4	K3	1,2,3,8,9,12	3
C353.5	Apply development tools and framework for virtual reality.	4	K3	1,2,3, 5,6,8,9,12	3
C353.6	Analyze and design a system or process to meet given specifications with realistic engineering constraints.	5	K4	1,2,3,4, 5,6,8,9,10,12	3

CO-PO Mapping

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C353.1	2	1						1	**1**						1
C353.2	2	1						1	**1**	1					1
C353.3	2	1						1	**1**						1
C353.4	3	2	1					1	**1**			1			2
C353.5	3	2	1		2	1		2	**2**			1			2
C353.6	3	3	2	1	1	1		2	**2**	1		1			3

20ECV65	COMMUNICATING EMBEDDED SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn basics of CAN bus and its OSI models
- To understated various frames in CAN
- To learn the principles, operation, and programming of MCP2515 CAN Controller
- To learn various CAN development tools
- To learn built-in functions in STM32 for CAN controller

PRE-REQUISITE: - NIL

UNIT - I CAN BUS AND ITS OSI MODEL **9**

Vehicle Network Systems - CAN Bus - LIN - MOST - Byteflight - Intellibus - A Brief History of CAN Bus - CAN in Automotive Industry - The Basic Structure of a CAN Automotive System - Advantages of CAN Bus - Disadvantages of CAN Bus - Properties of CAN Bus - The ISO/OSI Reference Model and CAN - CAN Bus ISO/OSI Model - CANopen - CAN Bus Termination - CAN Bus Data Rate - Cable Stub Length - CAN Bus Node - CAN Bus Signal Levels - CAN_H Voltage - CAN_L Voltage - CAN Signal Waveform - Bus Arbitration - Bus Transceiver - CAN Connectors - CAN Repeaters - CAN PC Interface.

UNIT - II CAN BUS FRAMES **9**

Data Frame - Start Of Frame (SOF) - Arbitration Field - RTF Field - Control Field - Data Field - CRC Field - ACK Field - End of Frame Field - Remote Frame - Error Frame - Overload Frame - Extended CAN Frames - Bit Stuffing - Bus Error Detection - Bit Error - Bit Stuffing Error - CRC Error - Frame Error - ACK Error - CAN Bus Fault Confinement - Data Exchange With Data Frames - Remote Frames on the Bus.

UNIT - III CAN BUS TIMING AND CONTROLLER **9**

Bit Timing - Selection of Bit Timing Segments - The Prop_Seg - Oscillator Tolerance - The Basic Structure of a CAN Transceiver - The Basic Structure of a CAN Controller - The MCP2515 CAN Controller (Without Built-in Transceiver) - The MCP2515 CAN Controller (With Built-in Transceiver).

UNIT - IV CAN BUS DEVELOPMENT TOOLS **9**

Hardware Development Tools - CAN MicroMOD Development Kit - mikroElektronika CAN Communication Kit - The RCDK8C CAN Development Kit - mikroElektronika CAN SPI Click Board - mikroElektronika CAN-1 board - CAN Bus Monitor Demo Board - CAN Bus Analyzers - Microchip Inc CAN Bus Analyzer - CANdo - PCAN Explorer - CAN-Bus-Tester 2 (CBT2) - BitScope Logic - LAP-C Logic Analyzer - CAN Bus Software Development Tools - Keil Real-Time Library (RL-ARM) - mikroElektronika mikroC Pro for ARM - STM32F2xx Standard Peripheral Library.

UNIT - V STM32 BUILT-IN CAN BUS FUNCTIONS **9**

The STM32 Family of ARM Microcontrollers - The STM32F107VCT6 Microcontroller - Basic Features of the STM32F407VCT6 - Internal Block Diagram - The Power Supply - Low Power Modes - The Clock Circuit-STM32F407VGT6 Microcontroller Built-in CAN Controller Module - Message Transmission - Message Reception - mikroC Pro for ARM CAN Bus Functions - Using a Logic Analyzer as a CAN Bus Analyzer - Using the Microchip Inc CAN Bus Analyzer (APGDT002) - Connecting the CAN BUS Analyzer to the PC and CAN BUS.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Ibrahim Dogan, “Controller Area Network Projects with ARM and Arduino”, Publitr Elektor, August 15, 2011.
2. Wilfried F. Voss, “A Comprehensible Guide to Controller Area Network”, Copperhill Media, August 2005.

REFERENCES:

1. Marco Di Natale, Haibo Zeng, Paolo Giusto and Arkadeb Ghosal, “Understanding and Using the Controller Area Network Communication Protocol Theory and Practice”, Springer New York, 2012.
2. Ibrahim Dogan, “Controller Area Network Projects with ARM and Arduino”, Publitr Elektor, 2016.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : COMMUNICATING EMBEDDED SYSTEMS		**Course Code :** 20ECV65			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C354.1	Explain the CAN bus and its OSI model.	1	K2	1,2,8,10	2
C354.2	Describe various frames, its error detection and correction.	2	K2	1,2,8,10	2
C354.3	Use MCP2515 CAN controller as trans receiver.	3	K3	1,2,3,8,10	2
C354.4	Discuss different development tools for CAN.	4	K3	1,2,3,8,10	2
C354.5	Apply built-in functions of STM32 for CAN controller.	4	K3	1,2,3,8,10	2
C354.6	Use CAN bus analyzer to connect with PC and CAN.	5	K3	1,2,3,8,9,10	2

CO-PO Mapping

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C354.1	2	1						2		2					2
C354.2	2	1						2		2					2
C354.3	3	2	1					2		2					2
C354.4	3	2	1					2		2					2
C354.5	3	2	1					2		2					2
C354.6	3	2	1					2	2	2					2

20ECV66	WIRELESS SENSOR NETWORK DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the fundamentals of wireless sensor network.
- To gain knowledge on the MAC and Routing Protocols of WSN.
- To get exposed to 6LOWPAN technology.
- To acquire knowledge on the protocols required for developing real time applications using WSN and 6LOWPAN.
- To gain knowledge about operating system related to WSN and 6LOWPAN.

PRE-REQUISITE: NIL

UNIT - I INTRODUCTION **9**

Principle of Wireless Sensor Network - Introduction to wireless sensor networks - Challenges, Comparison with ad hoc network, Node architecture and Network architecture, design principles, Service interfaces, Gateway, Short range radio communication standards - IEEE 802.15.4, Zigbee and Bluetooth. Physical layer and transceiver design considerations.

