Integral University, Lucknow

Effective from Session: 2021-2022							
Course Code	BE452	**Title of the Course**	Biotelemetry & Telemedicine	**L**	**T**	**P**	**C**
Year	IV	**Semester**	VII	**2**	**1**	**0**	**3**
Pre-Requisite		**Co-requisite**					
Course Objectives	To familiarize students with basic concepts of Biotelemetry & Telemedicine To teach students the application of Biotelemetry &Telemedicine						

Course Outcomes	
CO1	To familiarize students with basic concepts of Biotelemetry & Telemedicine
CO2	To teach students the application of Biotelemetry &Telemedicine
CO3	Describe basic Telemetry, Biotelemetry & Telemedicine system/subsystems .
CO4	Explain the application of Biotelemetry & Telemedicine in modern healthcare technology

U	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	BASICS OF TELEMETRY	Introduction, fundamental of RF telemetry, basic telemetry, system components of coding resolution, pulse code modulation, PCM multiplexing and conversion, PCM data transmission, PCM PSD system. Theoretical comparison of telemetry systems, sub modulation methods, power efficiency of combined systems, practical constraint of telemetry methods optimized power efficiency.	8	CO-1
2	BIOTELEMETRY	Measurement of Blood pressure Direct Methods and Indirect Methods - Temperature - Respiration rate - Heart rate measurement - Apnea detectors - Oximetry -Pulse oximeter, Ear oximeter - Computerized patient monitoring system Bedside, Central Monitoring system Biotelemetry: Basics components, and its different types.	8	CO-2
3	TELEMEDICINE AND HEALTH	History and Evolution of telemedicine, Functional diagram of telemedicine system, Telemedicine, Telehealth, Tele care, Organs of telemedicine, Global and Indian scenario, Ethical and legal aspects of Telemedicine - Confidentiality, Social and legal issues, Safety and regulatory issues, Advances in Telemedicine.	8	CO-3
4	TELEMEDICAL APPLICATIONS	Telemedicine access to health care services health education and self-care. Introduction to robotics surgery, telesurgery. Telecardiology, Teleoncology, Telemedicine in neurosciences, Electronic Documentation, e-health services security and interoperability., Telemedicine access to health care services health education and self-care, Business aspects-Project planning and costing, Usage of telemedicine.	8	CO-4

Reference Books:

O'Carroll, P.W., Yasnoff, W.A., Ward, E., Ripp, L.H., Martin, E.L. (Eds), Health Informatics

Rajarao -medical Universities press (India) Ltd, First Edition, Orient LongmanLtd,2001

e-Learning Source:

https://nptel.ac.in/courses/127106136

http://www.facweb.iitkgp.ac.in/~jay/telemed_slides.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
CO1	3	3	3	2	2	2	-	2	2	2	3	3	2	2	2	
CO2	3	3	3	3	3	2	-	2	2	2	3	3	3	2	3	
CO3	3	3	2	3	3	3	2	3	3	3	2	3	3	2	3	
CO4	2	2	3	3	3	3	2	3	3	3	3	3	3	2	3	

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

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

Integral University, Lucknow

Effective from Session: 2021-2022							
Course Code	BE300	**Title of the Course**	Industrial training	**L**	**T**	**P**	**C**
Year	IV	**Semester**	VII	**0**	**0**	**0**	**0**
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	This course deals with the students to provide comprehensive learning platform to students where they can enhance their employ ability skills and become job ready along with real corporate exposure.						

Course Outcomes	
CO1	Industrial training teaches and gives one the requisite skills using which students can effectively use his/her knowledge to achieve the pre-defined goals of the company or firm where he would .
CO2	Industrial training provides them with the required exposure to the real working condition and workplace, they get some sort of experience from. The newly acquired experience proves to be quite helpful for them when they get employed at some place after their training is complete.
CO3	Industrial training ensure students to interact with industrial personnel and follow engineering practices and discipline prescribed in industry.
CO4	Develop awareness about general workplace behavior and build interpersonal and team skills. Prepare professional work reports and presentations.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**

