Integral University, Lucknow

Effective from Session:							
Course Code	EC312	**Title of the Course**	Digital Communication Networks	**L**	**T**	**P**	**C**
Year	**III**	**Semester**	VI	**3**	**1**	**0**	**4**
Pre-Requisite	Signal and System	**Co-requisite**	Data Communication Network				
Course Objectives	This course describes the fundamental principles to develop a comprehensive understanding of Digital communication and network architectures, error detection, error control, performance, and wireless networks that explains current and emerging networking technologies.						

Course Outcomes	
CO1	Students shall be able to understand the digital modulation techniques and represent it into mathematical form.
CO2	For the error control in digital communication network, student shall be able to analyze the error in the network and applying the predefined coding method for the detection and correction of error in the network.
CO3	Student shall be able to understand the basics of data communication in the network. To achieve it, they will understand and Examine the OSI and TCP/IP Model and analyze the services provided to data link layer.
CO4	Students shall be able to understand and analysis of various protocols as well as fast Ethernet and internetworking devices.
CO5	Student shall be able understand the function of network layer, transport layer and learn how to apply it by using Dijkstra Algorithm. They will have the knowledge on network security.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Digital Modulation Technique:	Coherent Binary modulation techniques: BASK, BPSK, BFSK, Coherent quadrature modulation techniques: QPSK, MSK. Non-coherent Binary modulation techniques: BASK, BFSK, DFSK, Comparison of Binary and Quaternary Digital Modulation Techniques	8	CO-1
2	Error Control Coding:	Rationale for coding and types of Codes, Error Free Communication Over Noise Channel, Hamming sphere, Linear Block Codes: syndrome decoding, Hamming and Hamming bound distance, Cyclic codes: generator polynomial, parity check polynomial, Encoder and syndrome calculation, Convolution codes: code tree, trellis and state diagram, Viterbi Algorithm	8	CO-2
3	Data Communication Network	Basic concepts: Components, Networks, Protocols and standards, Categories of wireless networks , ISO-OSI-Model: OSI layered architecture ,TCP/IP Protocols, Data Link Layer: Services provided to network layer, Error Control, Flow Control, Sliding Window Protocols, HDLC, PPP	8	CO-3
4	MAC sub layer-contention protocols	ALOHA, CSMA/CD. IEEE Standards: 802.3: CSMA/CD, 802.4: token Bus, 802.5: Token Ring, 802.11: Wireless LAN, Ethernet, Fast Ethernet. Internetworking Devices: Bridges, Switches, Routers	8	CO-4
5	Network Layer	Services provided to Transport layer, Dijkstra Algorithm, Congestion control; Leaky Bucket, Token Bucket Algorithm, IP addresses and IP protocols. Transport layer: Services provided to user support layers, Crash recovery TCP & UDP, Introduction to Network Security	8	CO-5

Reference Books:

1. Haykin Simon, Digital Communication Systems, John Wiley & Sons India.
2. Data Communication & Networking, B.A.Forouzan, TMH
3. Computer Networks; Tanenbaum, PHI.
4. B.P. Lathi & Zhi Ding, Modern Digital & Analog Communication Systems, Oxford University Press, India

e-Learning Source:

https://archive.nptel.ac.in/courses/108/102/108102120/

https://archive.nptel.ac.in/courses/106/105/106105183/

	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**	**2**		**2**		**2**	**2**				**1**	**3**	**1**	**1**	**1**	**3**	**2**
CO2	**3**	**2**	**3**	**2**		**2**		**1**		**1**			**3**	**2**	**1**	**1**	**3**	**2**

CO3	3	2	2		2		2		1	1		1	3	2	2	1	3	2
CO4	3	2	2	2		1		1			1		3	1	2	1	3	2
CO5	3	3		2	2	1		1	2			1	3	2		3	3	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	EC313	**Title of the Course**	Digital Signal Processing	**L**	**T**	**P**	**C**
Year	**3rd**	**Semester**	VI	**3**	**1**	**-**	**4**
Pre-Requisite	Signals and Systems	**Co-requisite**					
Course Objectives	**Signals Analysis and Systems behaviour**						

Course Outcomes	
CO1	**Realization of the basic principles of DSP and systems.**
CO2	**Analysis techniques and system performance evaluation.**
CO3	**Perceptions of the LTI systems to understand more practical systems.**
CO4	**Design of digital FIR/ IIR Filter systems.**
CO5	**Comprehensive conclusions from solutions**

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	BASICS OF SIGNAL AND SYSTEMS	**Realization of the basic principles of DSP and systems. Analysis techniques and system performance evaluation. Perceptions of the LTI systems to understand more practical systems. Design of digital FIR/ IIR Filter systems. Comprehensive conclusions from solutions**	8	CO1
2	TRANSFORMS & LTI SYSTEMS	**DFT review, z-transform, one sided z- transform, DFT computation of signals, linear representation of DFT, radix 2 FFT algorithms,radix 2 FFT algorithms, frequency response of LTI systems, frequency selective systems, all pass systems, phase ch of LTI systems, min/max/mixed phase system**	8	CO2
3	ANALOG FILTERS	**analog filter ch., order of the filter calculation using butterworth app, chebychev and elliptic filters, FIR/IIR classifications, discretization of analog filters, impulse inv, matched z and bilinear transformations, impulse inv, matched z and bilinear transformations, design examples of IIR LPF/HPF**	8	CO3
4	DIGITAL FILTERS	**symmetric/antisymmetric filter ch, FIR impulse response, fourier coefficients, design of linear phase FIR filters, std windows, their ch, filter design with windows, frequency sampling method, design examples and realization of FIR/IIR filter**	8	CO4
5	MULTIRATE SIGNALLING	**symmetric/antisymmetric filter ch, FIR impulse response, fourier coefficients, design of linear phase FIR filters, std windows, their ch, filter design with windows, frequency sampling method, design examples and realization of FIR/IIR filter**	8	CO5

Reference Books:

1. Lawrence R. Rabiner & Bernard Gold, Theory and application of digital signal processing, Pearson Education, India

2. Alan V. Oppenheim & Ronald W. Schafer, Discrete Time Signal Processing, Prentice Hall of India. Recommended Pre-Requisites: Signals and Systems.

