Integral University, Lucknow

Effective from Session: 2016-17							
Course Code	EC401	**Title of the Course**	OPTICAL COMMUNICATION	**L**	**T**	**P**	**C**
Year	**4**	**Semester**	7	**3**	**1**		**4**
Pre-Requisite		**Co-requisite**					
Course Objectives	To provide students with the design and operating principles of modern optical communication systems and networks. Upon completion of the subject, students should be familiar with commonly used components and subsystems in optical communication and network systems.						

Course Outcomes	
CO1	To understand the concept of block diagram of optical fiber communication system, Advantages of optical communication. To learn the structure of optical wave guide light propagation in optical fiber, Ray & Wave theory, Modes in optical fiber: Step and graded fibers
CO2	To understand the concept of the transmission characteristics of optical fibers. To learn Attenuation, Intermodal and intermodal dispersion, Polarizations maintaining fibers
CO3	To understand the concept of optical sources & components. To learn the fabrications & characteristics of semiconductors, lasers and LEDs, Fiber Splicer, Fiber connector, Fiber couplers, Multiplexers.
CO4	To understand the concept of Optical detectors, Requirements for photo detectors, Characteristics of photo detectors, Noise in photo detectors. To learn the principle of APD and Pin Diodes, Photo transistor and Photo conductors.
CO5	To understand the concepts of Optical fiber communication system. To learn the optical transmitter circuits, Optical receiver circuits, Modulation and Demodulation format

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Introduction**	Block diagram of optical fiber communication system, Advantages of optical communication, Structure of optical wave guide light propagation in optical fiber, Ray & Wave theory, Modes in optical fiber: Step and graded fibers	8	1
2	**Transmission characteristics of optical fibers**	Attenuation, Intermodal and intermodal dispersion, Polarizations maintaining fibers.	8	2
3	**Optical sources & components:**	Fabrication & characteristics of semiconductors, lasers and LEDs, Fiber Splicer, Fiber connector, Fiber couplers, Multiplexers, Tunable Filters.	8	3
4	**Optical detectors**	Requirements for photo detectors, photo detectors, Characteristics of photo detectors, Principle of APD and Pin Diodes, Noise in photo detectors, Photo transistor and Photo conductors.	8	4
5	**Optical fiber communication system**	The optical transmitter circuits, the optical receiver circuits, Modulation and Demodulation format	8	5

Reference Books:

F.D.K.Mynlave, LL Schein, Fiber Optic Communication Technology, Pearson Edition, 200

Vivekanand Mishra & Sunita P.Ugale, "Fiber-optic Communication: Systems & Component", Wiley India, 2013.

G.Keiser, Optical fiber Communication, Mc Graw Hill, 2002

J.M.Senior, Optical fiber Communication, PHI, 2003

e-Learning Source:

https://getmyuni.azureedge.net/assets/main/study-material/notes/electronics-communication_engineering_optical-fiber-communication_transmission-characteristics-of-optical-fibers_notes.pdf

https://www.youtube.com/watch?v=6qWX4Wotyd8

https://www.youtube.com/watch?v=fnIebfgEgW8

https://www.youtube.com/watch?v=DYHcdqVrJ_g

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO4	PSO5	PSO6	PSO7
CO1	3	1	3	0	0	0	0	0	3	0	0	1	3	2	0	1	3	1
CO2	3	2	3						3			1	3				3	2
CO3	3	3	3	1	1				3				3	2		1	3	3
CO4	3	3	2						3			1	3				3	3

CO5																		

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session:							
Course Code	EC402	**Title of the Course**	VLSI Design	**L**	**T**	**P**	**C**
Year	**4th**	**Semester**	VII	**3**	**1**		**4**
Pre-Requisite	Integrated ciruits	**Co-requisite**					
Course Objectives							

Course Outcomes	
CO1	Design MOS/CMOS circuits and systems. Evaluate the system performance.
CO2	Use PSPICE simulation programme to simulate the CMOS designs.
CO3	Test existing systems and their own designs for simple fabrication faults. Integrate systems and sub-systems
CO4	Design MOS/CMOS circuits and systems. Evaluate the system performance.
CO5	Use PSPICE simulation programme to simulate the CMOS designs.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1		Int. to integrated circuits, IC nomenclature, technology, Overview of VLSI, design, performance indices, Planar IC processes, overview of the processes, characteristics,Processe design, process outcomes,Fabrication, basic device fabrication, R fabrication, diode fabrication, BJT and MOS fabrication details, NMOS process, Tubs/ twin tubs, CMOS fabrication		
2		MOS types, principle of working, MOS operations, characteristics, MOS as circuit element and applications, Frequency performance of the MOS, parasitics, parasitic capacitance calculation of single MOS, parasitic capacitance calculation of single CMOS, delay estimation of inverters Stick diagrams and layout, rules, stick diagrams of simple circuits, Characterisation and estimation of Resistance and Capacitance of layers, Delay estimation of MOS/CMOS circuit		
3		Int to basics of inverters, Depletion load and CMOS inverters, VTC, noise margin, power and delay analysis, NAND/ NOR design. Comples logic realization in depletion load nMOS and CMOS, pseuoNMOS, transistor equivalence in complex logics, design proceedures, Clocking and dynamic logic methodologies		
4		VLSI systems, system design considerations and approaches, System design examples, Pass logic, CPL fundamentals and basic logic implementation, dynamic and domino circuit methodologies, important problems, Flip Flops fundamentals, latch realization and circuit methodologies, Clocked F/F's, design of JK and D F/F's, Memory circuits and design considerations.		
5		VLSI design strategies, abstraction, top-down/ bottom-up approaches. Introduction to modular design approaches, design time considerations, Gate arrays, implementation and logic design with gate arrays. Int to array logic, ROM/ PAL/PLA, AND-OR, NAND-NAND, NOR-NOR methodologies, Logic design with logic arrays, circuit implementation, design considerations. Reliability of VLSI circuits, device faults, faults in VLSI circuits, testing of simple circuits		

Reference Books:

1. Pucknel and Eshraghian, Basic VLSI Design, PHI learning.
2. Sung-Mo Kang and Yusuf leblebici, CMOS Digital Integrated Circuits - Analysis and Design 3rd Ed, TMH
3. K. Gopaln, Introduction to Microelectronics Circuits, MGH India.
4. Weste and Eshraghian, Principles of CMOS Design PHI.

