SEMESTER VII

S. No	Category	Course Code	Course Title	L	T	P	C
Theory							
1	PC	EC20701	Antennas and Wave Propagation	3	0	0	3
2	PC	EC20702	Optical and Microwave Communication	3	0	0	3
3	PE	EC2045*	Professional Elective IV	3	0	0	3
4	PE	EC2055*	Professional Elective V	3	0	0	3
5	OE	EC2090*	Open Elective II	3	0	0	3
Practical							
6	PC	EC20703	Optical and Microwave Laboratory	0	0	4	2
7	EE	EC20704	Project Work (Phase I)	0	0	6	3
			TOTAL	**15**	**0**	**10**	**20**

SEMESTER VIII

S. No	Category	Course Code	Course Title	L	T	P	C
Theory							
1	PC	EC20801	Cognitive Radio Networks	3	0	0	3
2	PE	EC2065*	Professional Elective VI	3	0	0	3
Practical							
3	EE	EC20802	Project Work(Phase II)	0	0	12	6
			Total	**6**	**0**	**12**	**12**
							Total Credits : 164

PROFESSIONAL ELECTIVE IV

S. No	Category	Course Code	Course Title	L	T	P	C
1	PE	EC20451	Multimedia Compression Techniques	3	0	0	3
2	PE	EC20452	IoT Enabled System Design	3	0	0	3
3	PE	EC20453	Low Power VLSI	3	0	0	3
4	PE	IT20455	Machine Learning	3	0	0	3
5	PE	EC20454	Professional Readiness for Innovation, Employability and Entrepreneurship	0	0	6	3

PROFESSIONAL ELECTIVE – V

S. No	Category	Course Code	Course Title	L	T	P	C
1	PE	EC20551	Medical Image Processing	3	0	0	3
2	PE	EC20552	System Design with FPGA	3	0	0	3
3	PE	EC20553	Telecommunication System Modeling and Simulation	3	0	0	3
4	PE	IT20555	Deep Learning	3	0	0	3

PROFESSIONAL ELECTIVE – VI

S. No	Category	Course Code	Course Title	L	T	P	C
1	PE	EC20651	Video Analytics	3	0	0	3
2	PE	EC20652	Satellite Communication	3	0	0	3
3	PE	EC20653	System On Chip Design	3	0	0	3
4	PE	EC20654	Adhoc and Wireless Sensor Networks	3	0	0	3

OPEN ELECTIVE II

S. No	Category	Course Code	Course Title	L	T	P	C
1	OE	EC20903	Sensors and Transducers	3	0	0	3
2	OE	EC20904	Automotive Electrical and Electronics system	3	0	0	3

EC20701 **ANTENNAS AND WAVE PROPAGATION** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- acquire knowledge about the fundamentals of antennas.
- understand the concepts of Antenna Arrays
- know the working of different types of Antennas
- be familiar with the principles behind the measurement of Antenna parameters.
- have an in-depth knowledge about Wave Propagation.

UNIT I FUNDAMENTALS OF ANTENNA **9**

Antenna Parameters-Radiation Pattern, Radiation Intensity, Radiation Resistance, Input Impedance, Gain, Directivity, Directive Gain, Power Gain, Beam width, Bandwidth, Reciprocity Principle, Effective length, Effective Area, Friis Transmission formula; Radiation from Hertzian dipole and Half wave dipole - Power Radiated and Radiation Resistance.

UNIT II ANTENNA ARRAYS **9**

Expression for electric field from two element arrays - Broadside and End fire array, N element linear array ; Broadside and End fire array Uniform linear array - Pattern multiplication, Binomial array.

UNIT III SPECIAL ANTENNAS **9**

Helical Antennas, Horn Antenna, Yagi-Uda antenna, Log Periodic Dipole Array - Slot Antenna; Relation between dipole and slot impedances; Microstrip Patch antenna; Dielectric Lens and Metal Plane Lens antennas; Parabolic reflector antenna and its feed systems.

UNIT IV ANTENNA MEASUREMENTS **9**

Antenna Measurement Ranges; Antenna Impedance Measurement; Radiation Pattern Measurements; Measurement of Antenna Gain; Measurement of Radiation Resistance; Antenna Efficiency; Polarization; VSWR.

UNIT V WAVE PROPAGATION **9**

Modes of Propagation, Structure of Atmosphere - Ground Wave Propagation, Calculation of field strength at a distance; Space Wave Propagation - Resultant of direct and reflected ray at the receiver, Duct Propagation; Sky Wave Propagation - Mechanism of refraction, Refractive index, Virtual Height, Critical Frequency, Maximum Usable Frequency, Skip distance, Effect of Earth's Magnetic Field, Fading and Diversity reception.

TOTAL PERIODS **45**

COURSE OUTCOMES

At the end of the course, the students will be able to

- analyze the fundamental parameters of antennas
- elucidate the design and working of Antenna Arrays.

- describe the concept of special antennas
- perform measurement of antenna parameters
- explain the different types of wave propagation.

TEXT BOOKS

1. Prasad K.D, "Antennas and Wave Propagation", 4th Edition, Satya Prakashan Publications, New Delhi, 2019.
2. Kraus John D & Marhefka Ronald J& Ahmad S. Khan, "Antennas and Wave Propagation", 5th Edition, McGraw Hill, New Delhi, 2018.

REFERENCES

1. Balanis Constantine A, "Antenna Theory", 4th Edition, John Wiley & Sons, New York, 2016.
2. Edward C.Jordan and Keith G.Balmain" Electromagnetic Waves and Radiating Systems" Prentice Hall of India, 2006
3. R.E.Collin,"Antennas and Radiowave Propagation", Mc Graw Hill 1985.
4. Rajeswari Chatterjee- "Antenna Theory and Practice" Revised Second Edition New Age International Publishers- 2006.

CO-PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes : (1,2,3 indicates the strength of correlation) 3 – Strong , 2 – Medium , 1 – Weak														
COs	Programme Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	1	-	-	-	-	-	-	-	3	3	3
CO2	3	3	1	2	-	-	-	-	-	-	-	3	3	3
CO3	3	3	1	2	-	-	-	-	-	-	-	3	3	3
CO4	3	3	1	1	-	-	-	-	-	-	-	3	3	3
CO5	3	3	1	2	-	-	-	-	-	-	-	3	3	3

EC20702 **OPTICAL AND MICROWAVE COMMUNICATION** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- have knowledge on fundamentals of optical communication.
- understand about Fiber Optic link design.
- impart knowledge on fundamentals of Microwave components.
- enhance the knowledge in the area of various microwave tube design.
- get innovative ideas in real time applications

UNIT I **OPTICAL FIBRE SOURCE AND OPTICAL RECEIVER** **9**

Introduction to optical fibre communication - Optical spectral Bands, Key elements of optical fiber systems, Standards for optical communications; Photo detector; Optical Sources - Light emitting diodes, Laser diodes; Line coding; Light Source Linearity, Reliability Considerations; Optical Receivers-Fundamental receiver operation, Digital Receiver Performance, Eye Diagrams, Coherent Detection, Burst - Mode Receivers, Analog Receivers.

UNIT II **OPTICAL LINK DESIGN** **9**

Introduction to Optical link - Digital Links Point to point links, Power penalties, Error Control; Analog Links-Overview of Analog Links, Carrier to Noise Ratio, Multichannel Transmission Techniques, RF over Fiber , Radio - over - Fiber Links.

UNIT III **MICROWAVE COMPONENTS** **9**

Microwave Frequencies; S Parameters - Properties; Microwave passive devices; Coaxial cable, Connectors and Adapter ; Waveguide corners - bends and twists; Short circuit plungers; Actuators; Phase shifter; Waveguide Tees E, H and Magic Tees, Isolators; Circulators, Oscillators, Directional Couplers, Power divider and combiners; Active devices - Gunn Diodes, IMPATT diodes, Schottky Barrier diodes, PIN diodes.

UNIT IV **MICROWAVE TUBES** **9**

Klystrons - Reentrant Cavities, Velocity Modulation Process, Bunching Process; Reflex Klystrons - Velocity Modulation; Helix Traveling Wave Tubes - Slow Wave structures, Amplification Process, Convection Current; Axial Electric Field - Wave Modes, Gain Consideration; Microwave Crossed Field Tubes - Cylindrical Magnetron.

UNIT V **MICROWAVE MEASUREMENTS AND INDUSTRIAL APPLICATIONS** **9**

Introduction - Power measurement; VSWR measurement; Insertion loss measurement by a Reflectometer; Impedance measurement; Frequency measurement; Measurement of cavity and Dielectric constant; Measurement of scattering parameters; Microwave antenna measurement; Microwave applications - Microwave Radar Systems, Microwave Communication Systems, Industrial Application of Microwaves, Medical Applications.

