Integral University, Lucknow

Effective from Session: 2015-16							
Course Code	EC 702	**Title of the Course**	Instrumentation Sensors and Transducers	**L**	**T**	**P**	**C**
Year	**I**	**Semester**	I	**3**	**1**	**0**	**4**
Pre-Requisite		**Co-requisite**					
Course Objectives	• To make students understand the basics of sensors and instrumentation. • To familiarize with working of different sensors. • To understand the concepts of temperature measure and calibration of thermometer. • To study the design consideration of sensors. • To understand the application of transducers.						

Course Outcomes	
CO1	Students shall be able to define and explain flow visualization and its measurement
CO2	Students shall be able to define and explain Measurement of Acceleration, Vibration and Density
CO3	Students shall be able to define and explain pressure measurement and different types of pressure gauges
CO4	Standards of thermometers and their calibration.
CO5	Students shall be able to define and explain sensors, their types

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Measurement of flow	Local flow velocity, magnitude and direction. Flow visualization. Velocity magnitude from pilot static tube. Velocity direction from yaw tube, pivoted vane, servoed sphere, dynamic wind vector indicator. Hot wire and hot film anemometer. Hot-film shock-tube velocity sensor. Laser Doppler velocimeter gross volume flow rate: calibration and standards. Constant-area, variable-pressure drop meters (obstruction meters). Averaging pitot tubes. Constant drop, variable area meters (rotameters), turbine meters, and positive displacement meters. Metering pumps. Electromagnetic flow meters. Ultrasonic flow meters.	8	1
2	Measurement of Acceleration, Vibration and Density	Accelerometers- LVDT, Piezo electric, strain gauge and variable reluctance type accelerometers mechanical type vibration instruments seismic instrument as an accelerometer and vibrometer, calibration of vibration pickups, units of density, specific gravity and viscosity used in industries Baume scale API code pressure head type densitometer-float type densitometer- ultrasonic densitometer bridge type gas densitometer.	8	2
3	Pressure Measurement	Units of pressure, manometers, different types : elastic type pressure gauges-Bourde type bellows diaphragms, Electrical methods-elastic elements with	8	3

		LVDT and strain gauges, capacitive type pressure gauge- piezo resistive pressure sensor-resonator pressure sensor, measurement of vacuum, McLeod gauge, thermal conductivity gauges.		

4	Temperature Measurement	Definitions and standards — primary and secondary fixed points, calibration of thermometers different types of filled system thermometer — sources of errors in filled in systems and their compensation, Bimetallic thermometers, Electrical methods of temperature measurement Thermocouple, RTD, Thermister, signal conditioning of industrial RTDs and their characteristics. 3 lead and 4 lead RTDs. IR sensors and bolometer.	8	4

5	Classification of sensors	Classification of sensors, sensors type, classification of semiconductor sensors, sensor characterization. Acoustic sensors, SAW technique. Emerging sensor technologies: CNTs sensors and Graphene sensors.	8	5

Reference Books:

1. I . D.PatranabiS, Principles of Industrial Instrumentation, Tata McGraw Hill, New Delhi, 1999.
2. A.K.Sawhney, A course in Electrical and Electronic Measurement and Instrumentation — Dhanpat Rai and Sons, New Delhi, 1999.
3. P.Holman, Experimental Methods for Engineers International Student Edition, McGraw Hill, 1971.
4. SemiconductOr sensor: Ed. S.M. Sze, JohnWiley & Sons
5. D.Patranabi S, Principles of Industrial Instrumentation, Tata McGraw Hill, New Delhi, 1999.

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	1	1		1				3			2	3			1		
CO2	3	2	3		1				3			1	3	2	2			
CO3	3	3	1	1	1				3			2	3	2	2	1		
CO4	3	3	2		1				3			1	3	1				
CO5	3	2	2	1	1				3			1	3	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	EC705	**Title of the Course**	Laser Technology	**L**	**T**	**P**	**C**
Year	**I**	**Semester**	I	**3**	**1**	**0**	**4**
Pre-Requisite		**Co-requisite**					
Course Objectives	• To make students understand the basics of sensors and instrumentation. • To familiarize with working of different sensors. • To understand the concepts of temperature measure and calibration of thermometer. • To study the design consideration of sensors. • To understand the application of transducers.						