5	Rabey and Chandrakasan, Digital Integrated Circuits - A design Perspective, 2nd Ed, EEE-PHI
6	Uyemura, Introduction to VLSI Circuits, Wiley India
e-Learning Source:	

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO4	PSO5	PSO6	PSO7
CO1	**3**	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**3**	**2**	**2**	**1**	1	2	2	1	2
CO2	**3**	**3**	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**3**	**3**	**2**	**1**	2	2	1	2	1
CO3	**3**	**3**	**3**	**2**	**1**	**1**	**2**	**1**	**1**	**3**	**3**	**2**	**2**	2	1	1	2	1
CO4	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**1**	**2**	**3**	**3**	**2**	**2**	3	3	2	3	2
CO5	**3**	**3**	**2**	**2**	**3**	**2**	**1**	**1**	**3**	**3**	**2**	**2**	**2**	2	2	3	2	

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session:							
Course Code	EC 403	**Title of the Course**	Wireless Communication	**L**	**T**	**P**	**C**
Year	**IV**	**Semester**	VII	**3**	**1**	**0**	**4**
Pre-Requisite	Communication Enginnering	**Co-requisite**					
Course Objectives	❖ To understand the evolution and History of Wireless Technology and compare 1G,2G,3G, 4G & emerging systems. To learn RF propagation, reflection, diffraction, scattering, fading.To learn the concept of Mobile radio propagation, cellular system design, frequency reuse, handoff strategies, and interference. ❖ To understand every aspect of Improving coverage and capacity in cellular systems, cell splitting, sectoring, microcell zone and understand the different multiple access techniques**:** SDMA, FDMA, TDMA, CDMA & its spectrum efficiency. ❖ To understand mobile technologies like GSM and CDMA and study various Wireless networks like Bluetooth, ZigBee, ATM, Paging, WLL, Bluetooth, RFID & Cognitive radios and their applications. ❖ To understand the calculation of basic parameters in a satellite communication system. ❖ To understand every aspects of satellite communication like orbital mechanics, launching techniques, satellite link design, earth station technology and FM Improvement factor.						

Course Outcomes	
CO1	Students shall be able to Define Wireless and Radio. Determine and compare the techniques of various 1G,2G,3G, 4G systems with their characteristics and limitations. Learn different types of fading, indoor and outdoor propagation models and calculate losses.
CO2	Students shall be able to understand the concept of frequency reuse. Given a Multiple access techniques, student shall be able to know multiple access schemes used and channel assignment strategies and calculate spectrum efficiency and differentiate basic parameters of FDMA, TDMA, CDMA. Apply cellular concepts to evaluate the signal reception performance in a cellular network and traffic analysis to design cellular network with given quality of service constraints.
CO3	Understand GSM, CDMA concepts, architecture, frame structure, system capacity and services. Understand and compare personal area network (PAN) technologies such as Zigbee, Bluetooth etc plan a wireless communications system for a given environment in which it is to be deployed.
CO4	Students shall be able to define orbital mechanics and launch methodologies. Compare competitive satellite services and apply Kepler's First second & Third Law. Students shall be able to calculate basic parameters and angles in a satellite communication system.
CO5	Students shall be able to design link power budget for satellites and Explain satellite access techniques. Students shall be able to describe satellite subsystems.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1		**Evolution of wireless systems:** Introduction to 1G,2G,3G & 4G systems, RF propagation, reflection, diffraction, scattering, propagation models, fading. **Mobile communication concepts:** Mobile channels description, mobile call, frequency reuse, handoff strategies, co channel and adjacent channel interference.	8	1
2		Improving coverage and capacity in cellular systems, cell splitting, sectoring, microcell zone. **Multiple access techniques:** SDMA, FDMA, TDMA, CDMA & its spectrum efficiency.	8	2
3		**Wireless networks**: ATM, Paging, WLL, Bluetooth, RFID & Cognitive radios. **Wireless Systems & Standards:** GSM, personal satellite communication system, CDMA2000, WCDMA, 3G systems, UMTS.	8	3
4		**Satellite Communication**	8	4

		Origin and brief history of satellite communication, Elements of a satellite communication, Satellite Frequency allocation and band spectrum, Satellite Orbits, Advantages & Disadvantages of Satellite communication, Satellite Applications, Kepler's First second & Third Law, Equation of orbit, Describing the orbit, Locating the satellite in the orbit, Orbital elements, Apogee and perigee Heights, Look Angles, Azimuth Angle, Elevation Angle, Mechanism of launching a satellite.		
5		**Satellite subsystems:** Power Supply Subsystem, Altitude and orbital Control, Telemetry, Tracking & Command (TT&C), Communication subsystem, Transponder, Satellite Antenna, and Antenna Types. **Satellite channel and link design:** Basic Transmission theory, System Noise Temperature, C/N and G/T ratio, Design of down link and uplink, FM Improvement factor.	8	5

Reference Books:

1. William C.Y.Lee, "Mobile cellular telecommunications Analog & Digital systems", Tata Mc Graw Hill, India.
2. Pandya, "Mobile & personal communication Services & system", Prentice Hall of India Print.
3. Feher, "Wireless Digital communications: Modulation & spread spectrum Applications", Prentice Hall of India Print.
4. RoddyD/Satellite Communication/Prentice Hall/1989.
5. D.C.Agrawal/satellite Communication/Khanna publishing

e-Learning Source:

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO4	PSO5	PSO6	PSO7
CO1	**3**	**1**	**3**						3			1	3					
CO2	**3**	**2**	**3**						3			1	3	2	2			
CO3	**3**	**3**	**3**	1	1				3				3	2	2			
CO4	**3**	**3**	**2**						3			1	3	1				
CO5	**3**	**2**	**2**	1	1				3			1	3	1				

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session:							
Course Code	EC404	**Title of the Course**	Mechatronics Engineering	**L**	**T**	**P**	**C**
Year	**IV**	**Semester**	VII	**3**	**1**	**0**	**4**
Pre-Requisite		**Co-requisite**					
Course Objectives	1. Ability to design, analyze, and test "intelligent" products and processes that incorporate appropriate computing tools, sensors, and actuators. 2. Ability to demonstrate professional interaction and communicate effectively with team members.						