Reference Books:

e-Learning Source:

https://in.indeed.com/career-advice/career-development/internship-report

https://www.youtube.com/watch?v=nXmrI2A8Rv8

	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	2	2	1	2	2	1	2	2	3	3	3
CO2	2	1	2	1	2	1	1	1	2	2	2	2	3	2	3
CO3	3	2	3	2	2	1	1	1	2	1	2	2	1	2	3
CO4	2	2	2	1	1	1	1	1	2	2	2	2	2	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: 2020-2021							
Course Code	BE453	**Title of the Course**	MEDICAL IMAGE PROCESSING	**L**	**T**	**P**	**C**
Year	**4th**	**Semester**	7th	**2**	**1**	**0**	**3**
Pre-Requisite	NONE	**Co-requisite**	NONE				
Course Objectives	To introduce the learners the basic theory of digital image processing. To expose learners to various available techniques and possibilities of this field. To understand the basic image enhancement, transforms, segmentation,compression, morphology, representation, description techniques &algorithms.						

Course Outcomes	
CO1	To introduce the learners the basic theory of digital image processing.
CO2	To expose learners to various available techniques and possibilities of this field.
CO3	To understand the basic image enhancement, transforms, segmentation, compression, morphology, representation, description techniques &algorithms.
CO4	To prepare learners to formulate solutions to general image processing problems.
CO5	To develop hands-on experience in using computers to process images.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Digital image fundamentals	Image digitization, sampling and quantization, neighbour of pixels, connectivity, relations, equivalence and transitive closure, distance measures, arithmetic / logic operations, discrete transform, fast Fourier transform, 2-D Fourier transform, inverse Fourier transform.	8	1
2	Image Enhancement fundamentals	Spatial domain method, frequency domain method, contrast enhancement, histogram processing, image smoothing, image averaging, masking, image sharpening, removing of blur caused by uniform linear motion, enhancement in the frequency domain — low pass, high pass, mean and band-pass filtering.	8	1
3	Image restoration fundamentals	Degradation model, discrete formulation, algebraic approach to restoration — unconstrained & constrained.	8	1
4	Image compression and segmentation fundamentals	Fidelity criteria, image compression models, lossy and lossless compression technique. Image segmentation: point detection, line detection, edge detection, edge linking and boundary detection.	8	1

Reference Books:

Digital image processing by Gonzalez and Woods. r[d] ed.. Pearson

Digital image processing and analysis by Chanda & Majumdar, PHI

Fundamental of digital image processing by Jain, PHI

Pattern recognition by Tou and Gonzalez

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO3	PSO3
CO1	2	3	2	3	3	3	1	3	3	2	3	1	2	3	3
CO2	3	2	3	1	2	3	1	3	2	3	3	3	2	2	3
CO3	1	3	3	3	1	2	1	2	3	1	3	1	2	3	3
CO4	3	3	2	3	3	2	1	3	3	3	3	3	2	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: 2020-2021							
Course Code	BE454	**Title of the Course**	MEDICAL INFORMATICS	**L**	**T**	**P**	**C**
Year	**4th**	**Semester**	7th	**2**	**1**	**0**	**3**
Pre-Requisite	NONE	**Co-requisite**	NONE				
Course Objectives	Expose to the need for Bioinformatics tools Be familiar with the modelling techniques Learn microarrayanalysis Expose to Pattern Matching andVisualization						

Course Outcomes	
CO1	Expose to the need for Bioinformatics tools
CO2	Be familiar with the modelling techniques
CO3	Learn microarray analysis
CO4	Expose to Pattern Matching and Visualization

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	INTRODUCTION	Need for Bioinformatics technologies – Overview of Bioinformatics technologies Structural bioinformatics – Data format and processing – Secondary resources and applications – Role ofStructural bioinformatics - Biological Data Integration System.	8	1
2	DATAWAREHOUSING AND DATAMINING IN BIOINFORMATICS	Bioinformatics data – Data warehousing architecture – data quality – Biomedical data analysis – DNA data analysis – Protein data analysis – Machine learning – Neural network architecture and applications in bioinformatics	8	2
3	MODELING FOR BIOINFORMATICS	Hidden markov modeling for biological data analysis – Sequence identification –Sequence classification – multiple alignment generation – Comparative modeling –Protein modeling – genomic modeling – Probabilistic modeling – Bayesian networks – Boolean networks – Molecularmodeling – Computer programs for molecular modeling.	8	3
4	MICROARRAY ANALYSIS	Microarray technology for genome expression study – image analysis for data extraction – preprocessing – segmentation – gridding – spot extraction – normalization, filtering – cluster analysis – gene network analysis – Compared Evaluation of Scientific Data Management Systems – Cost Matrix – Evaluation model - Benchmark – Tradeoffs	8	4