TOTAL PERIODS **45**

COURSE OUTCOMES

At the end of the course, the students will be able to

- construct the optical sources and receivers with their use in optical communication system.
- design optical communication systems and its link designs.
- understand about microwave components

- illustrate the characteristics of fluid flow and actuation through micro channels.
- design microwave devices for different applications

TEXT BOOKS:

1. Gred Keiser, "Optical Fiber Communication", McGraw Hill Education (India) Private Limited. Fifth Edition, Reprint 2017.
2. Annapurna Das and Sisir K Das, "Microwave Engineering" - Tata McGraw Hill, 2020

REFERENCES

1. P Chakrabarti, "Optical Fiber Communication", McGraw Hill Education (India) Private Limited, 2016.
2. J.Gower, "Optical Communication System", Prentice Hall of India, 2001.
3. Samuel Y.Liao - "Microwave Devices and Circuits" - Pearson Education Inc., 2011.
4. Robert E Colin - "Foundations for Microwave Engineering"- John Wiley & Sons Inc - 2005.

CO-PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes :

(1,2,3 indicates the strength of correlation) 3 – Strong , 2 – Medium , 1 – Weak

COs	Programme Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2	-	-	-	-	-	-	-	3	3
CO2	3	2	2	2	2	-	-	-	-	-	-	-	3	3
CO3	3	2	2	2	2	2	2	-	-	-	-	-	3	3
CO4	3	2	2	2	2	-	-	-	-	-	-	-	3	3
CO5	3	2	2	2	2	2	2	-	-	-	-	-	3	3

EC20703 **OPTICAL AND MICROWAVE LABORATORY** **0 0 4 2**

COURSE OBJECTIVES

To enable the students to

- study the performance of parameters in fiber optics.
- establish communication links using Fiber optic cables.
- know the radiation pattern and guide wavelength, frequency measurements.
- understand the characteristics of different microwave components.

LIST OF EXPERIMENTS

I. OPTICAL EXPERIMENTS

1. Determination of Attenuation Measurement in Fibers.
2. Determine the characteristics of fiber optic source using LED.
3. Establishment of the Analog communication links using Fiber optic cables
4. Establishment of the Digital communication links using Fiber optic cables

II. MICROWAVE EXPERIMENTS

1. Determination of guide wavelength measurement.
2. Determination of guide frequency measurement.
3. Radiation Pattern measurement of pyramidal Horns.
4. Study the characteristics of Gunn diode.
5. Study the characteristics of Directional Couplers.
6. Study the characteristics of Magic Tee.

TOTAL PERIODS **60**

COURSE OUTCOMES

Upon the completion of the course, the students will be able to

- analyze the characteristics of optical source and detector
- demonstrate a fiber optic communication link and analyze its frequency responses.
- acquire the knowledge in microwave measurements.
- demonstrate the characteristics of Microwave sources

CO PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes:
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	-	3	-	-	-		-	-	-	3	3
CO2	3	3	3	-	3	-	-	-		-	-	-	3	3
CO3	3	3	3	-	3	-	-	-		-	-	-	3	3
CO4	3	3	3	-	3	-	-	-		-	-	-	3	3

EC20704 **PROJECT WORK (PHASE I)** **0 0 6 3**

COURSE OBJECTIVES

To enable the students to

- develop ability to identify problems and solve through project works.
- get exposure to literature review related to identified problem and finding the gap to solve throughproject work.
- get exposure to required design procedure, experimental setup, analysis package to solve the identifiedproblem.
- project reports and practice to face viva- voce examination.

GUIDELINES

1. The students are expected to get formed into a team of convenient groups of not more than four members for a project.
2. Every project team shall have a guide who is the member of the faculty of the institution. Identification of student group and their faculty guide need to be completed within the first two weeks from the dayof the beginning of 7th semester.
3. The group has to identify and select the problem to be addressed as their project work and study literature survey to finalize a comprehensive aim and scope of their work.
4. 30% of the total work of the project work has to be completed by end of 7th semester.
5. A project report of the phase I to this effect has to be submitted by each student group.
6. Three reviews and end semester review of the progress of the project work have to be conducted by a team of faculty (minimum 3 and a maximum of 5) along with their faculty guide as a member the review team.
7. The same team of faculty will evaluate the project phase-I report. This evaluation will form 50% of the internal assessment mark. The remaining 50% of the internal assessment mark will be given at the end of the 8th semester, at the time of completing the full project work.

TOTAL PERIODS 90

COURSE OUTCOMES

At the end of the project work, the students will be able to

- solve feasible problems to solve through project works
- collect literature through research journals and identify the gap in selected area
- devise the methodology to find solution through gathering complete knowledge on materials/design procedure/analysis and optimization techniques/ availability of experimental setup/ company permissionand other documentation procedures to execute the project
- prepare project report as per format and confidently face viva voce with proper PPT for presentation

CO - PO Mapping

Mapping of Course Outcomes with Programme Outcomes: (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak													
COs	Programme Outcomes(POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO 2
CO1	3	2	2	2	-	-	-	-	3	-	3	2	2	2
CO2	3	2	2	2	-	-	-	-	3	-	3	2	2	2
CO3	3	2	2	2	3	-	-	-	3	-	3	2	2	2
CO4	3	2	2	2					3	3	3	2	2	2

EC20801 **COGNITIVE RADIO NETWORKS** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- understand the software evolving defined radio cognitive radio techniques.
- study the basic architecture and standard for cognitive radio.
- learn spectrum sensing and dynamic spectrum access.
- understand the physical, MAC and Network layer design of cognitive radio.
- be familiar evolving applications and advanced features of cognitive radio.

UNIT I INTRODUCTION TO SOFTWARE - DEFINED RADIO AND COGNITIVE RADIO **9**

Introduction, Software Defined Radio - Evolution of Software Defined Radio; Cognitive radio - goals, benefits, definitions, architectures, relations with other radios, issues, enabling technologies, radio frequency spectrum and regulations.

UNIT II COGNITIVE RADIO ARCHITECTURE **9**

Cognition cycle - orient, plan, decide and act phases; Interference Hierarchy; Building the CRA on SDR; Architectures - SWR and SDR Architecture; Principles; Radio Architecture; SCA - Function; Transforms Model of radio; Architecture Migration; Overview of IEEE 802.22 standard for broadband wireless access in TV bands.

UNIT III SPECTRUM SENSING AND DYNAMIC SPECTRUM ACCESS **9**

Introduction; primary user detection techniques - energy detection, feature detection, matched filtering, cooperative detection and other approaches, fundamental Tradeoffs in spectrum sensing, Spectrum sharing models of dynamic spectrum Access - unlicensed and licensed spectrum sharing, fundamental limits of Cognitive Radio.

UNIT IV FUNDAMENTALS OF COMMUNICATION NETWORKS **9**

Introduction; architecture and building blocks ; protocol architecture; switching technologies; encapsulation and multiplexing ; naming and addressing; routing and forwarding ; congestion control; flow control; error control techniques ; multiple access schemes - polling , ALOHA, slotted ALOHA, CSMA - CSMA / CA.

UNIT V ADVANCED TOPICS IN COGNITIVE RADIO **9**

Overview of security issues in cognitive radios; auction based spectrum markets in cognitive radio networks; public safety and cognitive radio; cognitive radio for Internet of Things; features and applications; enabling technologies and protocols.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of the course, the students will be able to

- explain the software evolving defined radio cognitive radio techniques
- compare different SDR architectures.

- analyse the role of SDR and Cognitive radio communication.
- build experiments and projects with real time wireless application.
- apply the knowledge of advanced features of cognitive radio for real world applications.

TEXT BOOKS

1. Alexander M.Wyglinski, Maziar Nekovee, Thomas Hou, "Cognitive Radio Communications and Networks", Academic Press, Elsevier, 2010.
2. Huseyin Arslan (E.d), "Cognitive Radio, Software Defined Radio and Adaptive Wireless Systems, Springer, 2007.

REFERENCES

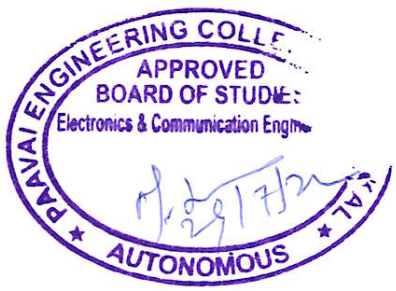
1. Bruce Fette, "Cognitive Radio Technology" Academic Press; 2nd edition ,2009
2. Kwang- Cheng Chen, Ramjee Prasad, "Cognitive Radio Networks", John Wiley and Sons, 2009.
3. Ezio Biglieri, Professor Andrea J.Goldmith, Dr Larry J. Greenstein, Narayan, B.Mandayam, H.Vincent Poor, "Principles of Cognitive Raadio", Cambridge University Press, 2012
4. Markus Dillinger, Kambiz Madani Nancy Alonistioti, "Software Defined Radio", John Wiley, 2003.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes:

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	-	-	-	-	-	-	-	-	3	3	3
CO2	3	3	3	1	-	-	-	-	-	-	-	-	3	3
CO3	3	3	3	3	-	-	-	-	-	-	-	-	3	3
CO4	3	3	3	-	-	-	-	-	-	-	-	3	3	3
CO5	3	3	3	-	-	-	-	-	-	-	-	3	3	3



EC20802 **PROJECT WORK (PHASE II)** **0 0 12 6**

COURSE OBJECTIVES

To enable the students to

- develop ability to identify problems to solve through project works.
- acquire knowledge on literature review related to project problem and how to find the gap.
- gain exposure to required design procedure, experimental setup, analysis package to solve the identified problem.
- get trained in preparing project reports and to face reviews and viva voce examinations

GUIDELINES

1. The students are expected to get formed into a team of convenient groups of not more than Members on a project.
2. Two mid semester review and another end semester review for the progress of the project work have to be conducted by a team of faculty along with the faculty guide as a member of the review team.
3. Progress of project work has to be monitored by the project guide and committee periodically.
4. Attendance for review is mandatory. If a student fails to attend review for some valid reasons, one more chance may be given.
5. The project report should be submitted by the student, one week before the model examination.