Course Outcomes	
CO1	Understand & describe basic concepts of digital electronics.
CO2	Understand the concepts of sensors and transducers.
CO3	Understand and describe the control theory and stability concepts.
CO4	Understand and describe the robotic theory and arm kinematics.
CO5	Understand the reliability concepts and different case studies on robots.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Introduction to Mechatronics**	Historical perspective, key elements of mechatronics system. Covalent bonds & doping material, PN junction, Zener diode, Tunnel diode, Schottky diode Power Supplies & active component. Minimization of Boolean expressions, Combinational Logic Module: Adder, Subtractor, Multiplexer, Demultiplexer, Decoder & Encoder. Sequential Logic Module: Flip flop (SR, JK, D, T& Master Slave), Analog Electronics: Introduction to amplifier, Different Amplifier (Inverting, Noninverting, Summing, and Integrator& Differentiator), Comparator, and Sample hold circuit.	**8**	**CO.1**
2	**Sensors & Actuators**	Introduction to Sensor & different sensor (Distance, pressure measurement, temperature measurement & proximity sensor), Actuators: Moving iron transducer, Solenoids, Servo motor, Kinematics chain, Gears, Cam mechanism, Different type of clutches.	**8**	**CO.2**
3	**Control Theory**	Introduction to Control Theory, closed loop, open loop control system, Transfer function, System response, zero, first & second order system, Routh Hurwitz Stability criterion, Root locus, Bode plot.	**8**	**CO.3**
4	**Robotic System**	Types of robots, Robotic arm terminology, Robotic arm configuration, Robot system, Robotic Manipulation kinematics, Robotic arm positioning concepts & Robotic arm path planning.	**8**	**CO.4**
5	**Reliability & Case Studies**	Introduction to reliability & reliability system, life curve, failure rate modes, response surface modeling. Different case studies of mechatronics systems on robots.	**8**	**CO.5**

Reference Books:

Godfrey Onwubolu, "Mechatronics: Principle & Application", India Reprint, Reed Elsewire India Private Limited, ISBN: 9788131205235.

MAHALIK, "Mechatronics: Principles, Concepts and Applications", McGraw Hill Education Private Limited, 2009.

RyszardJablonsk, "Recent Advances in Mechatronic", Springer, 2008-2009.

Bolton, "Mechatronics: A Multidisciplinary Approach: Electronic Control Systems in Mechanical and Electrical Engineering", Pearson, 4 Edition, 2010.

e-Learning Source:

Course Articulation Matrix: (Mapping of COs with POs and PSOs)																
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2		2		2	3	2				1	3	1	1	1
CO2	2	3	2		2			1		1			3	2	1	1
CO3	2	2		2		2	1		1	1		1	3	2	2	1
CO4	2	2	2		1			1			1		3	1	2	1
CO5	3		2	2	1		3	1	2			1	3	2		3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session:							
Course Code	EC406	**Title of the Course**	Digital System Design Using VHDL	**L**	**T**	**P**	**C**
Year	**IV**	**Semester**	VII	**3**	**1**	**0**	**4**
Pre-Requisite	None	**Co-requisite**	EC406				
Course Objectives	**1.** Use the industry-standard hardware description language VHDL into the digital design process. **2.** Design VHDL models ranging in complexity from a simple adder to more complex circuits. **3.** Understand the synthesis and testing of the models.						

Course Outcomes	
CO1	To understand the basic concepts of Digital Design
CO2	To implement various Combinational and sequential circuits using VHDL descriptions. Write simple VHDL programs in different styles
CO3	To design and verify the functionality of digital circuits (PLA, PAL, PLD) and Arithmetic Operations.
CO4	To identify the suitable Abstraction level for a particular digital design.
CO5	To write the programs more effectively using Verilog tasks and directives. Perform timing and delay Simulation.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Review of Logic Design Fundamentals:	Combinational logic, Boolean Algebra and Algebraic Simplification, Karnaugh maps, Designing with NAND and NOR gates, Hazards in combinational Networks, Flipflop and Latches, Mealy Sequential Network Design, Design of Moore Sequential Network, Equivalent states and reduction of state Tables, Synchronous Design, Tristate Logic and	8	CO1
2	Introduction to VHDL	VHDL Description of Combinational Networks, Modeling Flipflops using VHDL Processes, VHDL Models for a Multiplexer, Modeling a sequential Machine, Variables, signals, and constants, Arrays, VHDL operators, VHDL Functions, VHDL Procedures, Packages and Libraries	8	CO2
3	Styles of Descriptions	VHDL Data types, VHDL Styles of Description Data flow Description: Highlights of Data flow Description, Structure of Data flow Description, Data type-vectors, Common VHDL programming Errors	8	CO3
4	Designing with programmable Logic Devices	Read only memories, Programmable Logic Arrays, Programmable Array Logic, Other sequential programmable Logic Devices (PLDs), Generics, Generate statements. Design of Networks for Arithmetic Operations: Design of serial Adder with Accumulator, Design of Binary Multiplier, Multiplication of signed Binary Numbers, Design of Binary Divider	8	CO4
5	Synthesis	Highlights of synthesis, synthesis information from entity and module, Mapping process in the hardware domain- Mapping of signal assignment, variable L1, L2, L3 assignment, if statements, else-if statements, loop statement. Hardware Testing and Design for Testability: Testing Combinational Logic, Testing Sequential Logic.	8	CO5

Reference Books:

1. Digital Systems Design using VHDL", Charles H. Roth, Jr., The University of Texas at Austin. 2006 reprint, Thomson Asia Pte Ltd, Singapore
2. HDL Programming VHDL and Verilog", Nazeih M. Botros, 2009 reprint, Dreamtech press

e-Learning Source:

E books

You tube Lectures

PPT

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO4	PSO5	PSO6	PSO7
CO1	1	3	3	2	3		2		2		3							
CO2	2	1	2	1	3	1	2	2	2									
CO3	1	2	2	2	1	1		2		1								
CO4	2	3	2	2	1					1								
CO5	1	2	1	2		1	3	1	2									

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	Sign & Seal of HoD

Integral University, Lucknow

Effective from Session:							
Course Code	**EC407**	**Title of the Course**	**Digital Image Processing**	**L**	**T**	**P**	**C**
Year	**IV**	**Semester**	VII	**3**	**1**	**0**	**4**
Pre-Requisite	Signal & System	**Co-requisite**					
Course Objectives	❖ To learn the basics in digital image processing. To learn how to represent grayscale, binary and color image in mathematical form. ❖ To understand the need of processing in digital image. To learn 2D convolution in an image. To understand and apply edge detection technique on an image. To understand about image enhancement, restoration and segmentation. ❖ To understand about the need of compression. What are techniques and how can it be applied on image. ❖ To understand the feature extraction its representation and to learn the concept of topological, geometric attributes. ❖ To understand the applications of image processing techniques medical imaging, biometrics, watermarking, barcodes and image forensics.						

Course Outcomes	
CO1	Students shall be able to **understand** the actual view in 2D image form and **represent** 2D image into mathematical form, able to understand the basic difference between gray image, color image and binary image.
CO2	For a given image, **student** shall be able to **analyze** it by **applying** using enhancement, restoration and segmentation techniques.
CO3	For a given image, student shall be able to **understand** the difference between lossless and lossy compression. Further they will be **Examine** and **analyze** the compression techniques like Huffman Coding, Arithmetic coding, Transform Coding: JPEG, JPEG2000, Zero tree, Zero block coders.
CO4	Students shall be able to **understand** the Feature Extraction Representation of an image in order to object recognition.
CO5	Student shall be able **understand** and how to **apply** it in various field like medical imaging, CAT, Biometrics: Barcodes and Image Forensics.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Fundamentals of Digital Images	Digital Image, Elements of digital image processing system, Gray Image, Color Image, Binary Image, Conversion between Color Image and Gray Scale Image, Pseudo Color Images, Human Visual System (HVS).	8	1
2	Image Processing Basics	Histogram, Histogram Equalization, 2D Convolution, Image Filtering: Low Pass Noise Filter, optimal filter (Weiner Filter), Edge Detection, Image Enhancement, Restoration and Segmentation.	8	2
3	Image Compression	Image Redundancies, Lossless v/s Lossy Compression, Predictive Coding: Huffman Coding, Arithmetic coding, Transform Coding: JPEG, JPEG2000, Zero tree, Zero block coders.	8	3
4	Feature Extraction	Feature Extraction Representation, Topological Attributes, Geometric Attributes, Boundary based Description, Region based Description.	8	4
5	Image Processing Applications	Medical Imaging, CAT, Biometrics: Finger Print, Iris and Face Detection, CCTV system, Watermarking (Visible/Invisible), Barcodes, Image Forensics.	8	5

Reference Books:

1. Gonzalez R.C. & P. Wint, “Digital Image Processing, Addison Wesley.
2. Kenneth R. Castleman, “Digital Image Processing”, Pearson India.
3. S. Jayaraman, Digital Image Processing, Tata McGraw - Hill Education Pvt. Ltd.

e-Learning Source:

Digital Image Processing - Course (nptel.ac.in)

Image Signal Processing - Course (nptel.ac.in)

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2										2	1					
CO2	3	2											2		2			
CO3	3	2	3										1	2		2		
CO4	3	3	3	3										1	1	3		
CO5	3					3		1				2	2	2	1			

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session:							
Course Code	**EC408**	**Title of the Course**	**Spread Spectrum Communication**	**L**	**T**	**P**	**C**
Year	**4**	**Semester**	7	3	1	0	4
Pre-Requisite	Digital Communication & Networks (EC-312)	**Co-requisite**	NA				
Course Objectives	• An understanding of spread-spectrum concept and its implementation in various systems. • An ability to understand binary sequences and its generation. • An ability to design and provide solutions for practical and efficient system and Multiple Access Techniques. • An ability to evaluate performance of various Spread–Spectrum Systems in Jamming Environments						

Course Outcomes	
CO1	Students will be able to demonstrate their understanding on functioning of a spread-spectrum system and minimize the design challenges
CO2	Students will be able explain the concept of different coding techniques required for spread spectrum
CO3	Students will be able to explain the concept of different modulation and demodulation techniques required for spread spectrum
CO4	Students will be able to explain and design transmitter and receiver.
CO5	Students will be able to explain parameters and applications of Spread Spectrum Communication

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction to Spread Spectrum Communication	Introduction to spread spectrum, spread spectrum techniques, Direct sequence system, frequency hopping systems, pulse FM(chirp) system, hybrid systems.	8	1
2	Coding Technique In Spread Spectrum Communication	Coding for communication and ranging- Property of codes for spread spectrum, Autocorrelation and cross correlation of codes, composite codes, code selection and signal spectra, error detection and correlation codes.	8	2
3	Modulation & Demodulation in Spread Spectrum Communication	Modulation and demodulation – Balance modulator, quadriphase modulator, frequency synthesis for spread spectrum modulation, in line and heterodyne correlation, base band recovery, phase lock loop, costas loop, FM feedback, PDM and FH demodulators.	8	3
4	Synchronization in Spread Spectrum Communication	Need for synchronization, types of synchronizers, RF link- Noise figure, co-channel users, dynamic range and AGC, propagation medium, overall transmitter and receiver design.	8	4
5	Applications of Spread Spectrum Communication	Test and evaluation of spread spectrum system selectivity, sensitivity, jamming margin, synch acquisition, processing gain. Transmitter measurements	8	5