Reference Books:

Bryan Bergeron, “Bio Informatics Computing”, Second Edition, Pearson Education,2003.

Arthur M Lesk, “Introduction to Bioinformatics”, Second Edition, Oxford University Press,2005

e-Learning Source:

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

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

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

Integral University, Lucknow

Effective from Session: 2020-2021							
Course Code	BE455	**Title of the Course**	DESIGN CONCEPT & MAINTENANCE OF BIOMEDICAL INSTRUMENTS	**L**	**T**	**P**	**C**
Year	**4th**	**Semester**	7th	**3**	**1**	**0**	**4**
Pre-Requisite	NONE	**Co-requisite**	NONE				
Course Objectives	To introduce students with fundamentals instrumentation of the equipments used in health care systems To familiarize students with the application and troubleshooting, maintenance and repairing aspects of versatile medical equipments						

Course Outcomes	
CO1	To introduce students with fundamentals instrumentation of the equipments used in health caresystems.
CO2	To familiarize students with the application and troubleshooting, maintenance and repairing aspects of versatile medicalequipments.
CO3	Identify various medical equipments used in medical institute/research centres.
CO4	Explain the working theories of medicalinstruments.
CO5	Show the skills in the view points of maintenance, repairing and troubleshooting of medicalequipments.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Fundamentals of Medical Instrumentation	Bioelectric Signals and Physiological Transducers. Related Anatomy and Physiology. **Operation, functional circuit details**: Patient Safety, Repair, Service and Maintenance of a range of medical equipment	8	1
2	Mechanical Equipment	BP Apparatus, Suction Machine and Microscope. Recording and Monitoring Equipment: ECG and EEG Machines, Pulse Oximeter, Cardiac Monitor and Audiometer.	8	2
3	Clinical Lab Equipment	Colorimeter, Spectrophotometer, Semi-Auto Analyzer, Centrifuge and Oven. Imaging Systems: X-Ray and Ultrasound Machines.	8	3
4	Therapeutic Equipment	Cardiac Defibrillator, Short wave and Ultrasonic Diathermy. Anesthesia Machine.	8	4
5	Maintenance of pc based medical equipment	Introduction to - System configuration and BIOS, Identification & Troubleshooting of PC components viz-Motherboard, HDD, FDD, CD ROM, Monitor, Printers, Modems, Ports etc. Installation and operation of - Windows Operating System, Antivirus Software, Internetworking.	8	5

Reference Books:

R. S. Khandpur, Biomedical Instrumentation Technology and Applications, McGraw-Hill Professional, 2004 (UNIT I, II)

Raja Rao, C; Guha, S.K, Principles of Medical Electronics and Biomedical Instrumentation, Orient Longman Publishers (2000) (UNIT III, IV &V)

John G. Webster, Medical Instrumentation: Application and Design, 3rd edition, John Wiley & Sons, New York, 1998.

e-Learning Source:

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	3	3	3	1	3	3	3	3	3	2	2	2
CO2	3	3	1	3	1	3	2	2	2	3	2	1	3	3	3
CO3	2	3	3	2	3	2	1	3	3	2	3	3	3	2	2
CO4	3	1	3	3	2	3	1	1	2	3	1	2	3	3	3
CO5	2	2	2	2	3	3	2	3	3	2	3	3	1	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: 2020-2021							
Course Code	BE456	**Title of the Course**	MEDICAL IMAGE PROCESSING LAB	**L**	**T**	**P**	**C**
Year	4th	**Semester**	7th	**0**	**0**	**2**	**1**
Pre-Requisite	NONE	**Co-requisite**	NONE				
Course Objectives	To gain the practical knowledge about the processing of medical images, understand the fundamentals of digital image and its properties. To enhance the medical images by applying various filters and segment the region of interest using various image processing Algorithms.						