Course Outcomes	
CO1	Students shall be able to define and explain flow visualization and its measurement
CO2	Students shall be able to define and explain Measurement of Acceleration, Vibration and Density
CO3	Students shall be able to define and explain pressure measurement and different types of pressure gauges

CO4	Students shall be able to define and explain temperature measurement and the definitions and standards of thermometers and their calibration.
CO5	Students shall be able to define and explain sensors,their types

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Measurement of flow**	Local flow velocity, magnitude and direction. Flow visualization. Velocity magnitude from pilot static tube. Velocity direction from yaw tube, pivoted vane, servoed sphere, dynamic wind vector indicator. Hot wire and hot film anemometer. Hot-film shock-tube velocity sensor. Laser Doppler velocimeter gross volume flow rate: calibration and standards. Constant-area, variable-pressure drop meters (obstruction meters). Averaging pitot tubes. Constant drop, variable area meters (rotameters), turbine meters, and positive	8	1

		displacement meters. Metering pumps. Electromagnetic flow meters. Ultrasonic flow meters.		
2	Measurement of Acceleration, Vibration and Density	Accelerometers- LVDT, Piezo electric, strain gauge and variable reluctance type accelerometers mechanical type vibration instruments seismic instrument as an accelerometer and vibrometer, calibration of vibration pickups, units of density, specific gravity and viscosity used in industries Baume scale API code pressure head type densitometer-float type densitometer- ultrasonic densitometer bridge type gas densitometer.	8	2
3	Pressure Measurement	Units of pressure, manometers, different types : elastic type pressure gauges-Bourde type bellows diaphragms, Electrical methods-elastic elements with LVDT and strain gauges, capacitive type pressure gauge-piezo resistive pressure sensor-resonator pressure sensor, measurement of vacuum, McLeod gauge, thermal conductivity gauges.	8	3

4	Temperature Measurement	Definitions and standards — primary and secondary fixed points, calibration of thermometers different types of filled system thermometer — sources of errors in filled in systems and their compensation, Bimetallic thermometers, Electrical methods of temperature measurement Thermocouple, RTD, Thermister, signal conditioning of industrial RTDs and their characteristics. 3 lead and 4 lead RTDs. IR sensors and bolometer.	8	4
5	Classification of sensors	Classification of sensors, sensors type, classification of semiconductor sensors, sensor characterization. Acoustic sensors, SAW technique. Emerging sensor technologies: CNTs sensors and Graphene sensors.	8	5

Reference Books:

1. Optical Electronics, Ghatak & Thyagarajan, Cambridge U.K.
2. Essentials of Optoelectroflics, A. Rogers (Chapman Hall).
3. Lasers Theory and Applications: K.Thyagraian and A.K.Ghatak,Macmillan Publication.
4. W.T. Silfvast, Laser fundamentals, Cambridge University Press.
5. Laser Physics by P. W. Miloni, John Wiley and Sons.

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	PSO5	PSO6
CO1	3	1	1		1				3			2	3			1		
CO2	3	2	3		1				3			1	3	2	2			
CO3	3	3	1	1	1				3			2	3	2	2	1		
CO4	3	3	2		1				3			1	3	1				
CO5	3	2	2	1	1				3			1	3	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	EC703	**Title of the Course**	Digital Image Processing	**L**	**T**	**P**	**C**
Year	Course Work	**Semester**	Course Work	**3**	**1**	**0**	**4**
Pre-Requisite	Signal & System	**Co-requisite**					
Course Objectives	• To make students understand the basics of Digital Image Processing. • To understand and analyze various techniques on compression.						

Course Outcomes	
CO1	Student shall be able to understand the Image digitization, Fourier & Z-transform.
CO2	For a given image, student shall be able to design and analyze the Optimal filter, data processing, computing, truncation, optics and system.
CO3	For a given image, student shall be able to understand the application of enhancement, restoration and segmentation techniques.
CO4	Student shall be able to measures the shape, size and classifies the stereometric, stereoscopic image display.
CO5	Student shall be able understand the concept of modeling and coding of image.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Unit-I**	Introduction to Digital Signal processing: Fourier & Z-transform, Multidimensional sequence, Image digitizing, image processing soare, Histograms, point operations.	8	1
2	**Unit-II**	Introduction to algebraic operations, filtering: Convolution, optimal filter design, data processing, computing, truncation, optics and system analysis, diffraction limited optical systems, aberrations.	8	2
3	**Unit-III**	Application: Image restoration, approaches and models, image segmentation, various segmentation approaches, segmented image structure.	8	3
4	**Unit-IV**	Measurement and classification of size, shape measurement feature selection, classification, CAT Stereometric imaging, Stereoscopic Image Display, Shaded surface display.	8	4
5	**Unit-V**	Image Coding, entropy coding, Loss less / Lossy image compression, Measures of predominance, Modeling and coding, international standards for image coding (JPEG, JPEG 2000)	8	5

Text Books:

1. Kenneth R. Castleman, Digital Image processing/PHI.

Reference Books:

1. A. K. Jan/Image processing/ Pearson Education 2003.
2. Gonzalez R.C. & P. Wintel Digital Image processing, Addison Wesley.

e-Learning Source:

Digital Image Processing - Course (nptel.ac.in): **https://onlinecourses.nptel.ac.in/noc21_ee78/preview**

Image Signal Processing - Course (nptel.ac.in): **https://onlinecourses.nptel.ac.in/noc22_ee86/preview**