UNIT - II MAC AND ROUTING PROTOCOLS **9**

MAC protocols - fundamentals, low duty cycle protocols and wakeup concepts, contention and Schedule-based protocols - SMAC, BMAC,TRAMA, Routing protocols - Requirements, Classification - SPIN, Directed Diffusion, COUGAR, ACQUIRE, LEACH, PEGASIS.

UNIT - III 6LOWPAN **9**

6LoWPAN Architecture - protocol stack, Adaptation Layer, Link layers - Addressing, Routing - Mesh-Under - Route-Over, Header Compression - Stateless header compression - Context- based header compression, Fragmentation and Reassembly , Mobility - types, Mobile IPv6, Proxy Home Agent, Proxy MIPv6, NEMO - Routing - MANET, ROLL, Border routing.

UNIT - IV APPLICATION **9**

Design Issues, Protocol Paradigms - End-to-end, Real-time streaming and sessions, Publish/subscribe, Web service paradigms, Common Protocols - Web service protocols, MQ telemetry transport for sensor networks (MQTT-S), ZigBee compact application protocol (CAP), Service discovery, Simple network management protocol (SNMP), Real-time transport and sessions, Industry-Specific protocols.

UNIT - V TOOLS **9**

Tiny OS - Introduction, NesC, Interfaces, modules, configuration, Programming in Tiny OS using NesC, TOSSIM, Contiki - Structure, Communication Stack, Simulation environment - Cooja simulator, Programming.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Holger Karl and Andreas willig, “Protocol and Architecture for Wireless Sensor Networks”, John Wiley Publication, 2006.
2. Anna Forster, “Introduction to Wireless Sensor Networks”, Wiley, 2017.

REFERENCES:

1. Zach Shelby Sensinode and Carsten Bormann, “6LoWPAN: The Wireless Embedded Internet” John Wiley and Sons, Ltd., 2009.
2. The Contiki Operating System. http://www.sics.se/contiki.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : WIRELESS SENSOR NETWORK DESIGN		**Course Code :** 20ECV66			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C355.1	Design solutions for WSNs applications.	1	K2	1,2,8,10	2
C355.2	Develop efficient MAC and Routing Protocols.	2	K3	1,2,3,8,10	2
C355.3	Design solutions for 6LOWPAN applications.	3	K2	1,2,8,10	2
C355.4	Develop efficient layered protocols in 6LOWPAN.	3	K2	1,2,3,8,10	2
C355.5	Design industry specific protocols applications.	4	K3	1,2,3,8,10	2
C355.6	Apply Tiny OS and Contiki OS in WSNs and 6LOWPAN applications.	5	K3	1,2,3,5,8,10	2

CO-PO Mapping

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C355.1	2	1						2		2				1	
C355.2	3	2	1					2		2				2	
C355.3	2	1						2		2				1	
C355.4	3	2	1					2		2				2	
C355.5	3	2	1					2		2				2	
C355.6	3	2	1		2			2		2				2	

20ECV71	IC FABRICATION TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To teach fundamental principles of fabrication of VLSI devices and circuits.
- To understand the different techniques and measures for IC fabrication.
- To apply fabrication principles in industry as a fabrication engineer.
- To contribute for further research in IC fabrication.
- To discuss physical mechanism in novel devices.

PRE-REQUISITE:

Course Code: 20EC505
Course Name: Digital VLSI Design and FPGA Implementation

UNIT - I Environment and Crystal Growth for VLSI Technology 9

Environment: Semiconductor technology trend, Clean rooms, Wafer cleaning.

Semiconductor Substrate: Phase diagram and solid solubility, Crystal structure, Crystal defects, Czochralski growth, Bridgman growth of GaAs, Float Zone growth, Wafer Preparation and specifications.

UNIT - II Fabrication Processes Part 1 9

Deposition: Evaporation, Sputtering and Chemical Vapor Deposition.

Epitaxy: Molecular Beam Epitaxy, Vapor Phase Epitaxy, Liquid Phase Epitaxy, Evaluation of epitaxial layers.

Silicon Oxidation: Thermal oxidation process, Kinetics of growth, Properties of Silicon Dioxide, Oxide Quality, high κ and low κ dielectrics.

Diffusion: Nature of diffusion, Diffusion in a concentration gradient, diffusion equation, impurity behavior, diffusion systems, problems in diffusion, evaluation of diffused layers.

Ion Implantation: Penetration range, ion implantation systems, process considerations, implantation damage and annealing.

UNIT - III Fabrication Processes Part 2 9

Etching: Wet chemical etching, dry physical etching, dry chemical etching, reactive ion etching, ion beam techniques.

Lithography: Photoreactive materials, Pattern generation and mask making, pattern transfer, Electron beam, Ion beam and X-ray lithography.

Device Isolation, Contacts and Metallization: Junction and oxide isolation, LOCOS, trench isolation, Schottky contacts, Ohmic contacts, Metallization and Packaging.

CMOS Process Flow: N well, P-well and Twin tub Design rules, Layout of MOS based circuits (gates and combinational logic), Buried and Butting Contact.

UNIT - IV Measurements, Packaging and Testing 9

Semiconductor Measurements: Conductivity type, Resistivity, Hall Effect Measurements, Drift Mobility, Minority Carrier Lifetime and diffusion length.

Packaging: Integrated circuit packages, Electronics package reliability.

Testing: Technology trends affecting testing, VLSI testing process and test equipment, test economics and product quality.

UNIT - V SOI, GaAs and Bipolar Technologies 9

SOI Technology: SOI fabrication using SIMOX, Bonded SOI and Smart Cut, PD SOI and FD SOI Device structure and their features.

GaAs Technologies: MESFET Technology, Digital Technologies, MMIC technologies, MODFET and Optoelectronic Devices.

Silicon Bipolar Technologies: Second order effects in bipolar transistor, Performance of BJT, Bipolar processes and BiCMOS.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Shubham Kumar and Ankaj Gupta, "Integrated Circuit Fabrication", CRC Press, First Edition, 2021.
2. Simon Sze, "VLSI Technology", McGraw Hill Education, Second Edition, 2017.