Course Outcomes	
CO1	Knowledge in the science of medical images and image processing, including mathematical transforms.
CO2	Knowledge in the techniques of Digital Image Processing, including Image Enhancement in the Spatial and Frequency Domain, Compression, Morphology and Segmentation.
CO3	Knowledge Current science and technological practice in industry and advanced research topics in this area
CO4	To enhance the medical images by applying various filters and segment the region of interest using various image processing Algorithms
CO5	To gain the practical knowledge about the processing of medical images, understand the fundamentals of digital image and its properties

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	HISTOGRAM TECHNIQUE	Image enhancement — Histogram	2	2
2	IMAGE SEGMENTATION	Image smoothing, Image sharpening, PoinTdetection, Line detection, Edge detection.	2	2
3	IMAGE COPRESSION	Image data compression	2	3
4	IMAGE RESTORATION	Image Characterization, Vector & Matrix Indexing	2	3&5
5	IMAGE TRANSFORMATION	Fourier Transform,Image Transformation	2	1
6	MORPHOLOGICAL OF THE IAGE	Morphological Image Processing	2	5

Reference Books:

Digital image processing by Gonzalez and Woods. r^{d} ed.. Pearson

Digital image processing and analysis by Chanda & Majumdar, PHI

e-Learning Source:

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

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

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

Integral University, Lucknow

Effective from Session: 2021-2022							
Course Code	EC441	**Title of the Course**	Communication Systems	**L**	**T**	**P**	**C**
Year	**IV**	**Semester**	VII	**3**	**1**	**0**	**4**
Pre-Requisite	MT201	**Co-requisite**					
Course Objectives	This curriculum is designed for enabling the students to assimilate the principles of electronic communication. Theory of traditional communication systems, digital communication, wireless communication, information theory, Source coding, error correction strategies and their working methodology would be stressed.						

Course Outcomes	
CO1	Understand the basic concepts of the analog communication systems.
CO2	Perform the time and frequency domain analysis of the signals in a digital communication system.
CO3	Apply basic principles of digital communication techniques
CO4	To enable the student to understand advanced modulation and Coding Techniques.
CO5	To understand the basics of radio system (wireless system) design and applications.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	ANALOG COMMUNICATION	Source of Noise - External Noise- Internal Noise - Noise Calculation. Introduction to Communication Systems: Modulation – Types - Need for Modulation. Theory of Amplitude Modulation - Evolution and Description of SSB Techniques - Theory of Frequency and Phase Modulation – Comparison of various Analog Communication System (AM – FM – PM)	8	CO-1
2	DIGITAL COMMUNICATION	Amplitude Shift Keying (ASK) – Frequency Shift Keying (FSK) Minimum Shift Keying (MSK) – Phase Shift Keying (PSK) – BPSK – QPSK – 8 PSK – 16 PSK - Quadrature Amplitude Modulation (QAM) – 8 QAM – 16 QAM – Bandwidth Efficiency– Comparison of various Digital Communication System (ASK– FSK – PSK – QAM)	8	CO-2
3	DATA AND PULSE COMMUNICATION	Data Communication: History of Data Communication - Standards Organizations for Data Communication- Data Communication Circuits - Data Communication Codes - Error Detection and Correction Techniques - Data communication Hardware - serial and parallel interfaces. Pulse Communication: Pulse Amplitude Modulation (PAM) – Pulse Time Modulation (PTM) – Pulse code Modulation (PCM) - Comparison of various Pulse Communication System (PAM – PTM – PCM)	8	CO-3
4	SOURCE AND ERROR CONTROL CODING	Entropy, Source encoding theorem, Shannon fano coding, Huffman coding, mutual information, channel capacity, channel coding theorem, Error Control Coding, linear block codes, cyclic codes, convolution codes, viterbi decoding algorithm	8	CO-4
5	MULTI-USER RADIO COMMUNICATION	Advanced Mobile Phone System (AMPS) - Global System for Mobile Communications (GSM) – Code division multiple access (CDMA) – Cellular Concept and Frequency Reuse - Channel Assignment and Hand off - Overview of Multiple Access Schemes - Satellite Communication - Bluetooth	8	CO-5