TOTAL PERIODS 180

COURSE OUTCOMES

At the end of the project work, the students will be able to

- take up any challenging practical problems and find solution by formulating proper methodology.
- collect literature through research journals and identify the gap in selected area.
- devise the methodology to find solution through gathering complete knowledge on materials/design procedure/analysis and optimization techniques/availability of experimental setup/ company permission and other documentation procedures to execute the project.
- prepare project report as per format and confidently face viva voce with proper PPT for presentation.

CO - PO MAPPING

Mapping of Course Outcomes with Programme Outcomes: (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-weak													
COs	Programme outcomes(POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO 2
CO1	3	-	2	-	-	-	-	-	3	3	3	2	2	2
CO2	3	-	2	-	-	-	-	-	3	3	3	2	2	2
CO3	3	-	2	-	-	-	-	-	3	3	3	2	2	2
CO4	3	-	2	-	-	-	-	-	3	3	3	2	2	2

EC20451 **MULTIMEDIA COMPRESSION TECHNIQUES** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- inculcate the multimedia components and basics of compression.
- infer the compression techniques text.
- understand the concepts image compression techniques.
- know the concepts of speech and audio compression.
- learn the concepts of video compression standards.

UNIT I BASICS OF MULTIMEDIA **9**

Introduction to multimedia - Components of multimedia: Multimedia presentation - Graphics and image data representations; Data compression - Need for compression, Lossy and lossless compression techniques.

UNIT II TEXT COMPRESSION **9**

Characteristics of text data; Run length encoding - Huffmann coding, Adaptive Huffmann coding, Arithmetic coding; Dictionary techniques - LZW algorithm, GIF, TIF, JBIG, JBIG2.

UNIT III IMAGE COMPRESSION **9**

Fundamentals; Compression standards - JPEG standard; Orthogonal transforms; Vector quantization; Wavelet based methods - EZW, SPIHT coders; JPEG 2000 standards.

UNIT IV AUDIO COMPRESSION **9**

Audio compression - Sound, Digital audio, human auditory system; Wave audio format - μ - Law and A-Law companding : ADPCM audio compression; Speech compression; MPEG4, MPEG1/2 Advanced audio coding; Dolby AC-3.

UNIT V VIDEO COMPRESSION **9**

Composite and components of video; Digital video; History of video compression - Video compression techniques and standards - MPEG, MPEG4, H.261 and H.264.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of the course, the students will be able to

- describe the basics of the data compression techniques
- compare text compression algorithms in terms of speed and compression ratio.
- choose appropriate compression techniques for image compression.
- analyze various speech and audio compression techniques.
- compare various video compression standards.

TEXT BOOKS

1. Mark S. Drew, Ze-Nian Li, "Fundamentals of Multimedia", Prentice Hall of India, 2009.
2. David Solomon, "Data Compression - The Complete Reference", Fourth Edition, Springer Verilog, New York, 2010

REFERENCES

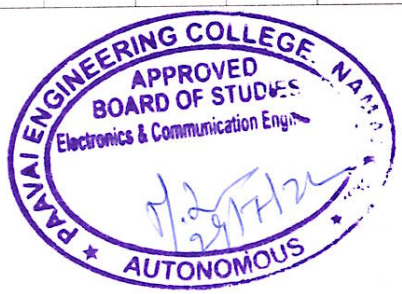
1. Morgan Kauffman, Khalid Sayood, "Introduction to Data Compression", 2nd Edition, Harcourt India, 2000.
2. Yun Q.Shi, Huifang Sun, "Image and Video Compression for Multimedia Engineering - Fundamentals, Algorithms & Standards", CRC press, 2003.
3. Peter Symes, "Digital Video Compression", McGraw Hill Pub., 2004.
4. Ranjan Parekh, "Principles of Multimedia", TMH 2006

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes:

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	-	-	2
CO2	3	3	-	-	-	-	-	-	-	-	-	-	-	2
CO3	3	3	2	2	-	-	-	-	-	-	-	-	-	2
CO4	3	3	2	2	-	-	-	-	-	-	-	-	-	2
CO5	3	3	2	2	-	-	-	-	-	-	-	-	-	2



EC20452 **IoT ENABLED SYSTEM DESIGN** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- understand smart objects and IoT architectures
- learn about various IoT protocol layers
- know the data analytics and cloud in the context of IoT
- bring out the needs of IoT in Industry
- develop IoT infrastructure for popular applications.

UNIT I **INTRODUCTION TO IoT** **9**

Genesis of IoT : IoT Impact : IoT Challenges : Comparing of IoT Architectures - Simplified IoT Architecture; The core IoT functional stack - IoT Data management and compute stack : Smart Objects - Sensors, Actuators; Smart Objects - Sensor Networks in IoT.

UNIT II **IoT PROTOCOL LAYERS** **9**

IoT Access Technologies - Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and LoRaWAN : Network Layer - IP versions, Constrained Nodes and Constrained Networks , Optimizing IP for IoT , From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks; Application Transport Methods - Supervisory Control and Data Acquisition , Application Layer Protocols , CoAP and MQTT.

UNIT III **DATA ANALYTICS AND SUPPORTING SERVICES** **9**

IoT data analytics challenges ; Network analytics applications : Business Intelligence ; Cloud platform for IoT ; Cloud Platform Services ; Structured Vs Unstructured Data ; Data in Motion Vs Data in Rest ; Role of Machine Learning ; No SQL Databases ; Hadoop Ecosystem :Apache Kafka ; Apache Spark ; Edge Streaming Analytics ; Network Analytics.

UNIT IV **INDUSTRIAL INTERNET OF THINGS** **9**

Evolution of IIoT ; Drivers and Advantages of IIoT ; Risk associated with IIoT ; Business and Industrial security approach ; Applications of IIoT ; Work flow of IIoT Security consideration and challenges of adopting IIoT ;Introduction to connected manufacturing ; architecture of connected industry ; Industrial automation control protocols ; connected factory security ; Edge computing in the connected factory.

UNIT V **APPLICATIONS AND CASE STUDIES** **9**

IoT Consumer applications ; Role of IoT in Agriculture and Education ; Government applications in IoT ; IoT energy ; Health care and Law enforcement application ; Power Utility Industry ; Grid Blocks Reference Model ; Smart and Connected Cities; Layered architecture, Smart Lighting, Smart Parking Architecture and Smart Traffic Control ; Case study of IoT - School bus Safety and public safety Information processing.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of the course, the students will be able to

- explain the concept of IoT.
- analyze various protocols for IoT.
- apply data analytics and use cloud offerings related to IoT.
- identify the needs of Industry based on IoT.
- analyze applications of IoT in real time scenario.

TEXT BOOKS

1. David Hanes – IoT Fundamentals Networking Technologies, protocols and use cases for the IoT, CISCO Publications,2022
2. Dr.Ashish kumar Srivastava – IoT a new age era of Technologies and Applications, GCS Publishers ,2022

REFERENCES

1. Arshdeep Bahga, Vijay Madisetti, - "Internet of Things – A hands-on approach", Universities Press, 2015.
2. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things - Key applications and Protocols", Wiley, 2012 (for Unit 2).
3. Jan Holler, Vlasios Tsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand, David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Elsevier, 2014.
4. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds),"Architecting the Internet of Things", Springer, 2011.

CO-PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes : (1,2,3 indicates the strength of correlation) 3 – Strong , 2 – Medium , 1 – Weak														
COs	Programme Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	-	-	-	-	-	-	2	3	3	2
CO2	3	2	2	3	-	-	-	-	-	-	2	3	2	3
CO3	3	3	2	2	-	-	-	-	-	-	2	2	3	2
CO4	3	2	2	2	-	-	-	-	-	-	2	2	2	3
CO5	3	3	2	2	-	-	-	-	-	-	2	2	3	2

EC20453 **LOW POWER VLSI** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- acquire knowledge about low power technologies
- be familiar with concepts of MOS inverters
- know about various sources of power dissipation
- have an in-depth knowledge supply voltage scaling techniques
- understand the software approaches for low power VLSI

UNIT I TECHNOLOGIES FOR LOW POWER **9**

Low power - Sources of power dissipation, dynamic static Low power design methodologies - CMOS Fabrication; Latch problem - prevention; Emerging technologies for low power.

UNIT II MOS INVERTERS **9**

Inverter- Characteristics; MOS Inverter Configurations - Inverter ratio, Switching characteristics, delay parameters, Driving Large capacitive loads.

UNIT III SOURCES OF POWER DISSIPATION **9**

Short circuit power dissipation; Switching power dissipation - dynamic power, reduced voltage swing, switching activity; glitching power dissipation; Leakage power dissipation - Band - Band tunneling current, sub-threshold leakage current.