REFERENCES:

1. Simon M. Sze and Ming-Kwei Lee, "Semiconductor Devices: Physics and Technology", Wiley, Third Edition, 2016.
2. James D. Plummer, Michael D. Deal and Peter B. Griffin, "Silicon VLSI Technology: Fundamentals Practice and Modeling", Pearson India, First Edition, 2009.
3. Gary S. May and Simon M. Sze, "Fundamentals of Semiconductor Fabrication", John Wiley & Sons Inc., First Edition, 2007.
4. Stephen A. Campbell, "The Science and Engineering of Microelectronic Fabrication", Oxford University Press Inc., Second Edition, 2001.
5. C.Y.Chang and S.M.Sze, "ULSI Technology", McGraw-Hill Higher Education, 1996.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : IC FABRICATION TECHNOLOGY		**Course Code :** 20ECV71			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C356.1	Explain the operation of a cleanroom.	1	K2	1,2,8,9	3
C356.2	Describe the basic operation principles of semiconductor fabrication equipment.	1	K2	1,2,8,9	3
C356.3	Discuss the process modules available in IC fabrication.	2	K2	1,2,8,9	3
C356.4	Explain the design process flows of IC fabrication technologies.	3	K2	1,2,8,9	3
C356.5	Discuss the effects of process parameters on final transistor characteristics.	4	K2	1,2,8,9	3
C356.6	Explain the measurement skills for microelectronic devices and IC characterization.	5	K2	1,2,8,9	3

CO-PO Mapping

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C356.1	2	1						1	1						1
C356.2	2	1						1	1						1
C356.3	2	1						1	1						1
C356.4	2	1						1	1						1
C356.5	2	1						1	1						1
C356.6	2	1						1	1						1

20ECV72	MASSIVE MIMO NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To gain knowledge about massive MIMO networks.
- To understand the massive MIMO propagation channels.
- To learn about channel estimation in single cell and multicell massive MIMO systems.
- To comprehend the concepts of massive MIMO deployment in the context of single cell and multicell deployment.

PRE-REQUISITE: - NIL -

UNIT - I MASSIVE MIMO NETWORKS **9**

Definition of Massive MIMO, Correlated Rayleigh Fading, System Model for Uplink and Downlink, Basic Impact of Spatial Channel Correlation, Channel Hardening and Favorable Propagation, Local Scattering Spatial Correlation Model.

UNIT - II THE MASSIVE MIMO PROPAGATION CHANNEL **9**

Favorable Propagation and Deterministic Channels - Capacity Upper Bound - Distance from Favorable Propagation - Favorable Propagation and Linear Processing-Singular Values and Favorable Propagation, Favorable Propagation and Random Channels - Independent Rayleigh Fading - Uniformly Random Line-of-Sight (UR-LoS) - Independent Rayleigh Fading versus UR-LoS - Finite-Dimensional Channels.

UNIT - III SINGLE-CELL SYSTEMS **9**

Uplink Pilots and Channel Estimation - Orthogonal Pilots - De-Spreading of the Received Pilot Signal - MMSE Channel Estimation, Uplink Data Transmission - Zero-Forcing - Maximum-Ratio, Downlink Data Transmission - Linear Precoding - Zero-Forcing - Maximum-Ratio, Discussion - Interpretation of the Effective SINR Expressions.

UNIT - IV MULTI-CELL SYSTEMS **9**

Uplink Pilots and Channel Estimation, Uplink Data Transmission - Zero-Forcing - Maximum-Ratio, Downlink Data Transmission - Zero-Forcing - Maximum-Ratio, Discussion - Asymptotic Limits with Infinite Numbers of Base Station Antennas - The Effects of Pilot Contamination - Non-Synchronous Pilot Interference.

UNIT - V CASE STUDIES **9**

Single-Cell Deployment Example: Fixed Broadband Access in Rural Area, Multi-Cell Deployment: Preliminaries and Algorithms, Multi-Cell Deployment Examples: Mobile Access - Dense Urban Scenario - Suburban Scenario - Minimum Per-Terminal Throughput Performance -Additional Observations - Comparison of Power Control Policies.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Thomas L. Marzetta, Erik G. Larsson, Hong Yang and Hien Quoc Ngo, “Fundamentals of Massive MIMO”, Cambridge University Press, 2016.
2. Emil Björnson, Jakob Hoydis and Luca Sanguinetti, “Massive MIMO Networks: Spectral, Energy, and Hardware Efficiency”, Foundations and Trends, 2017.

REFERENCES:

1. Long Zhao, Hui Zhao and Kan Zheng, “Wei Xiang Massive MIMO in 5G Networks: Selected Applications”, Springer 2018.
2. Leibo Liu, Guiqiang Peng and Shaojun Wei, “Massive MIMO Detection Algorithm and VLSI Architecture”, Springer 2019.
3. Shahid Mumtaz, Jonathan Rodriguez and Linglong Dai, “mmWave Massive MIMO A Paradigm for 5G”, Elsevier, 2017.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : MASSIVE MIMO NETWORKS		**Course Code :** 20ECV72			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C357.1	Understand and explain massive MIMO networks.	1	K2	1,2,3,8,10	2
C357.2	Explain massive MIMO propagation channels and their capacity bounds	2	K2	1,2,3,8,10	2
C357.3	Apply channel estimation techniques for single cell system.	3	K2	1,2,3,8,10	2
C357.4	Apply channel estimation techniques for multi cell system.	4	K2	1,2,3,8,10	2
C357.5	Illustrate the concepts of the deployment of single cell massive MIMO system.	5	K2	1,2,3,8,10	2
C357.6	Illustrate the concepts of the deployment of multi cell massive MIMO system.	5	K2	1,2,3,8,10	2

CO-PO Mapping

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C357.1	3	2	1					2		2				2	
C357.2	3	2	1					2		2				2	
C357.3	3	2	1					2		2				2	
C357.4	3	2	1					2		2				2	
C357.5	3	2	1					2		2				2	
C357.6	3	2	1					2		2				2	

20ECV73	VIDEO ANALYTICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart knowledge on the basic principles and concepts in digital image and video processing.
- To explore and demonstrate real time image and video analytics in solving practical problems of commercial and scientific interests.

PRE-REQUISITE: - NIL -

UNIT - I INTRODUCTION IMAGE SEGMENTATION AND COLOUR IMAGE PROCESSING 9

Overview of Image processing system – Image Enhancement – Image Segmentation – Detection of Discontinuities – Edge Linking and Boundary Detection – Thresholding – Region-Based Segmentation – Colour Image Processing – Transformations – Image Smoothing and Sharpening – Noise Reduction – Colour based Image Segmentation.

UNIT - II OBJECT RECOGNITION AND IMAGE RETRIEVAL 9

Overview of Object Recognition – Feature Extraction – Intensity features – Shape feature extraction – PCA – SIFT – SURF – Texture Analysis: statistical, structural and spectral analysis – Bayes' Parametric classification – Feature Selection and Boosting – Image Retrieval – Content – Feature and Object.