1. G. Prokis & D.G. Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, 4th Edition, Prentice Hall of India Print.

2. S. Salivahanan & C. Gnanapriya, Digital Signal Processing, 2nd Edition, TMH Publication

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	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**2**	**1**	**3**	**3**	**3**	**1**	**2**	**2**	**2**	**1**	**1**
CO2	**2**	**2**	**2**	**3**	**2**	**2**	**1**	**2**	**1**	**2**	**3**	**3**	**2**	**1**	**2**	**2**	**3**	**2**
CO3	**3**	**3**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**3**	**3**	**3**	**2**	**3**	**2**	**3**	**2**
CO4	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**3**	**1**	**2**	**3**	**2**	**2**	**3**	**3**	**3**	**3**	**3**
CO5	**3**	**3**	**3**	**2**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**3**	**3**	**2**	**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: 2017-18							
Course Code	EC314	**Title of the Course**	MICROPROCESSOR AND APPLICATIONS	**L**	**T**	**P**	**C**
Year	**III**	**Semester**	VI	**3**	**1**	**0**	**4**
Pre-Requisite		**Co-requisite**					
Course Objectives	• Identify a detailed software & hardware structure of the Microprocessor. • Illustrate how the different peripherals (8255, 8253 etc.) are interfaced with Microprocessor. • Distinguish and analyze the properties of Microprocessors & Microcontrollers. • Analyse the data transfer information through serial & parallel ports						

Course Outcomes	
CO1	Students shall be able to understand the 8-bit microprocessor's internal architecture and its operation, describe the memory organization.
CO2	Students shall be able to understand the instruction set, also able to evaluate basic binary math operations using the microprocessor and able to design and develop simple assembly language programs using 8085 microprocessors.
CO3	Students shall be able to understand the internal architecture and organization of 8086, design and develop assembly language programs and will be able to Compare and select the appropriate Microprocessor (8087 & 8088) according to the applications.
CO4	Students shall be able to describe the functions of different peripherals and able to apply the concepts of interfacing microprocessors with peripheral devices (8255, 8259 etc.).
CO5	Students shall be able to analyze and compare the features of microprocessors and Microcontrollers also they will be able to understand the features of advanced microprocessors

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction to Microprocessor	Introduction to 8-bit Intel microprocessors, pin configuration, architecture, register organization, PSW, machine instructions and addressing modes, instruction format execution, timing & control, bus interface, interrupt structures.	8	CO1
2	Assembly Language Programming	Instruction format, classification and description of instructions, assembler directives and operators, Translation of assembler instructions.	8	CO2
3	Introduction to 16-bit intel microprocessor and modular programming	Pin configuration, architecture, register organization, PSW, machine instructions, addressing modes, 8088, 8087, Linking and relocation, stacks, procedures, interrupts and routines, macros, program design and examples.	8	CO3
4	I/O Interfacing	I/O interfacing programmed, and interrupt driven I/O, DMA, parallel (8255 PPI), and series (8250/8251, std RS232) I/O,8259, 8237 and 8253/8254 controllers, memory interfacing and organization.	8	CO4
5	Microprocessor Interfacing and Applications	Keyboard and alphanumeric display interfacing, interfacing of light and temperature sensors, A/D(0808/0809ADC) and D/A (DAC IC 1408) conversions. Advances microprocessor: Introduction and features of 80X86 and Pentium processors. Introduction of microcontroller (8051): Architecture and pin diagram.	8	CO5

Reference Books:

1. Gaonkar, Ramesh S, Microprocessor Architecture, Programming and Applications with the 8085, Penram International Publishing.
2. Liu & Gibson, Microcomputer Systems 8086/8088 Family, PHI
3. Hall, D.V., Microprocessor and Interfacing, McGraw-Hill Education

	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	1	-	1	-	-	-	1	3	2	1	-	-	-

CO2	3	3	3	2	1	1	-	-	1	-	-	1	3	3	1	1	-	-
CO3	3	3	3	-	1	1	-	-	1	-	-	-	3	2	1	-	-	-
CO4	3	3	3	2	1		-	-	2	-	-	1	3	3	-	1	-	-
CO5	3	3	2	2	2	1	-	-	1	-	-	1	3	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	**EC 339**	**Title of the Course**	**SOLAR ENGINEERING**	**L**	**T**	**P**	**C**
Year	**III**	**Semester**	VI	**3**	**1**	**0**	**4**
Pre-Requisite	B.Tech	**Co-requisite**	NA				
Course Objectives	1. Build the student strong background in the field of Solar Engineering 2. To understand the basic concept of different types of radiation concepts of 3. To learn the basic concept of solar system, SPV and Solar cell.						

Course Outcomes	
CO1	Students shall be able to understand the actual Solar Radiation and measurement into different form, able to understand the basic difference between direct and diffuse radiation.
CO2	Student shall be able to analyse solar radiation, Optical properties of semiconductor, and different photodiode using latest concepts.
CO3	For a given solar PV arrangement, student shall be able to understand the difference between solar cell and solar film, solar cell fabrication, life and efficiency.
CO4	Students shall be able to understand the representation of solar cell, solar panel, solar module in order to application in larger domain.
CO5	Student shall be able understand and how solar panels can be apply it in various field like agriculture, industrial and communication applications.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Solar Radiation and measurement	Solar Radiation and measurement, solar insulation, extra-terrestrial solar radiation, solar constant, spectral Distribution variation, Solar radiation on earth surface, direct and diffuse radiation.	8	CO.1
2	Solar Electric conversion	Solar Electric (Direct) conversion, Optical properties of semiconductor, Theory of photovoltaic diode heterogeneous junction, Schottky Diode	8	CO.2
3	Silicon Solar Cell	Silicon Solar Cell, Thin Film and screen printed solar cell their fabrication, life and efficiency, transparent electrodes, MIS solar cells	8	CO.3
4 & 5	Solar modules	Silicon solar module, solar panel, concentrating system, Agriculture, domestic, Industrial and telecommunication application	16	CO.4,CO5

Reference Books:

1. Solar Photovoltaics: Fundamentals, Technologies And Applications by Chetan Singh Solanki,PHI,2009
2. Solar Cells/ Charles E Backes (Ed) IEEE
3. Solar Cell Array Design Handbook
4. The Solar Electricity Handbook by Michael Boxwell

e-Learning Source:

1. https://onlinecourses.nptel.ac.in/noc20_ph14/preview
2. https://onlinecourses.swayam2.ac.in/nou21_ge33/preview
3. https://www.classcentral.com/course/swayam-solar-energy-engineering-and-technology-19998
4. https://egyankosh.ac.in/handle/123456789/58677

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	2	1		2	1						1	2	2		2	1
CO2	2	3	2	2	2	1							3		2	2	1	3
CO3	3	2	1			1								2	1	3	3	
CO4	2	3	3	2	1		1								1	3	3	2
CO5	3	2		2	1								2	2	1	2	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: 2015-16							
Course Code	EC340	**Title of the Course**	Wind Engineering	**L**	**T**	**P**	**C**
Year	4	**Semester**	8	3	1	0	4
Pre-Requisite	NONE	**Co-requisite**	NONE				
Course Objectives	1. Students will understand the basic concepts of wind turbine and types of wind energy conversion systems. 2. Students will understand the fundamentals of site selection and evaluation of wind speed characteristics. 3. Students will understand the basics of power electronics components and their classification. 4. Students will be able to understand the concepts of grid connection and operations of different types of generators. 5. Students shall be able to understand the basics of hybrid energy systems.						

Course Outcomes	
CO1	Historical Background, Power contained in wind, thermodynamics in wind energy. Efficiency limit for wind energy conversion. Types of wind energy conversion devices.
CO2	Wind site Analysis and selection. Wind speed Measurements, wind speed statistics, site and Turbine selection. Basics of Induction and Synchronous Machines.
CO3	Power Electronics. Classification & components of Power electronics converter. Power semiconductor Devices, Diode, Thyristors Bipolar Power Transistor.
CO4	Grid connected and self-excited induction Generator operation. Constant voltage, Constant frequency Generators. Variable Voltage Variable frequency generation.
CO5	Hybrid energy systems. Diesel Generation and Photo-voltaic System. Wind Diesel hybrid system. Wind photo-voltaic system.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction	Historical Background, Power contained in wind, thermodynamics in wind energy. Efficiency limit for wind energy conversion. Types of wind energy conversion devices.	9	1
2	Production Planning and Control	Wind site Analysis and selection. Wind speed Measurements, wind speed statistics, site and Turbine selection. Basics of Induction and Synchronous Machines.	9	2
3	Method Study & Work Measurement	Power Electronics: Classification & components of Power electronics converter. Power semiconductor Devices, Diode, Thyristors Bipolar Power Transistor. Power MOSFET, IGBT, Uni-controlled Rectifier, Phase controlled converters. DC-DC PWM converters, The invertors DC-AC conversion.	9	3
4	Materials Management	Grid connected and self-excited induction Generator operation. Constant voltage, Constant frequency Generators. Variable Voltage Variable frequency generation.	9	4
5	Quality Assurance	Hybrid energy systems: Diesel Generation and Photo-voltaic System. Wind Diesel hybrid system. Wind photo-voltaic system.	9	5

Reference Books:

S. N. Bhadra, D. Kastha & S. Banerjee, Wind Electrical Systems, Oxford University Press India, First Edition.

Spera, D.A., Wind Turbine Technology: Fundamental concepts of Wind Turbine Engineering, ASME Press, 1994.

Duffie, A and Beckmann, W. A., Solar Engineering of Thermal Processes, John Wiley, 1991.

Freris, L.L., Wind Energy Conversion Systems, Prentice Hall, 1990

e-Learning Source:

https://nptel.ac.in/courses/108105058

https://alison.com/course/introduction-to-wind-energy

https://www.digimat.in/nptel/courses/video/121106014/L23.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	PSO3	PSO4	PSO5	PSO6
CO1	3	3	3	2	3	3	2	3	3	3			3	3	2	2		
CO2	3	3	2	2	1			1					3	1	1	2		
CO3	3	3	3	3	1			1					3	2	1	2		
CO4	3	3	2	1	2				2	3			3	2	2	1		
CO5	3	3	3	3	3	2	3	2	3				3	3	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	EC341	**Title of the Course**	Autotronics	**L**	**T**	**P**	**C**
Year	III	**Semester**	VI	**3**	**1**	**0**	**4**
Pre-Requisite	EC101 & EE101	**Co-requisite**					
Course Objectives	Describe the working of different electronic systems in automobiles. To give the detail understanding of all contextualized elements related to the electronic environment. Describe the computer controlled motor vehicle systems for the different part of automotive. Describe the working mechanism of the automotive battery system of electric automotive.						

Course Outcomes	
CO1	Students will be able to calculate the different parameters of the battery, to identify the appropriate battery for the different automotive and applications of each battery.
CO2	Students will be able to know the different type of motors use in the electric automotive as per requirements and its associated role in the automotive and also able to identify the charging (electrical) issue in the automotive
CO3	Students will be able to identify the issues related to the Ignition System in the electric driven automotive and able the explain of working of different plugs & magneto mechanism .
CO4	Students will be able to identify the faults in automotive through the diagnostic system, able to use the Multimeters, Oscilloscopes, Engine analyzer etc for the testing of the automotive and also able to choose the appropriate instrument for the testing of the part of the electric automotive
CO5	Students will be able to identify the issues in automotives through the REAL TIME OPERATING SYSTEM (RTOS) and also be able to use the various functions of REAL TIME OPERATING SYSTEM (Interrupt handling and task scheduling).