UNIT IV SUPPLY VOLTAGE SCALING **9**

Device feature size scaling : Architectural level approaches - Parallelism for low power, Multi-core for low power; Multi level voltage scaling- Challenges in MVS; Adaptive voltage scaling

UNIT V LOW POWER SOFTWARE APPROACHES **9**

Machine independent software optimization - Combining loop optimization with DVFS - Loop unrolling, Tiling, Permutation, Fusion; Power-Aware software prefetching

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of the course, the students will be able to

- analyse the various low power technologies
- develop various applications using the concepts of MOS Inverters
- explain about the power dissipation techniques
- examine the different scaling techniques for low power
- analyze the optimization techniques used in low power VSLI

TEXT BOOKS

1. Ajit Pal, - "Low power VLSI Circuits and Systems", Springer, 2015.
2. Kaushik Roy, Sharat Prasad, "Low-Power CMOS VLSI Circuit Design" Wiley,2000

REFERENCES

1. K.S. Yeo and K. Roy, Low-Voltage Low-Power Subsystems, McGraw Hill, 2004.
2. Gary K. Yeap, "Practical Low Power Digital VLSI Design", KAP, 2000.
3. Wayne Wolf, "Modern VLSI Design System on chip" - Pearson education,2012
4. John P.Uyemura-"Introduction to VLSI Circuits and Systems" - John Wiley & Sons,2016

CO-PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes :

(1,2,3 indicates the strength of correlation) 3 – Strong , 2 – Medium , 1 – Weak

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	-	-	-	-	3	3	3
CO2	3	2	1	2	-	-	-	-	-	-	-	3	3	3
CO3	3	2	1	2	-	-	-	-	-	-	-	3	3	3
CO4	3	3	1	1	-	-	-	-	-	-	-	3	3	3
CO5	3	3	1	2	-	-	-	-	-	-	-	3	3	3

IT20455 **MACHINE LEARNING** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- understand the need for machine learning for various problem solving.
- learn about the Linear Models and Classification in machine.
- study the various Neural networks and algorithms in machine learning.
- understand the latest trends and methods in machine learning.
- study of appropriate Unsupervised and reinforcement Learning.

UNIT I INTRODUCTION **9**

Types of Learning, Designing a learning system, concept learning, Find-s Algorithm, Candidate Elimination, Data Preprocessing, Data Cleaning, Data Scales, Transformation, Dimensionality Reduction.

UNIT II LINEAR MODELS **9**

Linear Regression Models, Maximum Likelihood Estimation, Least Squares, Bias - Variance Decomposition, Bayesian Linear Regression, Linear Models for Classification, Probabilistic Generative Models, Probabilistic Discriminative Models, Linear Discriminant Analysis.

UNIT III NEURAL NETWORKS AND DECISION TREES **9**

Feed-forward Networks - Network Training, Delta Rule, Gradient Descent, Error Back propagation, Regularization in Neural Networks, Generalization; Decision Tree Learning - Representation, Inductive Bias, Issues.

UNIT IV KERNEL AND GRAPHICAL METHODS **9**

Constructing Kernels, Radial Basis Function Networks, Gaussian Processes, Maximum Margin Classifiers, SVM, Bayes Theorem, Naive Bayes, Bayesian Networks.

UNIT V UNSUPERVISED AND REINFORCEMENT LEARNING **9**

Measures of Similarity and Dissimilarity, Clustering, Partitioning methods, K Means, Hierarchical Methods, Outliers; Reinforcement Learning - Reinforcement Learning Tasks, Q-learning.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of the course, the students will be able to

- differentiate between supervised, unsupervised, semi-supervised machine learning approaches.
- apply specific supervised or unsupervised machine learning algorithm for a particular problem.
- analyze and suggest the appropriate machine learning approach for the various types of problem.
- design and make modifications to existing machine learning algorithms to suit an individual application.
- analyze case studies on the advanced machine learning algorithms..

TEXT BOOKS:

1. Tom M. Mitchell, Machine Learningl, McGraw-Hill Education (India) Private Limited, 2013.
2. Christopher M Bishop , "Pattern Recognition and Machine Learning Learning", Springer, 2011.

REFERENCES

1. Trevor Hastie, Robert Tibshirani, Jerome friedman , "The Elements of Statistical learning", 2nd Edition, Springer, 2017
2. Ethem Alpaydin, Introduction to Machine Learning (Adaptive Computation and Machine Learning), 3rd Edition, PHI Learning, 2015.
3. Kevin Murphy , "Machine Learning - A Probabilistic Perspective", MIT Press, 2012.
4. Yaser S. Abu-Mostafa , "Learning from Data", AML, 2017.

CO-PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes : **(1,2,3 indicates the strength of correlation) 3 – Strong , 2 – Medium , 1 – Weak**														
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	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	1	-	-	-	-	1	-	-	2	1	2
CO2	3	3	3	1	-	-	-	-	1	-	-	1	1	2
CO3	3	3	3	1	-	1	-	-	1	-	-	1	2	1
CO4	3	3	3	1	-	-	-	-	1	-	-	2	1	1
CO5	3	3	3	2	-	-	-	-	-	-	-	-	1	1

EC20454 **PROFESSIONAL READINESS FOR INNOVATION, EMPLOYABILITY AND ENTREPRENEURSHIP**

COURSE OBJECTIVES **0 0 6 3**

To enable the students to

- To empower students with overall Professional and Technical skills required to solve a real world problem.
- To mentor the students to approach a solution through various stages of Ideation, Research, Design Thinking, workflows, architecture and building a prototype in keeping with the end-user and client needs.
- To provide experiential learning to enhance the Entrepreneurship and employability skills of the students.

This course is a four months immersive program to keep up with the industry demand and to havecritical thinking, team based project experience and timely delivery of modules in a project that solves world problems using emerging technologies.

To prepare the students with digital skills for the future, the Experiential Project Based Learning is introduced to give them hands-on experience using digital technologies on open-source platforms with an end-to-end journey to solve a problem. By the end of this course, the student understands the approach to solve a problem with team collaboration with mentoring from Industry and faculties. **This is an EEC category course offered as an elective, under the type,"Experiential Project Based Learning".**

Highlights of this course:

- Students undergo training on emerging technologies
- Students develop solutions for real-world use cases
- Students work with mentors to learn and use industry best practices
- Students access and use Self-Learning courses on various technologies, approachesand methodologies.
- Collaborate in teams with other students working on the same topic
- Have a dedicated mentor to guide

COURSE OUTCOMES

Upon completion of the course, the students will be able to:

- Upskill in emerging technologies and apply to real industry-level use cases
- Understand agile development process
- Develop career readiness competencies, Team Skills / Leadership qualities
- Develop Time management, Project management skills and Communication Skills
- Use Critical Thinking for Innovative Problem Solving
- Develop entrepreneurship skills to independently work on products

The course will involve 40-50 hours of technical training, and 40-50 hours of project development.The activities involved in the project along with duration are given in Table 1.

TABLE 1: ACTIVITIES

Activity Name	Activity Description	Time (weeks)
Choosing a Project	Selecting a project from the list of projects categorized various technologies & business domains	2
Team Formation	Students shall form a team of 4 Members before enrolling to a project. Team members shall distribute the project activities among themselves.	1
Hands on Training	Students will be provided with hands-on trainingon selected technology in which they are going to develop the project.	2
Project Development	Project shall be developed in agile mode. The status of the project shall be updated to the mentors via appropriate platform	6
Code submission, Project Doc and Demo	Project deliverables must include the working code, project document and demonstration video. All the project deliverables are to beuploaded to cloud based repository such as GitHub.	3
Mentor Review and Approval	Mentor will be reviewing the project deliverablesas per the milestone schedule and the feedback will be provided to the team.	1
Evaluation and scoring	Evaluators will be assigned to the team toevaluate the project deliverables, and the scoring will be provided based on the evaluationmetrics	1
TOTAL		**16 WEEKS**

Essentially, it involves 15 weeks of learning and doing, and one week for evaluation. The evaluation will be carried out to assess technical and soft skills as given in Table 2.

TABLE 2: EVALUATION

SCHEMA

PROFESSIONAL READINESS FOR INNOVATION, EMPLOYABILITY AND ENTREPRENEURSHIP			
Technical Skills		Soft Skills	
Criteria	Weightage	Criteria	Weightage
Project Design using Design Thinking	10	Teamwork	5
Innovation & Problem Solving	10	Time Management	10
Requirements Analysis using Critical Thinking	10	Attendance and Punctuality	5
Project Planning using Agile Methodologies	5	Project Documentation	5
Technology Stack (APIs, tools, Platforms)	5	Project Demonstration	5
Coding & Solutioning	15		
User Acceptance Testing	5		
Performance of Product / Application	5		
Technical Training & Assignments	5		
Total	70	Total	30
Total Weightage			100
Passing Requirement			50
Continuous Assessment Only			

AMENDMENT IN RESPECTIVE REGULATIONS:

1. Course is offered in the
   - $6^{th}/7^{th}$ semesters of UG programmes
2. This is an EEC category course offered as an elective under the type, "Experiential ProjectBased Learning".
3. **Evaluation of Experiential Project Based Learning:**
   - **Project Review & Scoring**: Evaluator accesses the project deliverables, reviews the work done by the team and assigns the score for defined metrics.
   - **Project Status Review**: Mentor reviews the deliverables submitted by studentteams and shares his/her comments. Mentor ensures the timely completion ofproject.
   - The evaluation shall be carried out as per the metrics given in Table 2.
4. If a student takes a break and rejoins the programme at a later point in time in a semesterother than the prescribed semesters identified for the course, he/she is permitted to opt for a professional elective in lieu of this course.