Reference Books:

Wayne Tomasi, "Advanced Electronic Communication Systems", 6th Edition, Pearson Education, 2009

Simon Haykin, "Communication Systems", 4th Edition, John Wiley & Sons,2004

B. P. Lathi, "Modern Analog and Digital Communication Systems", 3rd Edition, Oxford University Press,2007

Blake, "Electronic Communication Systems", Thomson Delmar Publications,2002

e-Learning Source:

https://nptel.ac.in/courses/108104091

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

https://nptel.ac.in/courses/117102059

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

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

Integral University, Lucknow

Effective from Session: 2021-2022							
Course Code	EC442	**Title of the Course**	Control Engineering	**L**	**T**	**P**	**C**
Year	IV	**Semester**	VII	**3**	**1**	**0**	**4**
Pre-Requisite	MT201	**Co-requisite**					
Course Objectives	To study the fundamental concepts of Control systems and mathematical modelling of the system.To study the concept of time response and frequency response of the system. To study the basics of stability analysis of the system.To study the state variable analysis. To study the problem solving technique and designing aspect of control system.						

Course Outcomes	
CO1	Design the of the different type of Position and velocity sensors
CO2	Understanding of the different type of control mechanism uses in the biomedical instruments
CO3	Designing of the control mechanism with the help of State variable analysis
CO4	Able to calculate the gain (phase margin and gain margin) through the graphical methods (Bode plot, Nyquist plot)
CO5	Analyze the response using the graphical models such as block diagrams and signal flow.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Introduction to Control Systems**	Classification of control systems with examples. Properties of Control Systems: Stability, disturbance rejection, insensitivity and robustness. Position and velocity sensors and encoders, servomotors and voice coil actuators.	8	CO-1
2	**Basic Control actions**	Proportional, integral, derivative, and their combinations. Review of Matrix Algebra: Rank of matrix, Generalized matrix inverse, eigenvalues, eigenvector, computation of function of matrix.	8	CO-2
3	**State variable analysis**	Concept of state, state variable, state model. State variable formulation of control system, diagonalization, Relating transfer function with state model. Time response of state model of linear time invariant system. Alternative representations in state space (cascade form, parallel form, controllable canonical form, observable canonical form). Elementary concept of controllability & observability.	8	CO-3
4	**Stability of linear systems**	Routh-Hurwitz criterion, Nyquist criterion. Stability margins. Root locus analysis. Effects of system gain and additional pole-zeros on stability. Design and compensation of control systems in frequency domain: Lagcompensator, lead compensator, lead-lag compensator and lag-lead compensator.	8	CO-4
5	**Block diagram representationof control systems**	Block diagram reduction and signal flow graph analysis. Review of frequency domain methods: Nichols plots. Frequency Domain Specifications in open loop and closed loop and their significance, Conceptof Bandwidth (3 dB BW & 90 degree BW) and Cut-off frequency, Effect ofaddition of poles and zeros on Bandwidth.	8	CO-5

Reference Books:

Gopal: Modern Control System, New Age International.

Kuo B.C., Automatic Control Systems, Prentice-Hall of India Pvt Ltd., New Delhi, 6th edition, 1991

Ogata K., Modern Control Engineering, Prentice-Hall of India Pvt Ltd., New Delhi, 3rd edition, 2000

e-Learning Source:

https://nptel.ac.in/courses/108106098

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	2	2	2	-	2	2	2	3	3	2	2	2	
CO2	3	3	3	3	3	2	-	2	2	2	3	3	3	2	3	
CO3	3	3	2	3	3	3	2	3	3	3	2	3	3	2	3	
CO4	2	2	3	3	3	3	2	3	3	3	3	3	3	2	3	
CO5	3	2	3	3	3	3	2	2	3	3	3	3	3	2	3	