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	TYPES OF BATTERIES	Principle and construction of Lead Acid Battery, Nickel – Cadmium Battery, Nickel Metal, Hybrid Battery, Sodium Sulphur Battery and Aluminum Air Battery, Characteristics of Battery, Battery Rating, Capacity and Efficiency, Various Tests on Battery, Battery–Charging Techniques, Maintenance of batteries	8	CO-1
2	ELECTRICAL COMPONENTS	Requirements of Starter Motor, Starter Motor types , construction and characteristics, Starter drive mechanisms, Starter Switches and Solenoids, Charging system components, Generators and Alternators, types, construction and Characteristics . Voltage and Current Regulation, Cut –out relays and regulators, Charging circuits for D.C. Generator, A.C. Single Phase and Three – Phase Alternators.	8	CO-2
3	IGNITION SYSTEMS	Battery Coil and Magneto–Ignition System, Circuit details and Components of Battery Coil and Magneto–Ignition System, Centrifugal and Vacuum Advance Mechanisms, Spark Plugs, Constructional details and Types.	8	CO-3
4	TEST EQUIPMENT FOR ELECTRIC AUTOMOTIVE	Multimeters, Oscilloscopes, Engine analyzer, OBD II scanner, Lucas Laser 2000 Tester, Multi Protocol Adapter. Onboard diagnostics – fault code displays. Off board diagnostics – engine. Diagnostic procedures of automotive, Bosch diagnostic system, case study	8	CO-4
5	REAL TIME OPERATING SYSTEM (RTOS)	Introduction to basic concepts of RTOS, Basics of real time & embedded system operating systems, RTOS – Interrupt handling, task scheduling; embedded system design issues in system development process – Action plan, use of target system, emulator, use of software tools.	8	CO-5

Reference Books:

Tom Denton, Automobile Electrical & Electronics Systems, Third Edition, Elsevier Butterworth-Heinemann, London, United Kingdom.

William B. Ribbens, Understanding Automotive Electronics, Fifth Edition, Elsevier Butterworth-Heinemann, United States of America.

e-Learning Source:

https://nptel.ac.in/courses/107106088

	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	3	2	2		1	1		2	1		2	3	2	3	2
CO2	3	3	3	2	1	1			1	1		2	3	2	3	3
CO3	3	3	2	2		1			1		2	2	3	1	3	2

CO4	3	3	2	2		1	1		2	1		2	3	1	3	3
CO5	3	3	3	2				1	1			2	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: 2012-13							
Course Code	EC315	**Title of the Course**	Nano Electronics	**L**	**T**	**P**	**C**
Year	III	**Semester**	VI	**2**	**1**	**0**	**3**
Pre-Requisite	VLSI Technology	**Co-requisite**					
Course Objectives	**1.** To develop understanding of fundamental ideas of Nanotechnology **2.** Understand various synthesis and characterization techniques of nanomaterials. **3.** To develop various classification of nanomaterials and its properties. **4.** To develop various applications of nanomaterial with focus on medical aspect also.						

Course Outcomes	
CO1	1. Understanding of usage of Fundamental issue of nanotechnology. 2. To know the various Limitations and downsides of nanotechnology. 3. Evaluate nanotechnology application for its optimum performance.
CO2	1. Understand nanostructure science and technology. 2. Understand various synthesis techniques of nanoparticles. 3. Understand function of nanostructure material.
CO3	1. Understand various types of nanodevices. 2. Develop knowledge about nanocomposites materials 3. Understand the various applications of nanocomposites materials.
CO4	1. Develop knowledge about applications of nanomaterial. 2. Understand different types electronics applications of nanomaterials. 3. Develop knowledge about uncertainties in the development of Nanoelectronics.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Development of Nanoelectronics	The development of microelectronics, region of nanostructure, challenge initiated by nano electronics, Band diagram of semiconductor technological process for micro miniaturization. Estimated optoelectronics, Basis of Nanoelectronics: Electromagnetic fields & photons, Quantization of Action, charge and flux, electron behaving waves (Schrodinger Equation), Electrons in Potential wells, photons interacting with Electrons in solids, diffusion process, Data and bits, data processing.	7	CO1
2	Synthesis and Characterization of Nanomaterials	Introduction to microfabrication and Moore's Law, E-beam lithography & Ion beam lithography, Dip Pen Nanolithography, Etching Techniques- Isotropic, Anisotropic Electrochemical etching, RIE, DRIE, Review of Vapor Deposition Techniques, Sputter technique-Ion assisted deposition cathodic arc deposition, pulsed laser deposition. Chemical Route- Sol-Gel technique, Spin Coating technique. Surface Characterization: Auger Electron Spectroscopy, SEM, TEM, XRD (Powder/Single Crystal), EDAX. Optical Characterization: Raman Spectroscopy, UV-Visible, Ellipsometry	7	CO2
3	Nanodevices	Integrated switches and basic circuits: Ideal and real switches. Threshold Gates, Fredkin Gate, Quantum Electronics Devices, short channel MOS Transistors, Split Gate Transistors, Quantum Cellular Automata, Quantum Dot Array, Switches based on Fullerenes and Nanotubes, Polymer Electrons, Optical Molecular Memories. Tunneling diode, Resonant Tunneling Diode (RTD), Digital Circuits based on RTDT, RTDT mobile, RTDT Threshold gate, RTDT Multiplexer, Single Electron Transistor (SET): Performance of single electron transistor technology, logic and memory circuits, SET Adder, Comparison between FET and SET	7	CO3
4	Nanoelectronics and application	Nanoelectronics with super conducting devices, The Macroscopic model, Cryotron, the Josephson Tunneling device, Memory cell, super conducting quantum interferometer device. Flux quantum device: LC gate, single flux quantum device. Limits of integrated electronics: Energy supply and heat dissipation, the limits due to thermal particles motion, thermal noise, reliability as limiting factor, physical limits, equal failure rates by tunneling and thermal noise. Uncertainties in development of nanoelectronics.	7	CO4

Reference Books:

1. Karl Goser "Nanoelectronics and Nanosystems", Springer International Editors
2. B.Bushan "Handbook of Nanotechnology", Springer 2004
3. P. Rai Choudhary, "Handbook of Microlithography, Micromachining and Microfabrication" Vol-2 SPIE Press 1997
4. Mick Wilson, "Nanotechnology basic science and Emerging Technology". UNSW Press.
5. G.Cao, "Nanostructure & Nanomaterial: Synthesis, Properties and Applications" Imperial college Press 2004.

e-Learning Source:

https://nptel.ac.in

www.youtube.com

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
PO-	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO4	PSO5	PSO6	PSO7

PSO / CO																		
CO1	3	2	2	1	2	2	2	1					3	3				
CO2	2	3	2	2	2	1	2	2					2	3				
CO3	3	2	3	1	2	3	2	3					3	2				
CO4	3	2	2	2	1	2	3	1					2	3				
CO5	3	2	2	3	2	2	1	3					2	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	EC316	**Title of the Course**	Embedded System Design	**L**	**T**	**P**	**C**
Year	**III**	**Semester**	V	**3**	**1**	**0**	**4**
Pre-Requisite	None	**Co-requisite**	EC316				
Course Objectives	1. Perform effectively as entry level Embedded Systems professionals. 2. Develop and maintain applications written using Embedded C. 3. Independently design and develop a hardware platform encompassing a microcontroller and peripherals.						