Reference Books:

1. Bernard Sklar/Digital Communication Fundamentals and Application/Pearson Publication, India/Second Edition.
2. Taub and Schilling/Principles of communication systems/Tata McGraw Hill Publication, India/Second Edition.
3. Haykin Simon/Communication Systems/Wiley India.

e-Learning Source:

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO4	PSO5	PSO6	PSO7
CO1	**3**	**1**				**1**	**1**						2					
CO2	**3**	**1**				**1**	**1**						1					
CO3	**3**	**1**				**1**	**2**						2					
CO4	**3**	**1**				**1**	**2**						1					
CO5	**3**	**1**				**1**	**2**						1					

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session:							
Course Code	**EC409**	**Title of the Course**	**Information Theory and Coding**	**L**	**T**	**P**	**C**
Year	**4**	**Semester**	7	3	1	0	4
Pre-Requisite	Signals & Systems (EC-210)	**Co-requisite**	Digital Communication & Networks (EC-312)				
Course Objectives	• Explain entropy, mutual information and characteristics of various types of noisy communication channels. • Discuss various source coding and decoding schemes. . • Discuss channel coding techniques for error-free transmission of message over a noisy communication channel. • The implications and consequences of fundamental theories and laws of information theory and coding theory with reference to the application in modern communication and computer systems						

Course Outcomes	
CO1	Student will calculate the information content of a random variable from its probability distribution. Relate the joint, conditional, and marginal entropies of variables in terms of their coupled probabilities
CO2	Student will be able to understand different types of error detection and correction codes.
CO3	Student will able to understand and analyze the correlation functions and also able to explain data compression codes, data encryption and decryption
CO4	Student will able to understand and obtain the Probability of error of convolution codes, orthogonal codes
CO5	Student will able to compare AM, FM and PCM systems.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1		Discrete messages, sampling Theorem, concept of entropy, marginal, joint, information rate, bit rate/baud rate. Coding to increase average information per bit, Shannon fanon algorithm, Hoffman coding, channel capacity, Shannon theorems, capacity of Gaussian channel, bandwidth, S/N trade-off, Efficiency of orthogonal signal transmission	10	1
2 &4		Introduction to coding, error detecting,/correcting codes, concepts of codes, length, minimum distance, weight, Binary symmetric channels, equivalence of codes, block codes, perfect codes, bar codes, ISBN codes, linear codes, encoding and decoding with a linear code, error correction, parity bit, parity check matrix, syndrome decoding, hamming codes, extended binary hamming codes, cyclic codes, cyclic redundancy check, convolution coding, decoding, Probability of error of convolution codes, orthogonal codes.	12	2 &4
3		Auto & cross correlation functions, generation algorithm of Prime, quasi prime codes, optical orthogonal codes, decoding schemes, S/N performance, automatic repeat request(ARQ) schemes, data compression codes, data encryption and decryption	8	3
5		Application of information theory and optimum modulation system ,comparison of AM system with the optimum system ,comparison of F.M with the optimum system, comparison of PCM and FM, Feedback communication, Trellis decoded modulation	8	5

Reference Books:

1. Shulin and Costello, Error Correcting Codes, 2nd Edition, Prentice Hall of India Print.
2. Dr. P.S Sathyanarayana, Probability, Informations and coding theory, Dynaram Publications, Bangalore.
3. John G. Prokis, Digital Communication, 4th Edition, Tata McGraw Hill Publication, India

e-Learning Source:

NPTEL :: Electrical engineering- NOC: Information Theory

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO4	PSO5	PSO6	PSO7
CO1	**3**	**3**	**2**	**2**		**1**	**1**	**1**	**1**	**1**		**2**	**3**	**3**				
CO2	**3**	**3**	**3**	**3**								**3**	**2**	**3**				
CO3	**2**	**2**	**2**	**1**	**2**	**2**							**3**	**3**				
CO4	**3**	**2**	**1**	**1**			**1**	**1**	**2**	**2**	**2**	**1**	**3**	**3**				
CO5	**3**	**2**	**2**	**1**		**1**	**1**	**1**	**1**	**1**		**2**	**1**	**1**				

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session:							
Course Code	EC 410	**Title of the Course**	Wireless Sensor Networks	**L**	**T**	**P**	**C**
Year	**IV**	**Semester**	VII	**3**	**1**	**0**	**4**
Pre-Requisite	Digital Communication & Networks (EC–312)	**Co-requisite**					
Course Objectives	• To make students understand the basics of Wireless sensor Networks. • To familiarize with learning of the Architecture of WSN. • To understand the concepts of Networking and Networking in WSN. • To study the design consideration of topology control and solution to the various problems.						

Course Outcomes	
CO1	Students shall be able to Define Wireless and Radio. Determine networks. Understand challenges, technologies and standards for wireless networks
CO2	Students shall be able to understand the concept of mobile ad hoc networks (MANETs) and wireless sensor networks (WSNs), concepts, Routing-proactive routing, reactive routing (on-demand), hybrid routing, and power aware routing
CO3	Describe the sensors, energy consumption of sensor nodes, operating system and execution Environments, design principles for WSN
CO4	Students shall be able to define physical layer and transceiver in WSN, MAC Protocols- Time synchronization.
CO5	Students shall be able to design Localization and positioning procedures and impact of anchor placement.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Introduction to Wireless Standards**	Broadcasting and multicasting: broadcast storm, network flooding avoidance, multicast routing, TCP over mobile ad hoc networks: IP address acquisition, effects of partitions on TCP, provisions for mobility and fairness, Wireless LAN (WiFi): 802.11 specifications, Medium Access Control Protocol issues; power control, spatial reusability, and QoS, Bluetooth: specifications, Piconet synchronization and master-slave switch, scatternet formations, interference issues, interoperability with WiFi.	8	1
2	**Mobile Ad-hoc and Sensor Networks**	Introduction to mobile ad hoc networks (MANETs) and wireless sensor networks (WSNs), concepts, Routing-proactive routing, reactive routing (on-demand), hybrid routing, and power aware routing.	8	2
3	**Architecture of WSN**	Introduction to sensors- Definition of sensor & its difference from transducer, Classification of sensors, internal architecture of sensors, application of sensors in various fields Architecture-single node architecture-hardware components, energy consumption of sensor nodes, operating system and execution environments, Network architecture-optimization goal and figure of merit-design principles for WSN ,service interface of WSN and Gateway concept challenges of WSN.	8	3
4	**Communication Protocols**	Wireless channel and communication fundamental, physical layer and transceiver design consideration in WSN, MAC Protocols-Fundamental of MAC Protocol, low duty cycle protocol and wakeup concepts, schedule based protocols, Link layer protocols, routing protocols naming and addressing, Time synchronization.	8	4