UNIT - III DIGITAL VIDEO PROCESSING, VIDEO SEGMENTATION AND TRACKING 9

Digital Video – Sampling of video signal – Video Enhancement and Noise Reduction – Rate control and buffering – H.264 – Inter frame Filtering Techniques – Fundamentals of Motion Estimation and Motion Compensation Change Detection – Background modelling – Motion Segmentation – Simultaneous Motion Estimation and Segmentation – Motion Tracking – Multi-target/Multi-camera tracking.

UNIT - IV VIDEO ANALYSIS AND FOREGROUND EXTRACTION 9

Video Analysis Action Recognition – Video based rendering – Context and scene understanding – Video Surveillance – Background estimation – Averaging – Gaussian Mixture Modelling – Optical Flow based Image Segmentation – Region growing – Region splitting – Morphological operations – erosion – Dilation – Tracking in a multiple camera environment.

UNIT - V VIDEO ANALYTICS FOR SECURITY, TRAFFIC MONITORING AND ASSISTANCE 9

Abandoned object detection – human behavioral analysis – human action recognition – perimeter security – crowd analysis and prediction of crowd congestion – Customer behavior analysis – people counting – Traffic rule violation detection – traffic congestion identification for route planning – Advanced Driver Assistance System.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing", Pearson Education, Fourth Edition, 2018.
2. NilanjanDey, Amira Ashour and Suvojit Acharjee, "Applied Video Processing in Surveillance and Monitoring Systems", IGI Global, 2016.

REFERENCES:

1. Murat Tekalp, “Digital Video Processing”, Prentice Hall, Second Edition, 2015.
2. Oge Marques, “Practical Image and Video Processing using MATLAB”, Wiley-IEEE Press, 2011.
3. Yu Jin Zhang, “Image Engineering: Processing, Analysis and Understanding”, Tsinghua University Press, 2009.
4. Mark Nixon and Alberto S. Aquado, “Feature Extraction & Image Processing for Computer Vision”, Academic Press, Third Edition, 2012.
5. Richard Szeliski, “Computer Vision: Algorithms and Applications”, Springer, 2010.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Video Analytics		**Course Code :** 20ECV73			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C358.1	Explain the concepts of colour image processing.	1	K2	1,2,8,9,10	2
C358.2	Identify the algorithm for feature extraction and retrieval of images.	2	K3	1,2,3,8,10	2
C358.3	Apply sampling for video enhancement and noise reduction.	3	K3	1,2,3,8,10	2
C358.4	Employ various methods for motion tracking.	3	K3	1,2,3,8,10	2
C358.5	Apply foreground extraction for video surveillance.	4	K3	1,2,3,8,10	2
C358.6	Describe the applications of video processing.	5	K2	1,2,8,9,10	2

CO-PO Mapping

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C358.1	2	1						2	2	2				1	
C358.2	3	2	1					2		2				2	
C358.3	3	2	1					2		2				2	
C358.4	3	2	1					2		2				2	
C358.5	3	2	1					2		2				2	
C358.6	2	1						2	2	2				1	

20ECV75	IOT SECURITY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the operational technology of IoT.
- To study various vulnerabilities, threats and risks in IoT.
- To explain various IoT security needs and issues.
- To learn different testing tools and different attacks of IoT.

PRE-REQUISITE: - NIL -

UNIT - I INTRODUCTION TO OPERATIONAL TECHNOLOGY 9

Overview of industrial control systems (ICS), ICS operation & components, Perdue model, SCADA systems, Cyber-physical systems (CPS) & IoT.

UNIT - II IOT VULNERABILITIES, THREATS AND RISKS 9

STRIDE methodology, OWASP IoT vulnerabilities, Privacy and trust, Insufficient authentication/authorization, Insufficient access control, Attacks on IoT data, Attacks on IoT layered architecture, Security concerns in IoT applications, Security concerns in SCADA.

UNIT - III IOT PEN TESTING 9

Active vulnerability analysis tools, Port scanning, Operating system fingerprinting and version scanning, Penetration testing, Attack surface mapping.

UNIT - IV TOOLS, FRAMEWORK FIRMWARE REVERSE ENGINEERING 9

Exploitation Tools & Frameworks Exploitation using I2C & SPI, JTAG debugging and exploitation, understanding firmware, Extracting firmware, Manual firmware extraction, Automated file system extraction, Firmware internals, Backdooring a firmware, Static & dynamic analysis.

UNIT - V RADIO AND SIDE CHANNEL ATTACKS 9

Software defined radio, Exploiting ZIGBEE & BLE, Power analysis attack, Invasive attack, Perturbation attacks, Electromagnetic side channel attack, fault injection attack, timing attack, covert channel attacks.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Shancang Li and Li Da Xu, “Securing the Internet of Things”, Syngress, First Edition, 2017.
2. Fei Hu, “Security and Privacy in Internet of Things (IoTs) Models, Algorithms, and Implementations”, CRC Press, First Edition, 2016.

REFERENCES:

1. Brian Russell and Drew Van Duren, “Practical Internet of Things Security”, Packt Publishing Limited, 2016.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : IOT SECURITY		**Course Code :** 20ECV75			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C359.1	Summarize the operational technology of IoT.	1	K2	1,2,8,10	2
C359.2	Describe various vulnerabilities, threats & risks in IoT.	2	K2	1,2,8,10	2
C359.3	Classify various IoT security issues.	3	K3	1,2,3,8,10	2
C359.4	Use different testing tools for IoT.	4	K3	1,2,3,8,10	2
C359.5	Identify to secure IoT from different attacks.	4	K3	1,2,3,8,10	2
C359.6	Relate various IoT security needs.	5	K3	1,2,3,8,9, 10	2

CO-PO Mapping

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C359.1	2	1						2		2					2
C359.2	2	1						2		2					2
C359.3	3	2	1					2		2					2
C359.4	3	2	1					2		2					2
C359.5	3	2	1					2		2					2
C359.6	3	2	1					2	2	2					2

20ECV76	BRAIN COMPUTER INTERFACE AND APPLICATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basic concepts of brain computer interface.
- To study the various signal acquisition methods.
- To study the signal processing methods used in BCI.