Course Assessment scheme: Assessed through **Continuous assessment mode**

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Passing Criteria:

The passing requirement for the courses of the type 'Experiential Project Based Learning' fallingunder the category of EEC is 50% of the continuous assessment marks only.

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PAVAI ENGINEERING COLLEGE, NAMAKKAL
APPROVED
BOARD OF STUDIES
Electronics & Communication Engineering
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EC20551 **MEDICAL IMAGE PROCESSING** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- inculcate the basic medical imaging modalities.
- infer the clinical image representation formats.
- understand the concepts feature extraction.
- know the concepts of segmentation and registration of images.
- learn the algorithms and image retrieval concepts.

UNIT I INTRODUCTION TO BIOMEDICAL IMAGE PROCESSING **9**

Introduction - Digital Image, Image resolution and Aspect ratio; Components of digital Image Processing; Sampling and quantization; Biomedical image processing - Various modalities of medical imaging, Problems with medical images; Image Enhancement; Other modalities of medical imaging.

UNIT II IMAGE REPRESENTATION AND FILTERS **9**

Image Representation - Pixels and voxels, Gray scale and color representation, Image file formats; DICOM - Other formats, Analyze 7.5, NIFTI - Image quality and the Signal-to-Noise Ratio; Noise reduction filters - Sources of noise and filters used for noise reduction, Spatial domain filters , Frequency domain filters.

UNIT III FEATURE EXTRACTION **9**

Feature Extraction and statistical measurement; Selection of features; Shape related features; Fourier descriptors; Texture Analysis; Breast tissue detection; Analysis of tissue structure.

UNIT IV RESTORATION AND SEGMENTATION **9**

Medical image restoration; Degradation model - Estimation of degradation function - Blur model; Medical image restoration - Blur identification; Image segmentation - Broad classification and applications - Point, line, edge detection methods, split and merge methods; Region growing methods - Watershed method, k-means clustering method.

UNIT V MEDICAL IMAGE RETRIEVAL **9**

Soft computing techniques; Fuzzy-based techniques; Neural network-based techniques; Genetic algorithm based techniques; Content-based image retrieval; Content-based medical image retrieval.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of the course, the students will be able to

- describe the basics of medical image processing methods.
- utilize appropriate filter processing method for specific image.
- use specific extraction for analysis.
- choose appropriate segmentation for the given image.
- apply proper soft computing algorithms for specific images.

TEXT BOOKS

1. G.R. Sinha, Bhagwati Charan Patel, "Medical Image Processing Concepts and Applications", PHI Learning Private Limited, 2014.
2. Wolfgang Birkfellner, "Applied Medical Image Processing-A Basic Course" CRC Press, 2016.

REFERENCES

1. Prince J L and Links J M, Medical Imaging Signals and Systems, Pearson, 2015.
2. Gonzalez R C and Woods R E, Digital Image Processing, Pearson, 2016.
3. Nishimura D, Principles of Magnetic Resonance Imaging, Stanford University Press, 2010.
4. Suetens P, Fundamentals of Medical Imaging, Cambridge University Press, 2009.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes:

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	3	3	-	-	-	-	-	2	3	2
CO2	3	3	2	2	3	3	-	-	-	-	-	2	3	2
CO3	3	3	2	2	3	3	-	-	-	-	-	2	3	2
CO4	3	3	2	2	3	3	-	-	-	-	-	2	3	2
CO5	3	3	2	2	3	3	-	-	-	-	-	2	3	2

EC20552 **SYSTEM DESIGN WITH FPGA** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- know the fundamentals of programmable logic devices
- study the field programmable gate array
- acquire the SRAM Programmable FPGAS
- learn the necessity of Anti-Fuse Programmed FPGAS
- gain the knowledge of design applications of FPGA

UNIT I BASICS OF PROGRAMMABLE LOGIC DEVICES **9**

Introduction; Programmable Logic Arrays; Programmable Array Logic; Programmable Logic Devices/Generic Array Logic - Architecture of Xilinx Cool Runner XCR3064XL CPLD; CPLD Implementation of a Parallel Adder.

UNIT II FIELD PROGRAMMABLE GATE ARRAYS **9**

Organization of FPGAs; FPGA Programming Technologies; Programmable Logic Block Architectures; Programmable Interconnects; Programmable I/O blocks in FPGAs; Applications of FPGAs.

UNIT III SRAM PROGRAMMABLE FPGAS **9**

Introduction - Programming Technology, Device Architecture, Xilinx XC3000, XC4000 Architectures.

UNIT IV ANTI-FUSE PROGRAMMED FPGAS **9**

Introduction - Programming Technology, Device Architecture, Actel ACT2, ACT3 Architectures.

UNIT V DESIGN APPLICATIONS **9**

Counter Examples; Fast Video Controller; Position Tracker for a Robot Manipulator; Designing Counters with ACT devices; Designing Adders and Accumulators with the ACT Architecture.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of the course, the students will be able to

- examine the challenges in programmable logic devices
- analyse the different concept field programmable gate array
- design the SRAM Programmable FPGAS
- evaluate the necessity of Anti-Fuse Programmed FPGAS
- apply the concept of design applications on FPGA

TEXT BOOKS

1. Charles H. Roth Jr, Lizy Kurian John, and Byeong Kil Lee, "Digital Systems Design Using Verilog", Cengage Learning, 2016.
2. Stephen M. and Trim Berger, "Field Programmable Gate Array Technology", Springer International
   Edition, 1994.

REFERENCES

1. John V. Oldfield and Richard C. Dorf, "Field Programmable Gate Arrays" Wiley India, 1995.
2. Pak K. Chan / Samiha Mourad, "Digital Design Using Field Programmable Gate Arrays", Pearson Low Price Edition, 2009.
3. Ian Grout, "Digital Systems Design with FPGAs and CPLDs" Elsevier, Newnes, 2008.
4. Wayne Wolf, "FPGA based System Design" Prentice Hall Modern Semiconductor Design Series, 2004.

CO/PO MAPPING:

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COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	-	-	-	-	2	-	-	3	3	3
CO2	3	3	3	2	-	-	-	-	2	-	-	-	3	3
CO3	3	3	3	-	-	-	-	-	-	-	-	-	3	3
CO4	3	3	3	2	-	-	-	-	-	-	-	3	3	3
CO5	3	3	3	2	-	-	-	-	2	-	-	3	3	3

EC20553 TELECOMMUNICATION SYSTEM MODELING AND SIMULATION 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the simulation techniques.
- know the concept of random variables and random process simulation.
- learn the concept of radio communication and channel modeling.
- acquire knowledge about the parameters for performance analysis
- know the various modeling environment and considerations

UNIT I SIMULATION METHODOLOGY 9

Introduction-Aspects of Methodology; Performance Estimation; Sampling Frequency; Low pass equivalent models for band pass signal; multicarrier signals; Non-linear and time varying systems; Post processing-Basic Graphical techniques and estimations.

UNIT II SIMULATION OF RANDOM VARIABLES AND RANDOM PROCESS 9

Generation of random numbers and sequence; Gaussian and uniform random numbers, Correlated Random Sequences; Testing of random numbers Generators; Stationary and uncorrelated Noise Goodness of fit test

UNIT III MODELING OF COMMUNICATION SYSTEMS 9

Radio frequency and optical Sources-Analog and Digital Signals; Communication channel and Models Free Space Channels; Multipath channel and discrete channel noise and interference.

UNIT IV ESTIMATION OF PERFORMANCE MEASURES FOR SIMULATION 9

Quality of estimator; Estimation of SNR; Probability density function and bit error rate; Monte Carlo method; Importance sampling method; Extreme value theory.

UNIT V STATISTICAL MODELING METHODOLOGY 9

Modeling environment - Hardware, Software simulation environment, considerations; Performance evaluation techniques; error source simulation; Validation.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of the course, the students will be able to

- synthesize programs in simulation techniques
- analyse and design communication channels
- apply the concept of modeling of communication systems
- estimate the performance measure for simulation
- perform modeling methodology in telecommunication system

TEXT BOOKS:

1. MC.Jeruchim, P.Balaban and Sam K Shanmugam, "Simulation of communication Systems: Modeling, Methodology and Techniques", Plenum Press, New York, 2001
2. Geoffrey Gorden, "System Simulation", 2nd Edition, Prentice Hall of India, 1992.

REFERENCES

1. Averill.M.Law and W.DavidKelton, "Simulation Modeling and Analysis", McGraw-Hill Inc., 2000.
2. W.Turin, "Performance Analysis of Digital Communication Systems", Computer Science Press, New York, 1990.
3. Jerry banks and John S.Carson, "Discrete Event System Simulation", Prentice Hall of India, 1984.
4. William H. Tranter, K. Sam Shanmugam, Theodore s. Rappaport, K.Kurt L.Kosbar, "Principles of Communication Systems Simulation", Pearson Education Pvt Ltd, 2004.

