Department of Electronics & Communication Engineering, Integral University, Lucknow

Effective from Session: 2025-26							
Course Code	EC209	**Title of the Course**	Digital Electronics	**L**	**T**	**P**	**C**
Year	II	**Semester**	IV	3	0	2	4
Course Objectives	• To understand the concepts of digital electronics and their applications. To provide a conversion in mathematical form. Can identify type of complements, can apply 1's and 2's complements. • To learn the Boolean Expression, K- Map method. To understand the basic concepts of various combinational circuit including gates, adders, subtractor, multiplexer and encoders. • To learn the analysis of various sequential circuits, flip flops, counters and various shift register. • To understand the concept and design of asynchronous sequential logic. • To understand the concepts of various logic devices programming logic array, programming array logic PROM and various memories.						

Course Outcomes	
CO1	Given a number, students shall be able to represent various conversion in mathematical form, identify type of complements, apply 1's and 2's complements and formulate conversion of any radix to decimal and decimal to any radix and solve 1's, 2's, 9's and 10's complements.
CO2	Given a Boolean Expression, student shall be able to analyze and evaluate various axioms and theorems also K- Map method. For a given Combinational circuit, student shall be able to understand its various building blocks and examine, analyze and evaluate various gates, adders, subtractor, multiplexer and encoders.
CO3	Given concept of sequential logic would be able to select suitable design of various flip flops, shift registers and counters.
CO4	Given concept of asynchronous sequential logic would be able to understand and analyze transition table, flow table, reduction of states and circuit with latches.
CO5	Given a AND and OR array, student shall be able to define various logic devices. Solve, analyze, and modify different PLD based design.
CO6	Students shall be able to understand, demonstrate the characteristics and functioning of different digital circuits and the working principle of different type of digital circuits.
CO7	Student shall be able to understand, analyze, design and implement the different digital circuits and the characteristics of circuits.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Boolean algebra and Number System	Digital System and Binary Numbers: Singed binary numbers, fixed and floating-point numbers, binary codes, cyclic codes, gray codes, error detecting and correcting codes, ASCII, EBCDIC codes. parity check and Hamming codes Boolean algebra and logic gates: Basic definition, basic theorem and properties of Boolean algebra, canonical and standard forms, other logic expressions.	08	CO1
2	Combinational Logic	Gate- Level Minimization: K-Map, don't care conditions, NAND and NOR implementation, Quine Mc-Clusky method (Tabular Method) Combinational Logic: Combinational circuits, Analysis procedure, design procedure, binary adder subtractor, decimal adder, binary multiplier, magnitude comparator, decoder (BCD to seven segment Decoder), encoder.	08	CO2
3	Sequential Circuits	Latches, Flip-Flop, Shift Registers, Counters: Synchronous and Asynchronous sequential circuits. Bi-directional register	08	CO3
4	Asynchronous Sequential Logic	Logic: Analysis Procedure: circuit with latches, design procedure, reduction of state and flow table, race Free State assignment.	08	CO4
5	Memory	Introduction to digital logic family such as RTL, DTL, TTL, ECL, CMOS etc., ROM: PROM, EPROM & EEPROM RAM: SRAM & DRAM PLD: PLA, PAL & FPGA	08	CO5

Practical

S. No.	**Experiment No.**	**List of experiments**	**Contact Hrs.**	**Mapped CO**
1	Experiment No. 1	Realize OR, NOR, XOR, XNOR gates using NAND gate and verify its truth table.	2	CO6
2	Experiment No. 2	Design and study of 1-bit Magnitude Comparator.	2	CO6
3	Experiment No. 3	Design of Shift Registers.	2	CO6
4	Experiment No. 4	(a) Design and test a CODE CONVERTER from decimal number to binary number. Use diode and LED's. (b) Measure voltage drop across the diodes, LED's and resistor R. Find the current	2	CO6