PRE-REQUISITE: NIL

UNIT - I INTRODUCTION TO BCI **9**

Fundamentals of BCI - Structure of BCI system - Classification of BCI - Invasive, Non-invasive and Partially invasive BCI - EEG signal acquisition - Signal Preprocessing - Artifacts removal.

UNIT - II ELECTROPHYSIOLOGICAL SOURCES **9**

Sensorimotor activity - Mu rhythm, Movement Related Potentials - Slow Cortical Potentials - P300 - Visual Evoked Potential - Activity of Neural Cells - Multiple Neuro mechanisms.

UNIT - III FEATURE EXTRACTION METHODS **9**

Time/Space Methods - Fourier Transform, PSD - Wavelets - Parametric Methods - AR, MA, ARMA models - PCA - Linear and Non-Linear Features.

UNIT - IV FEATURE TRANSLATION METHODS **9**

Linear Discriminant Analysis - Support Vector Machines - Regression - Vector Quantization - Gaussian Mixture Modeling - Hidden Markov Modeling - Neural Networks.

UNIT - V APPLICATIONS OF BCI **9**

Functional restoration using Neuro prosthesis - Functional Electrical Stimulation, Visual Feedback and control - External device control, Case study: Brain actuated control of mobile Robot.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Rajesh P.N. Rao, "Brain-Computer Interfacing: An Introduction", Cambridge University Press, 2013.
2. Guido Dornhege, José del R. Millán, Thilo Hinterberger, Dennis J. McFarland and Klaus-Robert Müller, "Toward Brain-Computer Interfacing", The MIT Press, 2007.

REFERENCES:

1. Bernhard Graimann, Brendan Allison, Gert Pfurtscheller, “Brain Computer Interfaces: Revolutionizing Human-Computer Interaction”, Springer, 2010.
2. R.Spehlmann, “EEG Primer”, Elsevier Biomedical Press, 1981.
3. Arnon Kohen, “Biomedical Signal Processing”, Vol. I and II, CRC Press Inc., Boca Rato, Florida, 1986.
4. C.M.Bishop, “Neural Networks for Pattern Recognition”, Oxford, Clarendon Press, 1995.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : BRAIN COMPUTER INTERFACE AND APPLICATIONS		**Course Code :** 20ECV76			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C360.1	Describe BCI system and its potential applications.	1	K2	1,2,6,10	2
C360.2	Explain event related potentials and sensory motor rhythms.	2	K2	1,2,6,8,9	2
C360.3	Compute features suitable for BCI.	3	K3	1,2,3,6,8,9	2
C360.4	Classify how to model and analyze brain signals using AR, MA and ARMA models.	3	K3	1,2,3,6,10	2
C360.5	Classify the different types of classifier for a BCI system.	4	K4	1,2,3,4,6,8,9	2
C360.6	Describe BCI for various applications.	5	K2	1,2,6,8,9	2

CO-PO Mapping

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C360.1	2	1				1				2				2	
C360.2	2	1				1		2	2					2	
C360.3	3	2	1			1		2	2					2	
C360.4	3	2	1			1				2				2	
C360.5	3	3	2	1		1		2	2					2	
C360.6	2	1				1		2	2					2	

20ECV83 MULTIMEDIA COMPRESSION TECHNIQUES

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the basic ideas of compression algorithms related to multimedia components – Text, speech, audio, image and Video.
- To understand the principles and standards and their applications with an emphasis on underlying technologies, algorithms, and performance.
- To appreciate the use of compression in multimedia processing applications.
- To understand and implement compression standards in detail.

PRE-REQUISITE: NIL

UNIT - I FUNDAMENTALS OF COMPRESSION **9**

Introduction To multimedia – Graphics, Image and Video representations – Fundamental concepts of video, digital audio – Storage requirements of multimedia applications – Need for compression –Taxonomy of compression Algorithms - Elements of Information Theory – Error Free Compression – Lossy Compression.

UNIT - II TEXT COMPRESSION **9**

Huffman coding – Adaptive Huffman coding – Arithmetic coding – Shannon-Fano coding – Dictionary techniques – LZW family algorithms.

UNIT - III IMAGE COMPRESSION **9**

Image Compression: Fundamentals – Compression Standards – JPEG Standard – Sub-band coding – Wavelet Based compression – Implementation using Filters – EZW, SPIHT coders – JPEG 2000 standards – JBIG and JBIG2 standards.

UNIT - IV AUDIO COMPRESSION **9**

Audio compression Techniques – law, A-Law companding – Frequency domain and filtering – Basic sub-band coding – Application to speech coding – G.722 – MPEG audio – progressive encoding – Silence compression, Speech compression – Formant and CELP vocoders.

UNIT - V VIDEO COMPRESSION **9**

Video compression techniques and Standards – MPEG video coding: MPEG-1 and MPEG-2 video coding: MPEG-3 and MPEG-4 – Motion estimation and compensation techniques – H.261 Standard – DVI technology – DVI real time compression – Current Trends in Compression standards.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Khalid Sayood, “Introduction to Data Compression”, Morgan Kauffman Harcourt India, Third Edition, 2010.
2. David Solomon, “Data Compression – The Complete Reference”, Springer Verlog, Fourth Edition, New York, 2006.

REFERENCES:

1. Yun Q. Shi and Huifang Sun, “Image and Video Compression for Multimedia Engineering, Algorithms and Fundamentals”, CRC Press, 2003.
2. Mark S. Drew and Ze-Nian Li, “Fundamentals of Multimedia”, PHI, 2009.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : MULTIMEDIA COMPRESSION TECHNIQUES		**Course Code :** 20ECV83			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C361.1	Explain the various error free and lossless compression and quantization techniques.	1	K2	1,2,8,10	2
C361.2	Apply Huffman coding Arithmetic coding, Shannon fano coding, Dictionary techniques and other algorithm for text compression.	2	K3	1,2,3,8,10	2
C361.3	Compare various compression standards applying for image processing.	3	K4	1,2,3,4,8,10	2
C361.4	Compare various compression standards applying for audio processing.	4	K4	1,2,3,4,8,10	2
C361.5	Implement basic compression algorithms with MATLAB and its equivalent open source environments for audio compression.	4	K3	1,2,3,5,8,10	2
C361.6	Compare various compression standards applying for video processing.	5	K4	1,2,3,4,8,9, 10	2

CO-PO Mapping

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C361.1	2	1						2		2				2	
C361.2	3	2	1					2		2				2	
C361.3	3	3	2	1				2		2				2	
C361.4	3	3	2	1				2		2				2	
C361.5	3	2	1		2			2		2				2	
C361.6	3	3	2	1				2	2	2				2	

20ECV84	ETHICS AND AI	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the morality and ethics in AI.
- To learn about the Ethical initiatives in the field of artificial intelligence.
- To study about AI standards and regulations.
- To study about social and ethical issues of robot ethics.
- To study about AI and ethics challenges and opportunities.