Course Outcomes

CO1	Embedded Systems surround us in the form of gadgets and devices that we use. It will have a significant practical component, which will be achieved through a MSP430 microcontroller kit, to be distributed for free, to selected participants
CO2	Learning out Embedded Systems will give the skills to design and manufacture embedded system products of the future which will help participants towards better employability
CO3	This course teaches embedded system design using a building block approach, which allows one to visualize the requirement of an embedded system and then to design it efficiently.
CO4	The course will teach embedded system design using a microcontroller, namely Texas Instruments MSP430 low power microcontroller.
CO5	The course will introduce various interfacing techniques for popular input devices including sensors, output devices and communication protocols. It will teach power supply design for embedded applications.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction to Embedded Systems.	Modular approach to Embedded System Design using Six-Box model: Input devices, output devices, embedded computer, communication block, host and storage elements and power supply. Microcontroller Based Embedded System Design and its Salient Features	8	CO1
2	Fundamentals of Physical Interfacing	Connecting Input Devices: Switches, Keyboard and Output devices: LEDs, Seven Segment Displays(SSD). Assignment: MCQ/MSQ Advanced Physical Interfacing: Driving load - high side, low side and H-bridge. Multiplexing displays including Charlieplexing. Shaft encoder.	8	CO2
3	Power Supply for Embedded Systems	Design of Power Supply for Embedded Systems. Linear Regulator Topologies. Switching Power Supply Topologies. Power Supply Design Considerations for Embedded Systems. Introduction to Lunchbox Platform	8	CO3
4	PWM and Capture modes	Generating Pulse Width Modulation (PWM) using Timer Capture Mode. ADC operation in MSP430. Interfacing analog inputs. Generating random numbers using LFSR and other methods. Timer Capture Modes. Measuring frequency and time period of external signals and events. Serial Communication Protocols: UART, SPI, I2C.	8	CO4
5	Prototyping techniques	Circuit Prototyping techniques. Designing Single Purpose Computers using Finite State Machine with Datapath (FSMD) approach. MSP430 Based Project Design and Implementation. Recap of Course Coverage.	8	CO5

Reference Books:

1. Designing Embedded Hardware, John Catsoulis. 2nd edition. Shroff Publishers and Distributors. ISBN-10: 9788184042597
2. Embedded System Design: A Unified Hardware / Software Introduction. Tony Givargis and Frank Vahid. Wiley. ISBN-10: 812650837X
3. MSP430 Microcontroller Basics. John H. Davies. Elsevier. ISBN-10: 9789380501857. Programming Embedded Systems in C and C++. Micheal Barr. Shroff Publishers and Distributors. ISBN-10: 817366076X

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	3	1	2	2	1	3		2		2								
CO2	2	1	1	2	2	3	1	2	1									
CO3	1	2	1	2	1		1			1								
CO4	2	1	2	1	1	2			1									
CO5	2	3	3	3	3	1	2	2		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 317	**Title of the Course**	Analog Signal Processing	**L**	**T**	**P**	**C**
Year	III	**Semester**	V	**3**	**1**	**0**	**4**
Pre-Requisite	Signals and systems	**Co-requisite**					
Course Objectives	❖ To understand the concepts of signals and their types and to understand the LTI systems. ❖ To learn about the frequency domain transformation and frequency analysis of signals. ❖ To learn about the filters and their types and their use in signal processing. ❖ To understand the sampling theorem and its applications in signal processing ❖ To understand Discrete Fourier Transform and frequency responses of digital and analog signals						

Course Outcomes	
CO1	Understand and explain continuous time and discrete time signals and systems, in time and frequency domain.
CO2	Apply the concepts of signals and systems to obtain the desired parameter/ representation.
CO3	Analyze the given system and classify the system/arrive at a suitable conclusion.
CO4	Design analog/digital filters to meet given specifications.
CO5	Design and implement the analog filters.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Basics of signals and systems**	Signal Definition, Signal Classification, System definition, System classification, for both continuous time and discrete time. Definition of LTI systems	8	1
2	**Frequency domain transformation**	Introduction to Fourier Transform, Fourier Series, Relating the Laplace Transform to Fourier Transform, Frequency response of continuous time systems.	8	2
3	**Filters and their analysis**	Ideal low-pass filter, Butterworth and Chebyshev magnitude response, pole locations, low-pass filter specifications, comparison of Maximally flat and Equal ripple responses.	8	3
4	**Sampling**	Sampling Theorem- Statement and converting the analog signal to a digital signal. Practical sampling.	8	4
5	**DFT and its applications**	The Discrete Fourier Transform, Properties of DFT, Comparing the frequency response of analog and digital systems.	8	5

Reference Books:

1. Analog and Digital Signal Processing by Baher, Hussein **Published by Wiley, 1990**

2. Paul R. Gray, Paul J. Hurst, Stephen H. Lewis, Robert G. Meyer, “Analysis and Design of Analog Integrated Circuits”, Wiley Publishers, Fifth Edition, 2009.

3. Sedra and Smith," Microelectronic Circuits", Oxford Press, 2004, Fifth Edition
e-Learning Source:
Lectures from youtube
PPTs from online resources like slideshare etc.