5	**Localization and Positioning**	Properties of Localization and positioning procedures, single hop localization, positioning in multihop environments, and impact of anchor placement.	8	5

Reference Books:

1. Holger Karl & Andreas Willig, Protocols and Architectures for Wireless Sensor Networks, Wiley.
2. Anna Hac, Wireless Sensor Network Designs, John Wiley & Sons Ltd., 2003.
3. Nirupama Bulusu and Sanjay Jha, Wireless Sensor Networks : A systems perspective, Artech House, August 2005.
4. Jr.,Edgar H. Callaway, Wireless Sensor Networks : Architecture and Protocols, Auerbach, 2003.
5. C.S.Raghavendra, Krishna M. Sivalingam and Taieb Znati, Wireless Sensor Networks, Springer, 2005.

e-Learning Source:

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO4	PSO5	PSO6	PSO7
CO1	**3**	**1**	**3**						3			1	3					
CO2	**3**	**2**	**3**						3			1	3	2	2			
CO3	**3**	**3**	**3**	1	1				3				3	2	2			
CO4	**3**	**3**	**2**						3			1	3	1				
CO5	**3**	**2**	**2**	1	1				3			1	3	1				

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session:							
Course Code	EC411	**Title of the Course**	Biomedical Instrumentation	**L**	**T**	**P**	**C**
Year	**IV**	**Semester**	VII	**3**	**1**	**0**	**4**
Pre-Requisite	Measurement & Instrumentation	**Co-requisite**					
Course Objectives	• The objective of this course is to introduce student to basic biomedical engineering technology and introduce different biological signals, their procurement, estimations and related requirements. • Enable the students the current voltage characteristics of semiconductor devices • To learn the the use of Monitors and Recorders . • Students shall be able to explain the respiratory and nervous systems						

Course Outcomes	
CO1	Given a biomedical signal sources, students shall be able to differentiate and analyse the signal, identify type of Biomedical sensors and transducers, and Analyze where and how sensors are used in healthcare.
CO2	GIVEN CONCEPT OF Monitors and Recorders: Biopotentials , amplifiers, monitors, galvanometric, potentiometric, ultraviolet, electrostatic, ink jet recorders, video monitors.
CO3	Given concept of Nervous system explain the respiratory and nervous systems and related measurements. Study design parameter of ECG, EEG
CO4	Given concept of Ophthalmology Instruments students shall be able to understand and analyze Electroretinagram, Electroocculogram, Ophthalmoscope, Tonometer for eye pressure measurement.
CO5	Given a Therapeutic Instruments students shall be able to understand and analyze Diathermy, Defibrillator, cardiac pacemaker, stimulators. design electrocardiographs. Compare pacemakers and defibrilators, understand principles of operation of electrosurgery and laser operating modes. Compare medical imaging methodes and equipment in radiology, nuclear medicine and medical ultrasound and MRI. .

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1		Human Anatomy & physiology: Biomedical potentiometric, leads & electrodes, Transducers for biological applications, Biomaterials.	8	1
2		Monitors and Recorders: Biopotentials , amplifiers, monitors, galvanometric, potentiometric, ultraviolet, electrostatic, ink jet recorders, video monitors, color printers, electro physical recorder, ECO, Working principles & clinical applications.	8	2
3		Nervous system measurements: Anatomy of the Nervous system, Neuronal communication, EPSP & IPSP, Neuronal firing measurements, EEG-block diagram, various Rhythms	8	3
4		Ophthalmology Instruments: Electroretinagram, Electroocculogram, Ophthalmoscope, Tonometer for eye pressure measurement.	8	4
5		Therapeutic Instruments :Diathermy, Defibrillator, cardiac pacemaker, stimulatorsX-Rays production & use, Radiographic Diagnostic and Therapeutic,Hint construction and processing ,interaction with body, Fundamentals of radiation therapy.	8	5

Reference Books:

1. W.F.Ganong/review of Medical Physiology/8th Asian Ed/Medical Publishers, 1977.
2. J.G.Websster, Eds / Medical instrumentation/ Houghton Mifflin, 1978.
3. A.M.Cook and Webster, Eds/ Therapeutic Medical Devices/ PHI, 1982.

e-Learning Source:

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO4	PSO5	PSO6	PSO7
CO1	**3**	**2**	**3**	**1**	**2**	**3**			**1**			**1**	**1**	**3**	**2**			
CO2	**3**	**3**	**3**	**1**	**2**	**3**			**1**			**1**	**3**	**2**	**2**			
CO3	**3**	**2**	**3**	**2**	**1**	**3**			**2**			**1**	**2**	**3**	**1**			
CO4	**3**	**3**	**2**	**2**	**2**	**3**			**1**			**1**	**3**	**2**	**1**			
CO5	**3**	**3**	**2**	**1**	**2**	**3**			**1**			**1**	**1**	**2**	**1**			

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session:							
Course Code	EC413	**Title of the Course**	Optical Communication lab	**L**	**T**	**P**	**C**
Year	**IV**	**Semester**	VII			**2**	**1**
Pre-Requisite		**Co-requisite**					
Course Objectives	**To provide students with the design and operating principles of modern optical communication systems and networks. Upon completion of the subject, students should be familiar with commonly used components and subsystems in optical communication and network systems**						