PRE-REQUISITE: NIL

UNIT - I INTRODUCTION **9**

Definition of morality and ethics in AI - Impact on society - Impact on human psychology - Impact on the legal system - Impact on the environment and the planet - Impact on trust.

UNIT - II ETHICAL INITIATIVES IN AI **9**

International ethical initiatives - Ethical harms and concerns - Case study: health care robots, Autonomous Vehicles, Warfare and weaponization.

UNIT - III AI STANDARDS AND REGULATION **9**

Model Process for Addressing Ethical Concerns During System Design - Transparency of Autonomous Systems - Data Privacy Process - Algorithmic Bias Considerations - Ontological Standard for Ethically Driven Robotics and Automation Systems.

UNIT - IV ROBO ETHICS: SOCIAL AND ETHICAL IMPLICATION OF ROBOTICS **9**

Robot - Robo ethics - Ethics and Morality - Moral Theories - Ethics in Science and Technology - Ethical Issues in an ICT Society - Harmonization of Principles - Ethics and Professional Responsibility - Robo ethics Taxonomy.

UNIT - V AI AND ETHICS: CHALLENGES AND OPPORTUNITIES **9**

Challenges - Opportunities - ethical issues in artificial intelligence - Societal Issues Concerning the Application of Artificial Intelligence in Medicine - decision-making role in industries - National and International Strategies on AI.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Y.Eleanor Bird, Jasmin Fox-Skelly, Nicola Jenner, Ruth Larbey, Emma Weitkamp and Alan Winfield, “The ethics of artificial intelligence: Issues and initiatives”, European Parliamentary Research Service Scientific Foresight Unit (STOA) PE 634.452, March 2020.
2. Patrick Lin, Keith Abney and George A. Bekey, “Robot Ethics: The Ethical and Social Implications of Robotics”, The MIT Press, January 2014.

REFERENCES:

1. Paula Boddington, “Towards a Code of Ethics for Artificial Intelligence (Artificial Intelligence: Foundations, Theory, and Algorithms)” November 2017.
2. Mark Coeckelbergh, “AI Ethics”, The MIT Press Essential Knowledge Series, April 2020.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : ETHICS AND AI		**Course Code :** 20ECV84			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C363.1	Describe about morality and ethics in AI.	1	K2	1,2,8,9,12	
C363.2	Express the knowledge of real time application ethics, issues and its challenges.	2	K2	1,2,4,8,9, 12	
C363.3	Understand the ethical harms and ethical initiatives in AI.	3	K2	1,2,8,9,12	
C363.4	Discuss about AI standards and Regulations like AI Agent, Safe Design of Autonomous and Semi-Autonomous Systems.	4	K2	1,2,4,8,9, 12	
C363.5	Understand the concepts of Robo ethics and Morality with professional responsibilities.	4	K2	1,2,8,9,12	
C363.6	Explain the societal issues in AI with National and International Strategies on AI.	5	K2	1,2,8,9,12	

CO-PO Mapping

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C363.1	2	1						2	2			2			
C363.2	2	1		1				2	2			2			
C363.3	2	1						2	2			2			
C363.4	2	1		1				2	2			2			
C363.5	2	1						2	2			2			
C363.6	2	1						2	2			2			

20OE305	FUNDAMENTALS OF IMAGE PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To get exposed to simple image enhancement techniques in Spatial and Frequency domain.
- To learn concepts of degradation function and restoration techniques.
- To study the image segmentation and representation techniques.
- To become familiar with image compression methods.

PRE-REQUISITE: NIL

UNIT - I DIGITAL IMAGE FUNDAMENTALS **9**

Steps in Digital Image Processing - Elements of Visual Perception - Image Sensing and Acquisition - Image Sampling and Quantization - Relationships between pixels - Color image fundamentals - RGB, HSI models, Two-dimensional mathematical preliminaries, 2D transforms - DFT, DCT.

UNIT - II IMAGE ENHANCEMENT **9**

Spatial Domain: Gray level transformations - Histogram processing - Basics of Spatial Filtering - Smoothing and Sharpening Spatial Filtering, Frequency Domain: Introduction to Fourier Transform - Smoothing and Sharpening frequency domain filters - Ideal, Butterworth and Gaussian filters, Homomorphic filtering.

UNIT - III IMAGE RESTORATION **9**

Image Restoration - degradation model, Properties, Noise models - Mean Filters - Order Statistics - Adaptive filters - Band reject Filters - Band pass Filters - Notch Filters - Optimum Notch Filtering - Inverse Filtering - Wiener filtering.

UNIT - IV IMAGE SEGMENTATION **9**

Edge detection, Edge linking via Hough transform – Thresholding - Region based segmentation – Region growing – Region splitting and merging – Morphological processing-erosion and dilation, Segmentation by morphological watersheds.

UNIT - V IMAGE COMPRESSION **9**

Fundamentals of image compression - Compression methods - Huffman Coding, Arithmetic Coding, LZW Coding, Run-Length coding, Symbol-Based Coding, Bit-Plane Coding, Block Transform Coding, Predictive Coding, Wavelet Coding.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Rafael C. Gonzalez and Richard E. Woods, “Digital Image Processing”, Pearson, Third Edition, 2010.
2. Anil K. Jain, “Fundamentals of Digital Image Processing”, Pearson, 2002.