	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	3	2	1	1	1		1	1			1	3	3	2	1
CO2	3	3	3	2	1	1			1			1	3	3	2	1
CO3	3	3	3	2	1	1			1				3	3	2	1
CO4	3	3	3	2	1				2				3	3	2	1
CO5	3	3	2	2					1				3	3	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	EC318	**Title of the Course**	Filter Design	**L**	**T**	**P**	**C**
Year	III	**Semester**	VI	**2**	**1**	**0**	**3**
Pre-Requisite	Integrated Circuit	**Co-requisite**					
Course Objectives	• To understand the underlying concepts and Filters basics. • To learn the analysis of a Biquad Filter. • To learn how the operational transconductance amplifier applicable in the implementation of resistors, integrators, amplifiers, summers etc. • To learn how the resistors are implemented using Switched Capacitor Filters.						

Course Outcomes	
CO1	Given an operational amplifier student can be able to understand categorization of various filters including low-pass filter, High-pass filter, Band-pass filter, Band-reject filter and Delay equalizers.
CO2	Given a system students student shall be able to analyze and evaluate various biquad circuits to implement basic low pass and band pass circuit and realization of the general biquadratic functions, summing of four amplifier biquad also realization of inductor using Gyrator and transformation of elements using the Frequency dependent negative resistance can be done.
CO3	Given concept of transconductance students shall be able to analyze various building blocks of operational transconductance amplifier including its applications as resistors, integrators, amplifiers, summers, gyrator also realize first, second and higher order filters using OTA.
CO4	Given concept of switched capacitor students shall be able to understand the MOS switch, the switched capacitor, first order building blocks, second order sections, sampled data operation and can realize switched capacitor first and second order filters.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Basic Filters	Review of op-amps circuits, Categorization of filters-Low-pass filter, High-pass filter, Band-pass filter, Band-reject filter, Delay equalizers.	8	1
2	Biquad Filter	Three amplifier Biquad: Basic low pass and band pass circuit, realization of the general Biquadratic Functions, summing of four Amplifier biquad, feed forward three amplifier biquad, Inductor Substitution using Gyrator, Transformation of elements using the FDNR.	8	2
3	Operational transconductance Amplifier	Elementary transconductor building blocks, resistors, integrators, amplifiers, summers, gyrator, First and second order filters, higher order filters.	8	3
4	Switched Capacitor Filters	The MOS switch, The switched capacitor, first order building blocks, Second order sections, sampled data operation, Switched capacitor first and second order filters.	8	4

Reference Books:

- Gobind Daryanani, "Principles of active network synthesis and design, John Wiley and Sons.
- R.Schaumann, M.E. Van Valkenburg, "Design of analog filters ,Oxford University Press.

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	3	3	3	1		1			1				3	2		1
CO2	3	3	3	1		1	1		1	1		1	2		1	
CO3	3	2	3	2	1	1			2		1		2		1	
CO4	3	3	2		1			1	1				3	2		
CO5	3	3	3	1		1			1				3	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	EC319	**Title of the Course**	RF AND MICROWAVE ENGINEERING	**L**	**T**	**P**	**C**
Year	3	**Semester**	5	**3**	**1**		**4**
Pre-Requisite	Communication Systems Engineering (EC-303	**Co-requisite**					
Course Objectives	**To learn the basics principles of various microwave solid state devices**						

Course Outcomes	
CO1	Acquire basic knowledge on Low frequency parameters-impedance, admittance, hybrid and ABCD. High frequency parameters-Formulation of S-parameters, S-matrix, properties, concept of N-port scattering matrix representation, Reciprocal and lossless networks, transmission matrix, RF behavior of Resistors, Capacitors and Inductor
CO2	Acquire basic knowledge of microwave semiconductor devices- Principles of tunnel diodes Transferred Electron Devices: Gunn diode, Avalanche Transit time devices, IMPATT and TRAPATT devices. Parametric devices: Principles of operation, applications of parametric amplifier
CO3	To understand the concepts of Microwave frequency range, significance of microwave frequency range, limitations of the conventional tubes, applications of microwaves. Microwave junctions, Tee junctions, Magic Tee, Rat race, Directional couplers, two hole directional couplers, Ferrites Devices: Gyrator, Isolator, Circulator, Attenuator, Phase shifter.
CO4	Acquire basic knowledge of microwave semiconductor devices- Principles of tunnel diodes Transferred Electron Devices: Gunn diode, Avalanche Transit time devices, IMPATT and TRAPATT devices. Parametric devices: Principles of operation, applications of parametric amplifier.
CO5	Acquire knowledge on Microwave tubes- High frequency limitations Principle of operation of two cavity Klystron, Reflex Klystron, Traveling Wave Tube, and Magnetron. Microwave measurements: Measurement of power, wavelength, impedance, VSWR, attenuation

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**TWO PORT RF NETWORKS-CIRCUIT REPRESENTATION**	Review: Low frequency parameters-impedance, admittance, hybrid and ABCD. High frequency parameters-Formulation of S-parameters, S-matrix formulation of two-port junction, properties of S parameters, Concept of N-port scattering matrix representation, Reciprocal and lossless networks, transmission matrix, RF behavior of Resistors, Capacitors and Inductor	8	1
2	**RF TRANSISTOR AMPLIFIER DESIGN AND MATCHING NETWORKS**	Characteristics of Amplifiers, Amplifier power relations, Stability considerations, gain considerations noise figure, impedance matching networks, Frequency response, T and Pi Matching Networks, Microstrip Line Matching Networks. Concept of circular waveguide, frequency allocations and frequency plans, letter designation for microwave bands**.**	8	2
3	**MICROWAVE PASSIVE COMPONENTS**	Microwave frequency range, significance of microwave frequency range, limitations of the conventional tubes, applications of microwaves. Microwave junctions, Tee junctions, Magic Tee, Rat race, Directional couplers, two hole directional couplers, Ferrites Devices: Gyrator, Isolator, Circulator, Attenuator, Phase shifter.	8	3
4	**MICROWAVE SEMICONDUCTOR DEVICES**	Microwave semiconductor devices- Principles of tunnel diodes Transferred Electron Devices: Gunn diode, Avalanche Transit time devices, IMPATT and TRAPATT devices. Parametric devices: Principles of operation, applications of parametric amplifier.	8	4
5	**MICROWAVE TUBES AND MEASUREMENTS**	Microwave tubes- High frequency limitations - Principle of operation of two cavity Klystron, Reflex Klystron, Traveling Wave Tube, and Magnetron. Microwave measurements: Measurement of power, wavelength, impedance, VSWR, attenuation.	8	5

Reference Books:

Robert E. Collin, Foundation of Microwave Engg, Mc Graw Hill.