CO-PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes : **(1,2,3 indicates the strength of correlation) 3 – Strong , 2 – Medium , 1 – Weak**													
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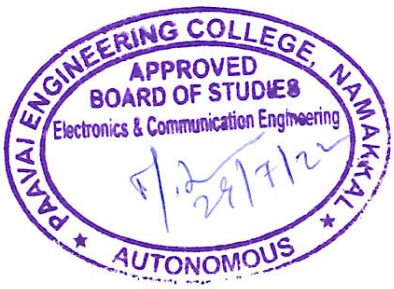
CO1	3	2	2	2	2	-	-	-	-	-	-	2	3	3
CO2	3	2	2	2	-	-	-	-	-	-	-	2	3	3
CO3	3	2	2	1	1	-	-	-	-	-	-	2	3	3
CO4	3	1	2	-	-	-	-	-	-	-	-	-	3	3
CO5	3	2	2	2	2	-	-	-	-	-	-	-	3	3



IT20555	DEEP LEARNING	3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the basic ideas and principles of neural networks.
- understand the basic principles of deep learning.
- familiarize with image processing facilities.
- understand and implement deep learning architectures.
- appreciate the use of deep learning applications.

UNIT I DEEP NETWORKS 9

Basic Concept of Neurons - Perceptron Algorithm; Deep Feed forward Networks - Learning XOR; Gradient Based Learning - Hidden Units, Architecture Design; Back-Propagation and Other Differentiation Algorithms.

UNIT II REGULARIZATION FOR DEEP LEARNING 9

Regularization for Deep Learning - Parameter Norm Penalties, Norm Penalties as Constrained Optimization; Regularization and Under-Constrained Problems; Dataset Augmentation; Noise Robustness; Semi - Supervised Learning; Multitask Learning; Early Stopping; Parameter Tying and Parameter Sharing; Sparse Representations - Bagging and Other Ensemble Methods Dropout; Adversarial Training - Tangent Distance, Tangent Prop and Manifold Tangent Classifier.

UNIT III CONVOLUTIONAL NETWORKS 9

The Convolution Operation - Motivation, Pooling; Convolution and Pooling as an Infinitely Strong Prior - Variants of the Basic Convolution Function; Structured Outputs; Data Types - Efficient Convolution Algorithms; Random or Unsupervised Features; The Neuroscientific Basis for Convolutional Networks.

UNIT IV RECURRENT AND RECURSIVE NETS 9

Unfolding Computational Graphs; Recurrent Neural Networks; Bidirectional RNNs; Encoder - Decoder Sequence-to-Sequence; Architectures; Deep Recurrent Networks; Recursive Neural Networks; The Challenge of Long-Term Dependencies-Echo State Networks

UNIT V APPLICATIONS 9

Images segmentation - Object Detection, Automatic Image Captioning, Image generation with Generative adversarial networks; Video to Text with LSTM models-Attention models for Computer Vision, Case Study: Named Entity Recognition - Opinion Mining using Recurrent Neural Networks - Parsing and Sentiment Analysis using Recursive Neural Networks, Sentence Classification using Convolutional Neural Networks, Dialogue Generation with LSTMs.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of the course, the students will be able to

- analyze the role of deep learning in machine learning applications.
- design and implement deep learning applications.
- critically analyze different deep learning models in image related projects.
- understand and implement deep learning architectures.
- know about applications of deep learning in NLP and image processing.

TEXT BOOKS

1. Ian Goodfellow, Yoshua Bengio , Aaron Courville ,"Deep Learning", MIT Press,2017
2. Francois Chollet, "Deep Learning with Python", Manning Publications, 2018

REFERENCES

1. Phil Kim, "Matlab Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence", Apress, 2017.
2. Ragav Venkatesan, Baoxin Li, "Convolutional Neural Networks in Visual Computing", CRC Press, 2018.
3. Navin Kumar Manaswi, "Deep Learning with Applications Using Python", Apress, 2018.
4. Joshua F. Wiley, "R Deep Learning Essentials", Packt Publications, 2016.

CO PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes: (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak														
COs	**Programme Outcomes (POs)**													
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CO1	1	1	-	-	-	-	-	-	-	-	-	-	3	1
CO2	2	1	-	-	-	-	-	-	-	2	-	-	2	1
CO3	2	1	-	-	-	-	-	-	-	2	-	-	2	1
CO4	2	1	-	-	-	-	-	-	-	1	-	-	2	-
CO5	2	1	-	-	-	-	-	-	-	-	-	-	2	1

EC20651 **VIDEO ANALYTICS** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- understand the basics of video compression for video analytics.
- know the various background modelling methods.
- infer the object classification methods for video analysis.
- learn the video object tracking methods and surveillance networks.
- illustrate the various video applications.

UNIT I BASIC CONCEPTS OF IMAGE AND VIDEO PROCESSING **9**

Basics of image processing; introduction to digital image processing; digital image processing systems - digital image processing methods; digital image segmentation; applications; need for video analytics - overview of video analytics.

UNIT II VIDEO COMPRESSION, MOTION ANALYSIS AND BACKGROUND MODELING **9**

Video compression - types of video compression; latency : mpeg compression; standards; motion segmentation - introduction, motion segmentation algorithms; optical flow methods - applications; background modeling techniques - non-statistical background modeling methods, statistical modeling methods, shadow detection and removal.

UNIT III OBJECT TRACKING AND RECOGNITION **9**

Object classification - shape based object classification, motion based object classification; viola jones object detection framework; object classification using convolutional neural networks; human activity recognition - motion history image based human activity recognition; Hidden Markov Models - HMM based activity recognition, dynamic time warping based activity recognition, abnormal activity recognition; challenges.

UNIT IV VIDEO OBJECT TRACKING AND SURVEILLANCE SYSTEMS **9**

Video object tracking - steps in video object tracking system; Kalman filter; region based tracking; contour based tracking; feature based tracking; model based tracking; mean shift based tracking; applications of tracking algorithms; camera network for surveillance - types of CCTV camera, smart cameras, smart images, multiple view geometry, camera network, camera calibration, camera placement, camera communication, multiple camera coordination and cooperation.

UNIT V VIDEO ANALYTICS APPLICATIONS AND ALGORITHMS **9**

Encoding human motion for automated activity recognition in surveillance applications; Object-based surveillance video synopsis using genetic algorithms; Technical evaluation, development, and Implementation of a remote monitoring system for a golf cart; Intelligent traffic monitoring system through auto and manual controlling using PC and android applications.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of the course, the students will be able to

- model the application based image processing.
- identify the proper compression and background modeling method for the target application.
- choose an appropriate object classifier for a given application.
- design the network for surveillance system.
- use video analytics concepts for various applications.

TEXT BOOKS

1. Maheshkumar H Kolekar, Intelligent Video Surveillance Systems: An Algorithmic Approach, Kindle Edition, Chapman and Hall/CRC; 1st edition, 2018.
2. Nilanjan Dey, Amira Ashour and Suvojit Acharjee, "Applied Video Processing in Surveillance and Monitoring Systems" IGI global, 2017.

REFERENCES

1. Zhihao Chen , Ye Yang , Jingyu Xue , Liping Ye , Feng Guo , "The Next Generation of Video Surveillance and Video Analytics: The Unified Intelligent Video Analytics Suite", Create Space Independent Publishing Platform,1st edition, 2014.
2. Caifeng Shan , Fatih Porikli, Tao Xiang, Shaogang Gong "Video Analytics for Business Intelligence", Springer, 2012.
3. Jean-Yves Dufour, "Intelligent video surveillance system", Network and Telecommunication Series, ISTE Ltd., John Wiley & Sons, 2013.
4. Yunqian Ma and Gang Qian, "Intelligent Video Surveillance Systems and Technology, CRC Press, Taylor & Francis Group, CRC Press, Taylor & Francis Group, 2010.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes:

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	1	1	-	-	-	-	-	2	3	2
CO2	3	3	3	2	2	1	-	-	-	-	-	2	3	2
CO3	3	3	3	2	2	1	-	-	-	-	-	2	3	2
CO4	3	3	3	2	2	1	-	-	-	-	-	2	3	2
CO5	3	3	3	2	2	1	-	-	-	-	-	2	3	2

EC20652 **SATELLITE COMMUNICATION** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- gain knowledge on fundamentals of satellite communication.
- know about geostationary orbit and space segment.
- impart knowledge on earth segment and space link.
- enhance the knowledge in satellite access.
- infer innovative idea in real time applications

UNIT I **OVERVIEW OF SATELLITE SYSTEMS, ORBITS AND LAUNCHING METHODS** **9**

Introduction - Frequency allocations for satellite services; Intelsat - U.S domsats ; Polar orbiting satellites; Argos Systrem; Cospas System; Orbits and Launching methods - Kepler's laws; Definitions of terms for earth orbiting satellites - Orbital elements, apogee and perigee height; Orbital perturbations - effects of a non-spherical earth, Atmospheric drag; Inclined orbits; Calendars - Universal time, Julian dates, Sidereal time; Orbital plane - geocentric - equatorial coordinate system; Horizon co-ordinate system; Sub-satellite point - predicting satellite position; standard time.