REFERENCES:

1. Kenneth R. Castleman, “Digital Image Processing”, Pearson, 2006.
2. Rafael C. Gonzalez, Richard E. Woods and Steven Eddins, “Digital Image Processing using MATLAB”, Pearson Education, Inc., 2011.
3. D.E. Dudgeon and R.M. Mersereau, “Multidimensional Digital Signal Processing”, Prentice Hall Professional Technical Reference, 1990.
4. William K. Pratt, “Digital Image Processing”, John Wiley, New York, 2002.
5. Milan Sonka, “Image processing, analysis and machine vision”, Brookes/Cole, Vikas Publishing House, Second Edition, 1999.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Fundamentals of Image Processing		**Course Code :** 20OE305			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO 1	Explain the fundamentals of digital image processing techniques.	1	K2	1,2,8,10	
CO 2	Apply the various transforms and its properties for 2D signals.	2	K3	1,2,3,8,10	
CO 3	Describe the various image enhancement technique used in digital image processing.	2	K2	1,2,8,9,10	
CO 4	Apply the various filters for image restoration.	3	K3	1,2,3,8,10	
CO 5	Examine feature extraction methods for segmentation.	4	K3	1,2,3,8,10	
CO 6	Apply the different coding methods for image compression.	5	K3	1,2,3,8,10	

CO-PO Mapping

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO 1	2	1						2		2					
CO 2	3	2	1					2		2					
CO 3	2	1						2	2	2					
CO 4	3	2	1					2		2					
CO 5	3	2	1					2		2					
CO 6	3	2	1					2		2					

20OE306	CONSUMER ELECTRONICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To give students an in depth knowledge of various electronic audio and video devices and systems.
- To introduce the consumer electronic gadgets/goods/devices like audio-systems, CD systems.
- To give organization structure and principles of working of various other components like visual display, keyboard drives and printers.
- To find employment in computer industry, repair and maintenance field.

PRE-REQUISITE: NIL

UNIT - I AUDIO SYSTEMS **9**

Microphones, their types: Carbon, velocity, crystal, condenser, cordless etc. Loud Speaker: Direct radiating, horn loaded woofer, tweeter, mid-range, multi-speaker system, baffles and enclosures. Sound recording on magnetic tape, its principles, block diagram and tape transport mechanism, Digital sound recording on tape and disc, CD system, Hi- Fi system, pre-amplifier, amplifier and equalizer system, stereo amplifiers, public address systems, Graphics Equalizer, speed Synthesizer, Electronic tuning.

UNIT - II VIDEO SYSTEMS **9**

B&W TV, color TV and HD TV systems, LCD, LED, PLASMA Systems, Electronic cameras, VCR, VCP, CD systems, Memory diskettes, Discs and drums. Dolby noise reduction digital and analog recording. Digital projection systems (LCD, DLP, SVGA to UXGA system) Block diagram and principles of working of cable TV and DTH, cable TV using internet.

UNIT - III COMPUTER SYSTEM **9**

Different types of mother boards - Single Board Based System - Different types of Buses PCI, ISA, SCSI & Serial and Parallel Ports, USB - Hard Disk Device (HDD) - Computer Monitor - Video Display Adopters - Keyboard - Mouse - Scanner - Printer - digitizer.

UNIT - IV MOBILE PHONE **9**

Architecture - Connectivity - RF Transceiver - Antennas - Tx/Rx switch - Baseband part - System-on-chip - ADC/DAC - Memory and storage - Camera - Sensors - Operating system - Microphone and Speaker - Display and Keypad - Battery.

UNIT - V HOUSEHOLD APPLIANCES **9**

Microwaves: Microwave Oven Block Diagram, LCD Timer with Alarm, Types of Microwave Ovens Washing Machines: Electronic controller for Washing Machines, Washing Machine Hardware, Air Conditioning: Components of Air Conditioning Systems, Remote Control-buttons, Unitary and Central Air Conditioning Systems, Split Air Conditioners. Refrigeration: Refrigerants, Refrigeration Systems, Dish Washers.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Jim Ledin, “Modern Computer Architecture and Organization: Learn x86, ARM, and RISC-V architectures and the design of Smartphones, PCs, and cloud servers”, Packt Publishing, Illustrated Edition, 2020.
2. S.P.Bali, “Consumer Electronics”, Pearson Education, 2007.

REFERENCES:

1. R.G. Gupta, “Audio and Video Systems: Principles, Maintenance and Troubleshooting”, McGraw Hill Education, Second Edition, 2017.
2. Jacob Beckerman, “How to Build a Computer: Learn, Select Parts, Assemble, and Install: A Step by Step Guide to Your First Homebuilt”, JIBB Publishing, First Edition, 2014.
3. R.R. Gulati, “Modern Television Practice: Transmission, Reception and Applications”, New Age International Private Limited, 2015.
4. Nick Vandome, “Android Phones for Seniors in easy steps: Updated for Android v7 Nougat”, In Easy Steps Limited, Second Edition, 2019.
5. Sajid Umair and Muhammad Yousaf Shah, “Mobile Devices and Smart Gadgets in Human Rights”, IGI Global, 2018.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Consumer Electronics		**Course Code :** 20OE306			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO 1	Describe the various audio system components and its functionalities.	1	K2	1,2,8,10	
CO 2	Explain the concepts and techniques employed in the construction of televisions.	2	K2	1,2,8,10	
CO 3	Analyse the construction of personal computers.	3	K3	1,2,3,8,10	
CO 4	Illustrate the various blocks and components used in the construction of mobile phones.	4	K2	1,2,8,10	
CO 5	Explain the various systems used in the residence.	5	K2	1,2,8,9,10	
CO 6	Analyse the commonly used consumer electronic gadgets used in our residences.	5	K3	1,2,3,8,10	

CO-PO Mapping

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO 1	2	1						2		2					
CO 2	2	1						2		2					
CO 3	3	2	1					2		2					
CO 4	2	1						2		2					
CO 5	2	1						2	2	2					
CO 6	3	2	1					2		2					

20OE307	FUNDAMENTALS OF DIGITAL SIGNAL PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the fundamentals of discrete time systems.
- To learn Discrete Fourier Transform, its properties and its application to linear filtering.
- To understand the characteristics of digital filters, design of FIR and IIR filters and its realization.
- To understand the effects of finite precision representation on digital filters.

PRE-REQUISITE: NIL

UNIT - I DISCRETE TIME SYSTEM ANALYSIS **9**

Classification of discrete time systems - linear, causal, stability, time invariance, dynamic, recursive and non-recursive, Sampling, Nyquist rate, Aliasing effect, Quantization and its error - Discrete Time Fourier Transform, magnitude and phase representation.

UNIT - II DISCRETE FOURIER TRANSFORM **9**

Frequency - Domain sampling: The Discrete Fourier Transform - Properties of DFT - Linear filtering methods based on the DFT - Efficient computation of the DFT: FFT algorithms: radix 2 FFT algorithms.

UNIT - III FINITE IMPULSE RESPONSE FILTERS **9**

Characteristics of practical frequency selective filters - Design of FIR filters: symmetric and Anti-symmetric FIR filters - Design of linear phase FIR filters using windows (Rectangular, Hamming and Hanning window), Frequency sampling method. Structures for FIR systems - linear phase structure, direct form realizations.