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

Integral University, Lucknow

Effective from Session: 2015-16							
Course Code	EC443	**Title of the Course**	ELECTRICAL & ELECTRONIC MEASUREMENT AND INSTRUMENTATION	**L**	**T**	**P**	**C**
Year	**IV**	**Semester**	VII	**3**	**1**	**0**	**4**
Pre-Requisite	Basics of Electronics devices	**Co-requisite**	Electronic Measurements				
Course Objectives	1. To familiarize students with basic measurement system & its components. 2. To introduce students with characteristics of measuring instruments & errors in measurement. 3. To familiarize students with basic electrical measuring instruments. 4. To familiarize students basic and advanced electronic measuring instruments.						

Course Outcomes	
CO1	Understand & describe basic measurement systems and their components. Describe the characteristics of instruments and different measurement errors.
CO2	Describe construction & operation of basic electrical instruments & analyze AC bridge circuits.
CO3	Understand and describe the configuration & working principle of different electronic instruments for the used in laboratories.
CO4	Distinguish between analog and digital instruments.
CO5	Understand and describe the working theory of basic data acquisition system & PC based instrumentation system. Realize the construction & working principle of Optical Power Measurement.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	General Features	Measurement systems – Static and Dynamic Characteristics – Units and Standards of measurements, –errors analysis, –moving iron meters, dynamometer, wattmeter– multimeter, –True rms meters–Bridge measurements, Wheatstone Bridge, Kelvin, Wein, Maxwell, Hay, Schering and Anderson Bridges.	**8**	**CO.1**
2	Basic Measurement Concepts	Electronic Multimeter Current measurement with analog electronic instruments. Chopper stabilized amplifier for measurement of very low voltage and currents. Cathode Ray Oscilloscopes- Block Schematic, Principles and applications. Dual Trace and Dual Beam Oscilloscopes, Digital Storage Oscilloscopes.	**8**	**CO.2**
3	Signal Generator and Analysis	Function Generators- RF Signal Generators- Sweep Generators – Frequency Synthesizer-Wave Analyzer-Harmonic Distortion Analyzer – Spectrum Analyzer.	**8**	**CO.3**
4	Digital Instruments	Comparison of analog & digital techniques- digital voltmeter- mutlimeter–frequency counters-measurement of frequency and time interval – extension of frequency range-measurement errors.	**8**	**CO.4**
5	Data Acquisition Systems	Elements of digital data acquisition system- interfacing of transducers – multiplexing – computer-controlled instrumentation: IEEE 488 BUS. Optical Power Measurement, Optical Time Domain Reflectometer.	**8**	**CO.5**

Reference Books:

1. Electronic Instrumentation by H. S. Kalsi. 3rd Ed. Tata McGraw-Hill Education.
2. A Course in Electrical and Electronic Measurements and Instrumentation by A.K. Sawhney, Puneet Sawhney. Dhanpat Rai Publications.

e-Learning Source:

https://swayam.gov.in/nd1_noc19_ee44/preview

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

PO-PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2		2		2	2				1	3	1	1	1
CO2	3	2	3	2		2		1		1			3	2	1	1
CO3	3	2	2		2		2		1	1		1	3	2	2	1
CO4	3	2	2	2		1		1			1		3	1	2	1
CO5	3	3		2	2	1		1	2			1	3	2		3

Name & Sign of Program Coordinator	Sign & Seal of HoD

Integral University, Lucknow

Effective from Session: 2021-2022							
Course Code	EC444	**Title of the Course**	VLSI & EMBEDDED SYSTEM	**L**	**T**	**P**	**C**
Year	**IV**	**Semester**	VII	**3**	**1**	**0**	**4**
Pre-Requisite	EC201, EC235	**Co-requisite**					
Course Objectives	Describe MOS transistor structure and operation State VLSI design flow and design hierarchy Design NAND, NOR, half adder, full adder transmission gate Describe different inverters(Resistive load, CMOS etc.) Design MOS based sequential circuit Design dynamic logic circuits Understand the fundamentals of the embedded systems Basic programming concepts of for embedded systems Describe the Basic OS fundamentals and the RTOS for embedded systems						