Course Outcomes	
CO1	To set up an Analog Link and Digital Link.
CO2	To measure the Numerical Aperture in an optical fibre and different types of attenuation losses.
CO3	To study Time Division Multiplexing of signals, Framing in time division multiplexing and the role of a Marker in Time Division Multiplexing.
CO4	Study of Manchester coding / decoding used in the OFT trainer and Study the role of a Marker in Time Division Multiplexing
CO5	To study the linearized A-law PCM Coding and the effect of EMI/RFI on a copper medium and on an optical fibre medium

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Analog Link.	To set up an Analog Link.	2	1
2	Digital Link.	To setup a Digital Link.	2	1
3	Numerical Aperture	To measure the Numerical Aperture in an optical fibre.	2	2
4	Attenuation losses	To measure different types of attenuation losses.	2	2
5	Time Division Multiplexing	Study of Time Division Multiplexing of signals.	2	3
6	Framing in time division multiplexing	Study of Framing in time division multiplexing. Generation of frame clock, bit clock, and slot clock.	2	3
7	Coding / decoding	Study of Manchester coding / decoding used in the oft trainer.	2	4
8	Role of a Marker	Study the role of a Marker in Time Division Multiplexing	2	4
9	Linearized A-law PCM	Study the linearized A-law PCM Coding.	2	5
10	EMI/RFI	Study the effect of EMI/RFI on a copper medium and on an optical fibre medium	2	5

e-Learning Source:

https://lo-au.vlabs.ac.in/

https://bvcoend.ac.in/index.php/optical-communication-lab-ece/

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO4	PSO5	PSO6	PSO7
CO1	3	1	3	0	0	0	0	0	3	0	0	1	2	0	1	0	0	0
CO2	3	2	3						3			1						
CO3	3	3	3	1	1				3				2		1			
CO4	3	3	2						3			1						
CO5	3	2	2	1	1				3			1	2		1			

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2017-18							
Course Code	EC414	**Title of the Course**	VLSI DESIGN LAB	**L**	**T**	**P**	**C**
Year	IV	**Semester**	VII	**0**	**0**	**2**	**1**
Pre-Requisite	Integrated Circuits.	**Co-requisite**					
Course Objectives	1. Basics of VLSI Design Lab. 2. To learn the analysis of a MOS circuits and systems and encoding of VLSI systems for fabrication. 3. To learn how o design a standard CMOS 2 input NAND gate and Standard CMOS 2 input NOR gate. 4. To learn the design on 5V biasing supply with 5µ technology standard CMOS 2 input NAND gate and Standard CMOS 2 input NOR gate. 5. Students will be able to Learn current mirror circuit and design and apply them in practice. 6. Learning about CMOS Inverter Delay Design.						

Course Outcomes	
CO1	Students shall be able to design a Depletion load NMOS Inverter ,symmetrical CMOS inverter for the given data and able to Evaluate noise margin and plot VTC.
CO2	Students shall be able to design a standard CMOS 2 input NAND gate and Standard CMOS 2 input NOR gate
CO3	Students shall be able to design a standard CMOS 2 input NAND gate and Standard CMOS 2 input NOR gate working on 5V biasing supply with 5µ technology
CO4	Students shall be able to calculate Power Consumption by CMOS Inverter and Design a CMOS NOR gate as an Inverter for the given data.
CO5	Students shall be able to design a current mirror for the given data and able to Evaluate CMOS inverter delay.

Experiment No.	**Title of the Experiment**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	DEPLETION LOAD NMOS INVERTER	(A) Depletion load NMOS Inverter V_{OL}<0.3 V in 5 micron technology V_{TOD}=1V, V_{TOL}-3V K_{PD}=K_{PL}=40 micron amp/$v^{2,}$ V_{DD}=5Volt. (B) For the above data, simulate VTC for Lambda=0.05 Gamma=0.4V.	2	1
2	SYMMETRICAL CMOS INVERTER	1. Design a symmetrical CMOS Inverter for the data given V_{DD} = 5V, IV$_{TP}$I=V_{Tn}=1V for 5µ technology $K^{"}_n$=100 µA/V^2 $K^{"}_p$=30 µA/V^2, γ=0.4, λ=0.1 a)Read V_m for VTC. b) Calculate noise margin. c) What is the minimum CMOS inverter size? d) Plot VTC with and without body effect. 2. Design a parallel CMOS inverter.	2	1
3	PARALLEL CMOS INVERTER	Design a parallel CMOS inverter	2	2
4	CMOS TWO INPUT NAND GATE	Design a standard CMOS 2 input NAND gate for V_m=2.5 V, working on 5V biasing supply with 5µ technology. Assume V_{TP}=-0.9V, V_{Tn}=0.8V, $K^{"}_n$=100 µA/V^2 $K^{"}_p$=35 µA/V^2, C_L=50pf. Verify NAND gate for the following input: - 1. A=0-1, B=0 2. A=1-0, B=0 3. A=0-1, B=1 4. A=1-0, B=1. Verify the NAND gate as an inverter.	2	2
5	CMOS TWO INPUT NOR GATE	Design a standard CMOS 2 input NOR gate working on 5V supply with 5µ technology. Assume V_{TP}=-0.9V, V_{Tn}=0.75V, $K^{"}_n$=75 µA/V^2 $K^{"}_p$=20 µA/V^2, C_L=50pf. (a) Verify NOR gate for the following inputs:- 1. A=0-1, B=0 2. A=1-0, B=0	2	3