Annapurna Das and Sisir K Das, Microwave Engineering, Mc Graw Hill

M.M. Radmanesh, RF & Microwave Electronics Illustrated, Pearson Education

Robert E.Colin, Foundations for Microwave Engineering, McGraw Hill

e-Learning Source:
https://www.youtube.com/watch?v=s8oPvj0VLCQ
https://www.youtube.com/watch?v=vgIMF4hisrk
https://www.youtube.com/watch?v=8HnpWRx81UM
https://www.youtube.com/watch?v=do3RkLocYCs

	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	3	2	2	1	1				3			1	3	2		1	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: 2017-18							
Course Code	EC334	**Title of the Course**	Microwave Engineering lab	**L**	**T**	**P**	**C**
Year	**III**	**Semester**	VI			**2**	**1**
Pre-Requisite		**Co-requisite**					
Course Objectives	An understanding of microwave waveguides, passive & active devices, tubes and network analysis. An ability to design microwave matching networks						

Course Outcomes	
CO1	To study and determine the frequency of microwave signal and wavelength in a rectangular wave guide
CO2	To study magic Tee and measure the coupling coefficient and directivity of a directional coupler.
CO3	To study the standing wave ratio and reflection coefficient also study the I-V characteristic of Gunn diode.
CO4	To study the isolators, circulators and attenuation (fixed and variable).
CO5	To Measure the polar pattern and gain of a wave guide horn antenna.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Frequency and Wavelength**	Determine the frequency of microwave signal and wave length in a rectangular wave guide	2	1
2	**Magic Tee**	Study of magic Tee.	2	2
3	**Directional Coupler**	Measurement of coupling coefficient, and directivity of a directional coupler.	2	2
4	**Standing wave ratio**	To Study Standing wave ratio and reflection coefficient.	2	3
5	**Gunn Diode**	To study the I-V characteristic of Gunn diode.	2	3
6	**Isolator and Circulator**	To study the isolators, circulators	2	4
7	**Attenuator**	To study the attenuator (Fixed and Variable type)	2	4
8	**Horn Antenna**	To Measure the polar pattern and gain of a wave guide horn antenna	2	5
e-Learning Source:				
https://www.iitk.ac.in/mimt_lab/vlab/index.php				

	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	1	0	0	
CO2	3	2	3						3			1	3					
CO3	3	3	3	1	1				3				3	2	1			
CO4	3	3	2						3			1	3					
CO5	3	2	2	1	1				3			1	3	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	EC335	**Title of the Course**	Microwave Communication lab	**L**	**T**	**P**	**C**
Year	**III**	**Semester**	VI			**2**	**1**
Pre-Requisite		**Co-requisite**					
Course Objectives	An understanding of microwave waveguides, passive & active devices, tubes and network analysis. An ability to design microwave matching networks.						

Course Outcomes	
CO1	To study and determine the frequency of microwave signal and wavelength in a rectangular wave guide
CO2	To study magic Tee and measure the coupling coefficient and directivity of a directional coupler.
CO3	To study the standing wave ratio and reflection coefficient also study the I-V characteristic of Gunn diode.
CO4	To study the isolators, circulators and attenuation (fixed and variable).
CO5	To Measure the polar pattern and gain of a wave guide horn antenna.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Frequency and Wavelength**	Determine the frequency of microwave signal and wave length in a rectangular wave guide	2	1
2	**Magic Tee**	Study of magic Tee.	2	2
3	**Directional Coupler**	Measurement of coupling coefficient, and directivity of a directional coupler.	2	2
4	**Standing wave ratio**	To Study Standing wave ratio and reflection coefficient.	2	3
5	**Gunn Diode**	To study the I-V characteristic of Gunn diode.	2	3
6	**Isolator and Circulator**	To study the isolators, circulators	2	4
7	**Attenuator**	To study the attenuator (Fixed and Variable type)	2	4
8	**Horn Antenna**	To Measure the polar pattern and gain of a wave guide horn antenna	2	5

e-Learning Source:

https://www.iitk.ac.in/mimt_lab/vlab/index.php

	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	0	0	
CO2	3	2	3						3			1	3					
CO3	3	3	3	1	1				3				3	2				
CO4	3	3	2						3			1	3					
CO5	3	2	2	1	1				3			1	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: 2017-18							
Course Code	EC331	**Title of the Course**	Communication II Lab	**L**	**T**	**P**	**C**
Year	**III**	**Semester**	VI			**2**	**1**
Pre-Requisite		**Co-requisite**					
Course Objectives	To practice the basic theories of analog communication system.. To use computer simulation tools such as P-SPICE, or Matlab to carry out design experiments as it is a key analysis tool of engineering design To give a specific design problem to the students, which after completion they will verify using the simulation software or hardware implementation						

Course Outcomes	
CO1	To study the Sampling/Analog to digital conversion & its reconstruction back to Analog signal.
CO2	To study TDM Pulse Amplitude Modulation (PAM), TDM Pulse Code Modulation (PCM) and Demodulation, Study of Pulse Width Modulation (PWM) and Demodulation
CO3	To study of Carrier Modulation and Demodulation Technique by Amplitude Shift Keying (ASK) method and Technique by Frequency Shift Keying (FSK) method.
CO4	To study the Data Coding and Decoding technique from Non-return to Zero format.
CO5	.To Study of single bit error detection and correction using Hamming Code.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Sampling/Analog to digital conversion	Study of Sampling/Analog to digital conversion & its reconstruction back to Analog signal.	2	1
2	TDM Pulse Amplitude Modulation (PAM)	Study of TDM Pulse Amplitude Modulation (PAM) and Demodulation	2	2
3	TDM Pulse Code Modulation (PCM)	Study of TDM Pulse Code Modulation (PCM) and Demodulation	2	2
4	Pulse Width Modulation (PWM)	Study of Pulse Width Modulation (PWM) and Demodulation	2	2
5	Carrier Modulation and Demodulation	Study of Carrier Modulation and Demodulation Technique by Amplitude Shift Keying (ASK) method.	2	3
6	Frequency Shift Keying (PSK)	Study of Carrier Modulation and Demodulation Technique by Frequency Shift Keying (FSK) method	2	3
7	Phase Shift Keying (PSK)	Study of Carrier Modulation and Demodulation Technique by Phase Shift Keying (PSK) method.	2	3
8	Delta Modulation	Study of Delta Amplitude Modulation and Demodulation.	2	4
9	Data Coding and Decoding technique	Study of Data Coding and Decoding technique from Non-return to Zero format such as- Non-return to Zero-Level(NRZ-L),Non-return to Zero-Mark, Return to Zero (RZ)	2	4
10	Hamming Code	Study of single bit error detection and correction using Hamming Code	2	5