	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							2	2	2			
CO2	3		2	3		2								1	2			
CO3	3	2	3										2		1			
CO4	3	2		3		2							1	2				
CO5	3		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 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	EC 701	**Title of the Course**	Advanced VLSI Design	**L**	**T**	**P**	**C**
Year		**Semester**		**3**	**1**	**0**	**4**
Pre-Requisite		**Co-requisite**					
Course Objectives	• To understand the concepts of design of MOS/CMOS circuits and systems. • To Evaluate Low Power Design and Layout design rules and stick diagram. • To analyze basic building blocks in advance CMOS logic design, Domino CMOS logic, NORA CMOS logic, Single Phase Dynamic logic, Differential CMOS. • To understand Synchronous and Asynchronous Systems, CMOS flip flop design, Mely and Moore Machines, FSM design PSPICE simulation Programme to simulate the CMOS designs. • To identify the technology for bipolar and BiCMOS logic Gate and Gallium Arsenide Digital Circuits. • To understand and to identify the Design Economics						

Course Outcomes	
CO1	Given a system Students shall be able to understand about VLSI technology trends, Moore's law. Difference between MOS and BJT's, MOS transistor characteristics, types of MOS transistors, NMOS & CMOS inverters, and transmission gated structure. Operation of inverter circuits. .
CO2	For a given system, student shall be able to VLSI fabrication techniques, Lithographic process, Twin-tub and SOS process,Design rules specification of layers, delay and timings calculations , power estimation.
CO3	For a given Sequential Circuit system students can understand NMOS & CMOS circuits for combinational and sequential logics, Stick notation, Shannon's expansion theorem, realization of Boolean functions using CMOS. PLA generators, Pseudo NMOS circuits, Clocked logic, Simple flip flop realization, Shift registers, dynamic shift registers, super buffers, RAMs and ROMSs
CO4	Students shall be able to identify the System·design: VLSI Design level system, design examples. VLSI System Design Methodology: Structure Design, Strategy, Hierarchy, Regularity, Modularity ,and Locality. System on Chip Design options: programmable logic and structure programmable interconnect, programmable gate arrays, Sea of gate and gate array design, standard cell design, full custom mask design.
CO5	Students shall be able to Design Economics: Non recurring and recurring engineering Costs, Fixed Costs, Schedule, Person power , example VLSI System Testing & Verification: Introduction, A walk through the Test Process, Reliability, LogicVerification Principles, Silicon Debug Principles, Manufacturing Test Principles, Designfor Testability.e.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Introduction to VLSI DESIGN**	VLSI technology trends, Moore's law. Difference between MOS and BJT's, MOS transistor characteristics, types of MOS transistors, NMOS & CMOS inverters, and transmission gated structure. Operation of inverter circuits.	8	1
2	**FABRICATION TECHNIQUES**	VLSI fabrication techniques, Lithographic process, Twin-tub and SOS process,Design rules specification of layers, delay and timings calculations , power estimation.	8	2
3	**COMBINATIONAL AND SEQUENTIAL CIRCUITS**	NMOS & CMOS circuits for combinational and sequential logics, Stick notation, Shannon's expansion theorem, realization of Boolean functions using CMOS. PLA generators, Pseudo NMOS circuits, Clocked logic, Simple flip flop realization, Shift registers, dynamic shift registers, super buffers, RAMs and ROMS.	8	3
4	**SYSTEM DESIGN**	System·design: VLSI Design level system, design examples. VLSI System Design Methodology: Structure Design, Strategy, Hierarchy, Regularity, Modularity ,and Locality. System on Chip Design options: programmable logic and structure programmable interconnect, programmable gate arrays, Sea of gate and gate array design, standard cell design, full custom mask design.	8	4
5	**DESIGN ECONOMICS**	Design Economics: Non recurring and recurring engineering Costs, Fixed Costs, Schedule, Person power , example VLSI System Testing & Verification: Introduction, A walk through the Test Process, Reliability, LogicVerification Principles, Silicon Debug Principles, Manufacturing	8	5

		Test Principles, Designfor Testability.		

Text Books:

1. Neil H.E.Weste, Davir Harris,"CMOS VLSI Design: A Circuits and System Perspectives"AddisonWesley-Pearson Education, 3rdEdition,2004.

2. Mukherjee Amar,"Introduction to NMOS and CMOS VLSI System Design",Prentice HalI India.

Reference Books:

1. Mead,Conway," Introductionto VLSI Systems", AddisonWesley
2. NielHEWeste,KamranEshranghia:fl,"PrinciplesofVLSIdesign",PearsonEduAsia.1993.
3 Wayne,Wolf,"ModemVLSIDesign:SystemonSilicon"PrenticeHallPTR/PearsOn Education,SecondEdition,1998
4. DouglasAPucknell&KamranEshragiatl,"BasicVLSIDesign"PHI3rdEdition.

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**