UNIT II GEOSTATIONARY ORBIT AND SPACE SEGMENT **9**

Introduction - Antenna look angles; Polar mount antenna; Limits of visibility; Near geostationary orbits; Earth eclipse of satellite; Sun transit outage; Launching orbits; Space Segment - Power supply, Attitude control, Spinning satellite stabilization, Momentum wheel stabilization, Station keeping; Thermal control - TT&C subsystem; Transponders -Wide band receiver, Input demultiplexer, Power amplifier; Antenna subsystem - Morelos and Satmex 5, Anik-Satellite, Advanced Tiros, N spacecraft.

UNIT III EARTH SEGMENT AND SPACE LINK **9**

Introduction - Receive - Only home TV systems; Outdoor unit, Indoor unit for analog (FM) TV, Master antenna TV system, Community antenna TV system; Transmit-Receive earth stations; The Space Link - Equivalent isotropic radiated power, transmission losses; Link power budget equation; System noise - Carrier to-Noise ratio; Uplink – Downlink, Effects of rain, Combined uplink and downlink C/N ratio, Inter modulation noise; Inter Satellite Links.

UNIT IV SATELLITE ACCESS **9**

Single access - Pre-assigned FDMA, Demand assigned FDMA, SPADE system; Bandwidth - Limited and power - Limited TWT amplifier operation, FDMA downlink analysis; TDMA - On-board signal processing for TDMA / FDMA operation, Satellite switched TDMA; Code Division Multiple Access.

UNIT V SATELLITE NAVIGATION AND GLOBAL POSITIONING SYSTEM 9

Introduction - Radio and Satellite Navigation, GPS Position Location Principles, Position Location in GPS, GPS Time, GPS Receivers and Codes; C/A Code-Satellite Signal Acquisition; GPS Navigation Message - GPS Signal Levels, Timing Accuracy; GPS Receiver Operation- GPS C/A Code Accuracy-Differential GPS.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of the course, the students will be able to

- explain the various satellite systems, orbits and launching methods.
- design geostationary orbit and space segment for various application.
- analyse about earth segments and space links
- describe the access techniques of satellite communication
- design satellite navigation and the global positioning system for different applications

TEXT BOOKS:

1. Dennis Roddy, "Satellite Communications", 4th Edition, McGraw Hill Publication, 2017.
2. Timothy Pratt, Charles Bostian and Jeremy Allmuti, "Satellite Communications", John Willy and Sons Asia Pvt. Ltd. 2004.

REFERENCES

1. Wilbur L. Pritchars, Henri G. Suyder Hond and Robert A. Nelson, "Satellite Communication Systems Engineering", 2nd Edition, Pearson Education Ltd., 2003.
2. Richharia M., "Satellite Communication Systems Design Principles", 2nd Edition, Macmillan Press Ltd, 2003.
3. Wilbur L Pritchard," Satellite communication systems engineering,2009
4. Pantelis-Daniel Arapoglou, Shree Krishna Sharma, Symeon Chatzinotas "Satellite Communications in the 5G Era", 2018.

CO/PO Mapping

(3/2/1 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak

COs	Programme Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	1	1	-	-	-	-	-	-	2	-	2	2
CO2	3	3	3	3	-	-	-	-	-	-	3	3	2	2
CO3	3	3	3	3	-	-	-	-	-	-	3	3	3	3
CO4	3	3	3	3	-	-	-	-	-	-	3	3	2	2
CO5	3	3	3	3	-	-	-	-	-	-	3	3	2	2

EC20653 **SYSTEM ON CHIP DESIGN** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- know the components of the system.
- study the basic of time, area, power and reliability of chip.
- explain the internal and external memory design.
- understand the customization and configurability of the system.
- know the application to various area.

UNIT I SYSTEM ARCHITECTURE **9**

Components of the system - processors, memories, and interconnects; hardware and software - programmability versus performance, processor architectures, functional view, an architectural view, memory and addressing, SoC memory examples; addressing; architecture of memory - memory for SoC operating system, approach for SoC design, requirements and specifications, design iteration; system architecture and complexity; product economics and implications for SoC; dealing with design complexity.

UNIT II CHIP BASICS: TIME, AREA, POWER, RELIABILITY AND PROCESSORS **9**

Introduction - design trade-offs, requirements and specifications; cycle time-defining a cycle, optimum pipeline, performance - die area and cost, processor area, processor subunits, ideal and practical scaling , power, area-time-power trade-offs in processor design, workstation processor, embedded processor - reliability, error detection and correction, dealing with manufacturing faults, memory and function scrubbing, configurability.

Processor selection for SoC, basic concepts in processor architecture, basic concepts in processor microarchitecture, basic elements in instruction handling.

UNIT III MEMORY DESIGN **9**

Overview of SOC external memory- flash, SOC internal memory, placement, the size of memory ,scratchpads and cache memory, basic notions, cache organization, cache data, write polices; Strategies for Line Replacement at Miss Time, Multilevel Caches, Virtual-to-Real Translation, SOC (on-die) memory systems - board-based (off-die) memory systems, Simple DRAM and the Memory Array, Models of Simple Processor-Memory Interaction.

UNIT IV CUSTOMIZATION AND CONFIGURABILITY **9**

Introduction - Estimating Effectiveness of Customization; SOC Customization-Overview, Customizing Instruction Processors, Reconfigurable Functional Units (FUs), reconfigurable Interconnects; Software Configurable Processors - Mapping Designs Onto Reconfigurable Devices, Instance-Specific Design, Customizable Soft Processor - Example, Reconfiguration.

UNIT V APPLICATION STUDIES **9**

Introduction - SOC Design Approach - Application Study; AES - AES, Algorithm and Requirements; AES-Design and Evaluation ; Application Study- Image Compression, JPEG Compression , Example JPEG System for Digital Still Camera ; Video Compression-MPEG and H.26X Video Compression;

Requirements , H.264 Acceleration, Designs, MP3 Audio Decoding, Software-Defined Radio with 802.16.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of the course, the students will be able to

- explain the processor selection criteria and limitations
- explain the chip basics.
- elucidate the memory architectures on SOC.
- analyse the customization and reliability of SOC.
- apply the SoC concepts in to real time applications

TEXT BOOKS

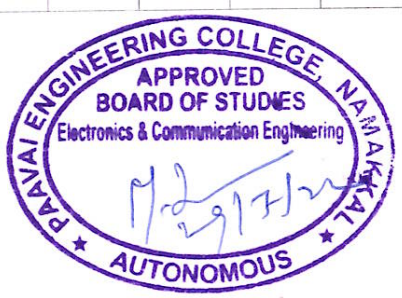
1. Michael J. Flynn and Wayne Luk, "Computer System Design System-on-Chip", Wiely India Pvt. Ltd.,2011.
2. Steve Furber, "ARM System on Chip Architecture", Addison Wesley Professional, 2nd Ed, 2000.

REFERENCES

1. Ricardo Reis., "Design of System on a Chip: Devices and Components", 3rd Edition, 1st Ed., Springer.,2004
2. Prakash Rashinkar, Peter Paterson and Leena Singh L." System on Chip Verification - Methodologies and Techniques", Kluwer Academic Publishers, 2001
3. P. Marwedel, "Embedded System Design: Embedded Systems Foundations of Cyber-Physical Systems", 3rd Edition, Springer, 2018.
4. D. C. Black, J. Donovan, B. Bunton, A. Keist, "System C: From the Ground Up", 2nd Edition, Springer, 2010.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes: (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak													
COs	Programme Outcomes(POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	-	-	-	-	2	-	-	3	3	3
CO2	3	3	3	2	-	-	-	-	2	-	-	-	3	3
CO3	3	3	3	-	-	-	-	-	-	-	-	-	3	3
CO4	3	3	3	2	-	-	-	-	-	-	-	3	3	3
CO5	3	3	3	2	-	-	-	-	2	-	-	3	3	3



EC20654 **ADHOC AND WIRELESS SENSOR NETWORKS** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- acquire knowledge about adhoc MAC protocols.
- be familiar with Adhoc routing protocols.
- know the concepts of wireless sensor networks
- have an in-depth knowledge about sensor localisation and time synchronization.
- understand the various network platforms

UNIT I ADHOC NETWORKS - MAC PROTOCOLS **9**

Adhoc Wireless Networks - Issues, Applications; MAC Protocols - Issues in designing , design goals; Classification of MAC protocols - Contention based protocols - MACAW,FAMA; Contention based with Reservation mechanisms - CATA,HRMA;FPRP; Contention based with Scheduling mechanisms - DWOP;

UNIT II ADHOC ROUTING PROTOCOLS **9**

Routing Protocol - Issues in Designing Classifications of Routing Protocols; Table Driven Routing Protocols - Destination Sequenced Distance Vector Routing protocol; On-demand Routing - Dynamic Source Routing, Adhoc On-Demand Distance Vector routing protocol; Hybrid Routing protocol - Zone Routing Protocol.