Course Outcomes	
CO1	Analyze one transistor (MOSFET, NMOS) amplifier circuit (draw DC, AC, small signal model equivalent circuits, find their parameters and parameters of amplifier).
CO2	Design different types of with and without memory element digital electronic circuits for particular operation, within the realm of economic, performance, efficiency, user friendly and environmental constraints.
CO3	Understand the key concepts of embedded systems such as I/O, timers, interrupts and interaction with peripheral devices.
CO4	Recognize and classify embedded and real-time systems
CO5	Ability to use commercial tools to develop RTOS based applications

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction to MOSFETs	MOS-transistor structure, operation, characteristics. VLSI design flow and design hierarchy. Brief overview of circuit design techniques (Hierarchical design, Design abstraction, computer aided design). MOS Inverter: Simple inverter structure, VTC, Critical voltages, different types of inverter, Noise margin. CMOS combinational circuit::NAND gate, NOR gate, Half adder, Full adder, Other complex logic circuits, CMOS transmission gates, Simple circuits design with CMOS transmission gate	8	CO-1
2	Sequential MOS Logic Circuits	SR Latch, JK Latch, D latch, Edge triggered Flip flops. Dynamic Logic Circuits: Dynamic logic circuits basics, Pre-charge and evaluate logic, cascading problem, Domino Logic.	8	CO-2
3	Introduction to Embedded systems	Embedded Systems –Definition, Difference between Embedded system and General Computing Systems, Importance of Embedded Systems, Hardware architecture of the real time systems, Different hardware units & processor overview for embedded systems.	8	CO-3
4	**P**rogramming Concepts for Embedded systems	ALP and High level language, Macros, functions, data types, data structures, modifiers, statements ,loops, pointers Queue, stack, Lists and ordered lists, compilers and cross-compilers.	8	CO-4
5	Real Time Operating Systems	Operating system basics, Tasks, Process and Threads, Multiprocessing and multitasking, task communication, task synchronization, Multiple tasks scheduling in real time systems by RTOS.	8	CO-5

Reference Books:

Neil H.E Weste, Kim Haase, David Harris, A. Banerjee, "CMOS VLSI Design: A circuits & Systems Perspective", Pearson Education

Wayne Wolf," Modern VLSI Design – System-on-chip Design", Prentice Hall India/Pearson Education

Sung-MoKang & Yusuf Lablebici, "CMOS Digital Integrated Circuits, Analysis & Design", Tata McGraw-Hill Edition

Introduction to Embedded System: Shibu K. V. (TMH)

Embedded System Design – A unified hardware and software introduction: F. Vahid (JohnWiley)

	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

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

Integral University, Lucknow

Effective from Session: 2021-2022							
Course Code	**BE451**	**Title of the Course**	**Seminar**	**L**	**T**	**P**	**C**
Year	4th	**Semester**	8th	**0**	**0**	**0**	**3**
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	To develop the Communication & Research Comprehension. To developed leadership skills. To develop the ability to seek knowledge and defend the idea.						

Course Outcomes	
CO1	Learner should be able review available literature and extract idea from them.
CO2	Learner should be able to work in a team as leader or effective team member.
CO3	Learner should be able to write technical reports and to present their work.

	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	1	1	1	3	3	1	1	3	3	3	1	3	3	3	3
CO2	1	1	1	3	3	1	1	3	3	3	1	3	3	1	3
CO3	1	1	1	1	3	1	1	1	3	3	1	3	1	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: 2021-2022							
Course Code	**BE499**	**Title of the Course**	**B.Tech Project**	**L**	**T**	**P**	**C**
Year	4th	**Semester**	8th	**0**	**0**	**0**	**12**
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	To enable students to work as a team to develop the methodology for the project. To develop the capability to apply the engineering principles to carry out the project work. To define the conclusion of the project undertaken with in depth understanding of the topic.						

Course Outcomes	
CO1	Ability to work as a team of plan the execution of the undertaken project.
CO2	Capability to use the engineering knowledge and principles on an undertaken project.
CO3	Capacity to complete the undertaken project on time with effective communication to deliver the project successfully.

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

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

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