UNIT - IV INFINITE IMPULSE RESPONSE FILTERS **9**

Characteristics of commonly used analog filters - Butterworth filters, Chebyshev filters. Design of IIR filters from analog filters: Impulse invariance method, Bilinear transformation. Structure of IIR systems - Direct form structures, Cascade and parallel structures.

UNIT - V FINITE WORD LENGTH EFFECTS **9**

Representation of Numbers - Quantization of filter coefficients - Round-off effects in Digital filters: Limit cycle oscillations in recursive systems - scaling to prevent overflow.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. John G. Proakis and Dimitris G. Manolakis, “Digital Signal Processing – Principles, Algorithms & Applications”, Pearson Education / Prentics Hall, Fourth Edition, 2016.
2. Sanjay K. Mitra, “Digital Signal Processing: A Computer based approach”, Tata McGraw Hill, Fourth Edition, 2017.

REFERENCES:

1. Emmanuel C. Fleachor and Barrie W. Jervis, “Digital Signal Processing”, Fourth Edition, Pearson Education / Prentice Hall, 2007.
2. Vinay K. Ingle and John G. Proakis, “Digital Signal Processing using MATLAB”, Cengage Learning Custom Publications, Third Edition, 2011.
3. A.V. Oppenheim, R.W. Schafer and J.R. Buck, “Discrete – Time Signal Processing”, Indian Reprint, Pearson, Twenty Eight Edition, 2004.
4. Andreas Antoniou, “Digital Signal Processing”, Tata McGraw Hill, 2006.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Fundamentals of Digital Signal Processing		**Course Code :** 20OE307			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO 1	Classify the discrete time systems and its frequency response.	1	K3	1,2,3,8,10	
CO 2	Compute DFT and IDFT coefficients of a discrete time sequences using FFT algorithms and output of the discrete time system.	2	K3	1,2,3,8,10	
CO 3	Determine the transfer function of FIR digital filters.	3	K3	1,2,3,8,10	
CO 4	Determine the transfer function of IIR digital filters.	4	K3	1,2,3,8,10	
CO 5	Construct the realization structures for digital filters.	4	K3	1,2,3,8,10	
CO 6	Explain the fundamental concepts of number representation, quantization errors and limit cycle oscillations.	5	K2	1,2,8,9,10	

CO-PO Mapping

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO 1	3	2	1					2		2					
CO 2	3	2	1					2		2					
CO 3	3	2	1					2		2					
CO 4	3	2	1					2		2					
CO 5	3	2	1					2		2					
CO 6	2	1						2	2	2					

20OE308	INTRODUCTION TO VLSI TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the VLSI era.
- To introduce the fundamental concepts relevant to VLSI fabrication.
- To enable the students to understand the various VLSI fabrication technique.

PRE-REQUISITE: NIL

UNIT - I LOGIC DESIGN WITH MOSFETS **9**

Ideal Switches and Boolean Operations - MOSFETs as Switches- Basic Logic Gates in CMOS - Complex Logic Gates in CMOS - Transmission Gate Circuits - Clocking and Dataflow Control.

UNIT - II PHYSICAL STRUCTURE OF CMOS INTEGRATED CIRCUITS **9**

Integrated Circuit Layers - Interconnect Resistance and capacitance – MOSFETs - Electrical Conduction in silicon - nFETs and pFETs - Current flow in a FET - driving the gate capacitance - CMOS Layers - Designing FET Arrays.

UNIT - III FABRICATION OF CMOS INTEGRATED CIRCUITS **9**

Overview of Silicon Processing - Material Growth and Deposition - Silicon dioxide - Silicon Nitride - polycrystal silicon – metals - doped silicon layers - chemical mechanical polishing – Lithography - The CMOS Process Flow - Design Rules.

UNIT - IV ELECTRICAL CHARACTERISTICS OF MOSFETS **9**

MOS Physics - derivation of threshold voltage - nFET Current - Voltage Equations - SPICE level 1 equation - body bias effects - derivation of the current flow equation - The FET RC Model - pFET Characteristics - Modeling of Small MOSFET.

UNIT - V ELECTRONIC ANALYSIS OF CMOS LOGIC GATES **9**

DC Characteristics of the CMOS Inverter - Inverter Switching Characteristics - Power Dissipation - DC Characteristics: NAND and NOR Gates - NAND and NOR Transient Response - Analysis of Complex Logic Gates - Gate Design for Transient Performance - Transmission Gates and Pass Transistors.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. John P. Uyemura, “Introduction to VLSI Circuits and Systems”, John wiley & sons, 2001.
2. S.K. Gandhi, “VLSI Fabrication Principles”, John Willey & Sons, Second Edition, 2008.

REFERENCES:

1. Kamran Eshraghian, Douglas A. Pucknell and Sholeh Eshraghian, “Essentials of VLSI Circuits and Systems”, PHI, 2005.
2. Neil H.E. Weste and K. Eshraghian, “Principles of CMOS VLSI Design: A System Perspective”, McGraw Hill, 2010.
3. Sung-Mo Kang, Yusuf Lablebici and Chulwookim, “CMOS Digital Integrated Circuits, Analysis and Design”, McGraw Hill, Fourth Edition, 2019.
4. Partha Pratim Sahu, “VLSI Design”, McGraw Hill, 2013.
5. Neil H.E. Weste, “CMOS VLSI Design: A Circuit and System Perspective”, Pearson Education, 2011.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Introduction to VLSI Technology		**Course Code :** 20OE308			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO 1	Explain the introduction of MOSFET as simple logic controlled switches and then concentrate on the design of CMOS static logic gates at the Boolean level.	1	K2	1,2,8,10	
CO 2	Generalize the views of an integrated circuit as a set of patterned material layers that are used to control the flow of signals.	2	K3	1,2,3,8,10	
CO 3	Discuss the switch level description down to the physical level.	2	K2	1,2,8,10	
CO 4	Discuss the general and specific aspects of the manufacturing process of CMOS.	3	K2	1,2,8,10	
CO 5	Derive the equations for RC switching model based on the square law equation.	4	K3	1,2,3,8,9	
CO 6	Develop the electrical properties of CMOS logic circuits.	5	K3	1,2,3,8,9,10	

CO-PO Mapping

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO 1	2	1						2		2					
CO 2	3	2	1					2		2					
CO 3	2	1						2		2					
CO 4	2	1						2		2					
CO 5	3	2	1					2		2					
CO 6	3	2	1					2	2	2					