e-Learning Source:

https://www.etti.unibw.de/labalive/

	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	1	0	0	
CO2	3	2	3						3			1	3					
CO3	3	3	3	1	1				3				3	2	1			
CO4	3	3	2						3			1	3					
CO5	3	2	2	1	1				3			1	3	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	EC332	**Title of the Course**	Digital Signal Processing Lab	**L**	**T**	**P**	**C**
Year	**III**	**Semester**	VI	**0**	**0**	**2**	**1**
Pre-Requisite		**Co-requisite**					
Course Objectives	1. Understand the handling of discrete/digital signals using MATLAB. 2. Understand the basic operations of Signal processing 3. To understand the concept of the Analog to Digital conversion & its reconstruction back to analog signal. 4. Analyze the spectral parameter of window functions 5. To design of the FIR filters using MATLAB						

Course Outcomes	
CO1	Analyze the circuit and understand the concept of the Analog to Digital conversion & it's reconstruction back to analog signal.
CO2	Analyze the circuit of 2 channels Time Division Multiplexing and reconstruction of the analog signal in receiving section
CO3	Identification of Signal frequencies for a Noisy Signal using periodogram frequency analysis using MATLAB.
CO4	Determine the Generation of ASK/PSK using MATLAB & display the waveform.
CO5	Designing of the FIR filters using MATLAB.

Experiment No.	**Title of the Experiment**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Sampling	Analog to Digital conversion & its reconstruction back to analog signal. a) Study of difference between Sample & hold method and its reconstruction signal. b) Effect of different sampling frequencies on the reconstructed signal. c) Effect of varying duty cycle frequencies on the reconstructed signal. d) Study of 2nd order & low pass filter.	2	CO1
2	Pulse Amplitude Modulation	To study 2 channels Time Division Multiplexing and sampling of analog signal and it's de-multiplexing & reconstruction of the analog signal in receiving section.	2	CO1
3	Data Coding & Decoding	Study of data coding and decoding techniques for Non-return to Zero formats such as a) Non return to Zero Level(NRZ-L) b) Non return to Zero Mark(NRZ-M) c) Return to Zero(RZ)	2	CO2
4	Noisy Signal using period gram	Identification of signal frequencies for a noisy signal using period gram frequency analysis using Mat-Lab.	2	CO2
5	FFT method of Signals	FFT method of signal analysis and signal frequency detection using Mat-Lab.	2	CO3
6	Linear Convolution	To study of Linear convolution to find the system response using Mat-Lab.	2	CO3
7	Cheb2ord Analysis	To study the performance and design of the cheb2ord analysis Filters using Mat-Lab.	2	CO4
8	Generation of ASK signals	Generation of ASK signals using Mat-Lab and display the waveform.	2	CO5

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
CO1	**3**	**2**		**1**									**1**		
CO2	**3**		**2**									**1**	**1**	**2**	
CO3	**3**		**2**									**1**	**1**	**2**	
CO4	**3**	**2**	**1**									**3**	**1**		**3**
CO5	**3**	**1**			**1**								**1**	**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: 2017-18							
Course Code	EC333	**Title of the Course**	Microprocessor & Application Lab	**L**	**T**	**P**	**C**
Year	**III**	**Semester**	VI	**0**	**0**	**2**	**1**
Pre-Requisite		**Co-requisite**					
Course Objectives	• To study programming based on 8086 microprocessors. • To study 8086 microprocessor based ALP using arithmetic, logical and shift operations. • To study loop and jump. • To study to interface 8086 with I/O and other devices. • To study parallel and serial communication using 8255 /8251 micro controller.						

Course Outcomes	
CO1	Learn to perform the various arithmetic and logical operation.
CO2	Learn to sorting data
CO3	Learn to Interface various I/O peripherals.
CO4	Learn to loop , conditional jump .
CO5	Learn to parallel/serial interfacing to peripheral devices .

Experiment No.	**Title of the Experiment**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Addition	1. Addition of two 16 bit numbers.	2	CO1
2	Multiplication	2. Multiplication of two 16 bit numbers.	2	CO1
3	Subtraction of nos.	3. Subtraction of two8- bit numbers.	2	CO3
4	Division of nos.	4. Division of two 8- bit numbers.	2	CO4
5	Compliment of no.	5. Compliment of numbers getting from Port.	2	CO2
6	Sort big from array	6. Factorial of a 16-bit numbers using 8086 trainer kit.	2	CO3
7	Factorial of no.	7. Greater no from given data array of 8 bit nos.	2	CO5
8	Parallel data r/w	8. Interfacing 8086 kit with I/O trainer kit using 8255.	2	CO5
9	Stepper motor control	9. Interfacing Stepper motor with 8086 trainer kit using 8255		
10.	Add data from Port.	10. Addition of 8 bit data gets from parallel port.		
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
CO1	3	3	2	3	2	3			3	2		3	3	2	2
CO2	3	3	2	3	2	3			3	2		3	3	2	2
CO3	3	3	2	3	2	3			3	2		3	3	2	2
CO4	3	3	2	3	2	3			3	2		3	3	2	2
CO5	3	2	2	2	2	3			2	2		3	3	2	2

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

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