		3. A=0-1, B=1 4. A=1-0, B=1. (b) Verify NOR gate as an inverter.		
6	CMOS TWO INPUT NAND GATE AS AN INVERTER	Design CMOS 2 input NAND gate as an Inverter for V_m=2.5 V, working on 5V biasing supply with 5µ technology. Assume V_{TP}=-0.9V, V_{Tn}=0.8V, K'_n=100 µA/V^2 K'_p=35 µA/V^2, C_L=50pf.	2	3
7	CMOS TWO INPUT NOR GATE AS AN INVERTER	Design a CMOS NOR gate as an Inverter working on 5V supply with 5µ technology. Assume VTP=-0.9V, VTn=0.75V, K‟n=75 µA/V2 K‟p=20 µA/V2, CL=50pf.	2	4
8	Power Consumption by CMOS Inverter	Determine the power consumption by CMOS inverter completing one switching operation with help of power VDD=5V, CL=1pf, CY=100pf RY=100K determine the effect of lambda on power study the power reported by SPICE in o/p file.	2	4
9	CURRENT MIRROR	(A) Design a single MOSFET current Mirror for I_0=50µA (B) Design a current for Io =200 µA(Sync) and 100 µA(Source)	2	5
10	CMOS INVERTER DELAY	Design a CMOS inverter delay not more than 100ps for any transition also the inverter is to be symmetrical. Assume 5 µ technology, V_{TOn}=0.9V, V_{Tp} = -1.1V, C_L=1pf K_n‟ = 80 µA/V^2, K_p‟ =30 µA/V^2, V_{DD}=5V	2	5
e-Learning Source:				
https://vdtt.iitd.ac.in/MENU/Research/Labs.php **https://iitg.ac.in/eee/vlsilab/index.html**				

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO4	PSO5	PSO6	PSO7
CO1	3	1	3	0	0	0	0	0	3	0	0	1	2	0	1	0	0	0
CO2	3	2	3						3			1						
CO3	3	3	3	1	1				3				2		1			
CO4	3	3	2						3			1						
CO5	3	2	2	1	1				3			1	2		1			

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2016-17							
Course Code	EC417	**Title of the Course**	**Digital System Design Lab**	**L**	**T**	**P**	**C**
Year	4	**Semester**	7	**0**	**0**	**2**	**1**
Pre-Requisite		**Co-requisite**					
Course Objectives	This lab provides hands-on experience on the implementation of digital circuit designs using HDL language, which are required for the development of various projects and research work.						

Course Outcomes	
CO1	To describe Verilog/VHDL hardware description languages (HDL).
CO2	To design Digital Circuits in Verilog/ VHDL.
CO3	To write behavioral models of digital circuits
CO4	To write Register Transfer Level (RTL) models of digital circuits.
CO5	To verify behavioral and RTL models.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Exp-01**	To design the multiplexer using HDL	2	CO1
2	**Exp-02**	To design the de multiplexer using HDL	2	CO1
3	**Exp-03**	To design the decoder using HDL	2	CO2
4	**Exp-04**	To design the encoder using HDL	2	CO2
5	**Exp-05**	To design the HDL code for carry look ahead adder	2	CO3
6	**Exp-06**	To design the code converters using HDL	2	CO3
7	**Exp-07**	To design full adder and full subtractor using behavioral modeling	2	CO4
8	**Exp-08**	To design the universal shift register	2	CO4
9	**Exp-09**	To design the 4 bit counters using verilog HDL	2	CO5
10	**Exp-10**	To design Traffic light controller using HDL	2	CO5

Reference Books:

1. Palnitkar, Samir. Verilog HDL: a guide to digital design and synthesis. Vol. 1. Prentice Hall Professional, 2003.

2. Ashenden, Peter J. Digital design (verilog): An embedded systems approach using verilog. Elsevier, 2007.

3. McAndrew, Colin C., et al. "Best practices for compact modeling in Verilog-A." IEEE Journal of the Electron Devices Society 3.5 (2015): 383-396.

e-Learning Source:

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PS04
CO1	3	1	2	1	1	1				1		1	3	2	1	1
CO2	2	2	3		2	2				1		2	3		2	
CO3	3	3	1	1	3	3						3	2	2		1
CO4	2	2	2		2	2				2		1	2	1	1	1
CO5	1	3	1		3	3				3		2	1	2	1	1

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2017-18							
Course Code	EC418	**Title of the Course**	Multimedia and Image Processing Lab	**L**	**T**	**P**	**C**
Year	IV	**Semester**	VII	**0**	**0**	**2**	**1**
Pre-Requisite		**Co-requisite**					
Course Objectives	1. Basics of Multimedia and Image Processing Lab. 2. The students will gain overview about the available techniques and possibilities of this field. 3. Students will be able to perform the basic techniques and apply them in practice. 4. Learning about image conversion into mathematical form and application of algorithms to major findings.						

Course Outcomes	
CO1	Students shall be able to understand and apply the coding technique for image and its histogram and produce mirror image.
CO2	Students shall be able to understand and apply the bit plane method for gray scale image.
CO3	Students shall be able to apply and examine program to find negative and shrinking of an image.
CO4	Students shall be able to apply and examine program to show zooming and cropping of an image.
CO5	Students shall be able to apply and examine program for the display of Image in Grayscale, Red, Green and Blue.

Experiment No.	**Title of the Experiment**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Histogram	To write a program to display an image and its histogram	2	2
2	Mirror Image	To write a program to produce mirror image of the image passed to it and also displays both the original and mirror image.	2	2
3	Extraction of Bit Plane	To write a program to write a program for extraction of bit plane in gray scale image.	2	2
4	Bitplane	To write a program to convert image into bitplane and extract next bitplane.	2	2
5	Negative of An Image	To write a program to find negative of an image.	2	2
6	Shrinking of An Image.	To write a program to show shrinking of an image.	2	2
7	Zooming of An Image.	To write a program to show zooming of an image.	2	2
8	Cropping of Image.	To write a program to show image cropping.	2	2
9	Image In Grayscale, Red, Green and Blue	To write a program for the display of Image in Grayscale, Red, Green and Blue.	2	2

e-Learning Source:

https://www.vlab.co.in/

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)															
PO-PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2											3	2		
CO2	3	2											3			
CO3	3	2	3										3	2		
CO4	3	3	3										3		2	
CO5	3					3		1					3	2		

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**