UNIT III WIRELESS SENSOR NETWORKING CONCEPTS **9**

Sensor network - Issues and challenges; Sensor network architecture - Layered, Clustered; Data dissemination-Flooding, Gossiping; MAC protocol for sensor networks; Quality of sensor network - Coverage, exposure.

UNIT IV SENSOR LOCALISATION AND TIME SYNCHRONIZATION **9**

Localization - Indoor, Range - Based, Range - free, Event - driven; Time Synchronization - Synchronization problem, clocks, Time synchronization protocols.

UNIT V SENSOR NETWORK PLATFORMS **9**

Sensor node hardware - Berkeley motes, Programming Challenges; Node level software platforms - Tiny Operating System, CONTIKIOS.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of the course, the students will be able to

- analyse the different MAC protocols for various applications.
- develop various routing protocols for networking concepts
- apply the basic concepts of wireless sensor networks.
- examine different synchronization and localization algorithms for managing node and network level functions.
- develop the design of software and hardware components required for an sensor network application

TEXT BOOKS

1. C. Siva Ram Murthy and B. S. Manoj - AdHoc Wireless Networks Architectures and Protocols, Prentice Hall, 2006.
2. Holger Karl, Andreas Willig, - Protocol and Architecture for Wireless Sensor Networks, John Wiley Publication, 2007.

REFERENCES

1. Feng Zhao and Leonidas Guibas, "Wireless Sensor Networks: an Information Processing Approach", Elsevier Publication, 2004
2. Waltenegus Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice",1st Edition, John Wiley & Sons , 2011
3. Sitharama Iyengar S, Nandan Parmeshwaran, Balkrishnan N and Chuka D, "Fundaments of Sensor Network Programming, Applications and Technology", John Wiley & Sons, 2011.
4. Fei Hu and Xiaojun Cao, "Wireless Sensor Networks Principles and Practice", CRC Press, 2010

CO PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes: (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak														
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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	-	-	-	-	3	3	3
CO2	3	2	1	2	-	-	-	-	-	-	-	3	3	3
CO3	3	2	1	2	-	-	-	-	-	-	-	3	3	3
CO4	3	3	1	1	-	-	-	-	-	-	-	3	3	3
CO5	3	3	1	2	-	-	-	-	-	-	-	3	3	3

EC20903 SENSORS AND TRANSDUCERS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the measurement process.
- learn about various distance measurement sensors.
- infer about the sensors used to measure various physical parameters.
- know the concepts of optical, pressure and temperature sensor.
- learn the fundamentals of signal conditioning, data acquisition and communication systems.

UNIT I INTRODUCTION 9

Basics of Measurement, Classification of errors - Error analysis, Static and dynamic characteristics of transducers; Performance measures of sensors; Classification of sensors; Sensor calibration techniques; Sensor Output Signal Types.

UNIT II MOTION, PROXIMITY AND RANGING SENSORS 9

Motion Sensors - Potentiometers, Resolver, Encoders, Optical, Magnetic, Inductive, Capacitive, LVDT, RVDT - Synchro - Microsyn, Accelerometer; GPS, Bluetooth, Range Sensors - RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR).

UNIT III FORCE, MAGNETIC AND HEADING SENSORS 9

Strain Gage, Load Cell, Magnetic Sensors types, principle, requirement and advantages; Magneto resistive Hall Effect; Current sensor Heading Sensors - Compass, Gyroscope, Inclinometers.

UNIT IV OPTICAL, PRESSURE AND TEMPERATURE SENSORS 9

Photo conductive cell, photo voltaic, Photo resistive, LDR, Fiber optic sensors, Pressure, Diaphragm, Bellows, Piezoelectric - Tactile sensors, Temperature - IC, Thermistor, RTD, Thermocouple; Acoustic Sensors - flow and level measurement; Radiation Sensors ; Smart Sensors; Film sensor; MEMS and Nano Sensors; LASER sensors

UNIT V SIGNAL CONDITIONING AND DAQ SYSTEMS 9

Amplification; filtering; sample and hold circuits; data acquisition-single channel and multi-channel data acquisition; data logging - applications, automobile, aerospace, home appliances, manufacturing, environmental monitoring.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of this course, the students will be able to

- be expertise in various calibration techniques and signal types for sensors.
- elucidate various distance measurement sensors
- explain various force, magnetic and heading sensors

- use smart sensors in different applications.
- implement the DAQ systems with different sensors for real time applications

TEXT BOOKS

1. Ernest O Doebelin, "Measurement Systems - Applications and Design", Tata McGraw-Hill, 2009.
2. Sawney A K and Puneet Sawney, "A Course in Mechanical Measurements and Instrumentation and Control", 12th edition, Dhanpat Rai & Co, New Delhi, 2013.

REFERENCES

1. Patranabis D, "Sensors and Transducers", 2nd Edition, PHI, New Delhi, 2010.
2. John Turner and Martyn Hill, "Instrumentation for Engineers and Scientists", Oxford Science Publications, 1999.
3. Richard Zurawski, "Industrial Communication Technology Handbook" 2nd edition, CRC Press, 2015.
4. Ian Sinclair, "Sensors and Transducers", 3rd Edition, 2000.

CO/PO MAPPING:

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CO1	3	2	1	1	-	-	-	-	-	-	-	3	3	3
CO2	3	2	1	2	-	-	-	-	-	-	-	3	3	3
CO3	3	2	1	2	-	-	-	-	-	-	-	3	3	3
CO4	3	3	1	1	-	-	-	-	-	-	-	3	3	3
CO5	3	3	1	2	-	-	-	-	-	-	-	3	3	3

EC20904	AUTOMOTIVE ELECTRICAL AND ELECTRONICS SYSTEM	3 0 0 3

COURSE OBJECTIVES

To enable the students to

- learn the basics of batteries and starter system
- understand the principle of charging and light auxiliary system
- learn the EEMS and various control modes
- acquire the concept of vehicle control motion
- gain knowledge about the significance of telematics and vehicle diagnosis

UNIT I BATTERIES AND STARTING SYSTEMS 9

Vehicle Batteries; Lead acid battery; Battery Rating; Lead Acid battery Charging methods; Testing Methods; Fault Diagnosis; Requirement of a starting System; Starter motor- Construction and Working of Starter Drive Mechanism, Starter Motor Fault Diagnosis; New Developments in Battery Technologies and Starting System.

UNIT II CHARGING SYSTEM AND LIGHTING AUXILIARIES 9

Alternator; D.C Generator; Alternator Charging Circuits and Rectification of AC to DC; Alternator Testing Methods; Mechanical and Electronic Voltage regulator; Lighting Fundamentals and Lighting Circuit Conventional Headlamps and LED Lighting System; Wiper system and Signaling and Warning system.

UNIT III ELECTRONIC ENGINE MANAGEMENT SYSTEM 9

Gasoline Engine Fuel Injectors; Single point and Multi Point Fuel Injections; Testing of Fuel Injectors Conventional Ignition System; Electronic Ignition System; Programmed ignition system; Distributor less Ignition System; Digital Engine Control Modes; EGR Control and variable valve timing; Ignition Controlling; Closed loop ignition timing; Spark Advance Correction Scheme.

UNIT IV FUNDAMENTALS OF VEHICLE MOTION CONTROL 9

Cruise Control System; Adaptive Cruise Control System; Throttle Actuator ; Stepper Motor Based Control; Antilock Braking Mechanism; Tire Slip Controller; Electronic Suspension System; Variable Damping; Variable Spring rate; Electric Power Assisted Steering Mechanism; Four Wheel Steering and Steer-by Wire.

UNIT V TELEMATICS AND VEHICLE DIAGONSTICS 9

GPS Navigation; GPS Structure; Dead Reckoning using Inertial Navigation System; Electronic Control System Diagnostics; OBDII-Diagnostics Fault Codes; Introduction to Model-based Sensor Failure Detection; Case Study on MAF Sensor calibration.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of the course, the students will be able to

- examine the basics of batteries and starting system
- analyze the principle of lighting auxiliaries
- apply the ignition system in various machines
- synthesize the principle of vehicle control
- utilize the concepts of vehicle diagnostics

TEXT BOOKS

1. Tom Denton "Automobile Electrical and Electronic Systems" 3rd edition, Elsevier Butterworth- Heinemann 2004.
2. William. B. Ribbens,"Understanding Automotive Electronics" 7th edition Butterworth-Heinemann publications, 2012.

REFERENCES

1. Allan.W.M.Bonnick "Automotive Computer Controlled System" Butterworth Heinemann .2001.
2. Robert Bosch Gobh "Bosch Automotive Electric and Electronics" 5th edition ,Springer-Vieweg. 2007.
3. Bechhold "Understanding Automotive Electronics", SAE, 2003.
4. Young A.P. & Griffiths.L. "Automotive Electrical Equipment", ELBS & New Press, 1999.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes:
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak

COs	Programme Outcomes(POs)													
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CO1	2	1	1	1	-	-	1	-	-			-	3	3
CO2	2	-	-	1	-	-	1	-	-			1	3	3
CO3	1	1	1	-	1	1	1	-	-	-	-	-	3	3
CO4	2	2	2	1	1	-	1	-	1	-	-	1	3	3
CO5	2	1	1	2	2	1	1	-	1	-	-	1	3	3