		flowing through LED.		
5	Experiment No. 5	(a) Assemble the half Adder circuit using X-OR and AND gates. Verify the truth table for Half Adder. (b)Using two Half Adder and an OR gate, assemble Full Adder circuit, verify truth table. (c)Express sum and carry with all the minterms in minimization possible?	2	CO6
6	Experiment No. 6	Display of decimal digits using 7-segments LED display and a suitable decoder. (a)Use a BCD to 7 segment decoder 0-9 digits. (b)Study the 7 segment LED display. Is it common anode or common cathode type? What is a suitable value or R for bright display of digit? (c)Design a BCD to 7 segment decoder using NAND gates. Use K-Maps and don't care terms to implement the design with minimum number of gates.	2	CO7
7	Experiment No. 7	STUDY OF FLIP-FLOPS (F/F) (a)Design and test J-K Master-Slave F/F IC 74LS76. Make special observation of edge triggering present and clear. (c)Make and test D-F/F and T-F/F and verify its truth table.	2	CO7
8	Experiment No. 8	STUDY OF COUNTER (a)Design MOD-10 Counter using Master – Slave F/F (7476) and logic gates (7400 & 7408). Verify truth table.	2	CO7
9	Experiment No. 9	Study and verify 4-bit adder / Subtractor circuit using IC7483 and IC7486.	2	CO7
10	Experiment No. 10	STUDY THE X-OR GATE IC-MODULE (7486) (a)Verify the truth table and record voltage levels. (b) Design a 3-input X-OR gate using 2-input X-OR gate. Obtain its truth table. F1= A⊕ B⊕C (c) Design a 3-input X-NOR gate using 7486 &7402. Obtain its truth table. F2= AʘBʘC (d) Find expressions of F1 and F2 as Sum of product (SOP) and compare F1 and F2.	2	CO7

Text Books:

1. Mano M Morris / Digital Design / Person Education India
2. Mano M Morris/ Digital Logic and Computer Design/ Person Education India
3. Bignell James/ Digital Electronics: Logic and Systems/ Cengage Learning

Reference Books:

1. G. K Kharate / Digital Electronics/ Oxford University Press India
2. Gopalan, K Gopal/ Introduction to Digital Microelectronics Circuits/ Mc Graw- Hill Education India
3. Jacob Millman and Herbett Taub/ Pulse, Digital & Switching wave forms/ Mc- Graw- Hill Education India

e-Learning Source:

1. https://onlinecourses.nptel.ac.in/noc21_ee75/preview
2. https://youtu.be/X7M3rUxUpOc
3. https://onlinecourses.nptel.ac.in/noc22_ee55/preview
4. https://youtu.be/oNh6V91zdPY

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	1		1		1			2	3	2		1
CO2	3	3	3	1		1		1			1	3		1	
CO3	3	2	3	2	1	1		2			2	3		1	
CO4	3	3	2	2	1			1			2	3	2		
CO5	3	3	2	1				1			2	3		1	
CO6	3	3	2	2	2			2			1	3	3	2	1
CO7	3	3	2	2	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
Department of Electronics & Communication Engineering

Effective from Session:							
Course Code	EC210	**Title of the Course**	Signals and Systems	**L**	**T**	**P**	**C**
Year	II	**Semester**	IV	**3**	**0**	**0**	**3**
Pre-Requisite	NA	**Co-requisite**	NA				
Course Objectives	❖ To understand the concepts of signals and their applications. State the basics of signal analysis and processing for communication engineering ❖ To know the methods of characterization of LTI systems in time domain. ❖ To analyze continuous time signals and system in the Fourier and Laplace domain. ❖ To analyze discrete time signals and system in the Fourier and Z transform domain.						

Course Outcomes	
CO1	For a given signal, students shall be able to represent signals in mathematical form, identify type of system, and formulate convolution integral and convolution sum.
CO2	Given a system, student shall be able to identify the type of systems and able analyze the LTI system and its characteristic.
CO3	For a given signal, student shall be able to understand the mathematical formulation of Fourier series and its ability to represent periodic signals and how the Laplace transform generalizes the Fourier transform. Apply Fourier transform techniques to analyze LTI systems in the frequency domain. Learn the formulation and significance of the DTFT for discrete signals.
CO4	Student shall be able to analyze the importance of magnitude and phase in reconstructing signals. Explore the implications of frequency response on system design, such as filter performance and stability. Recognize and mitigate practical challenges like aliasing in signal processing.
CO5	For a given signal student shall be able to develop the ability to represent discrete-time signals and systems using the Z-transform. Develop the ability to translate system transfer functions or difference equations into practical implementations.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Signal Classification	Signal Classification: continuous time vs discrete time, periodic vs non-periodic, even vs odd, deterministic vs random. Basic signals: Sinusoidal, exponential, unit impulse, unit step, unit ramp. Mathematical operations on signals: scaling, folding, time shifting, addition and multiplication. Convolution integral and convolution sum.	8	1
2	Basics of Systems	Classification of systems: static and dynamic systems, time invariant and time variant, linear and nonlinear systems, causal and non-causal systems, stable and unstable systems. Linear Time invariant systems (LTI) representation; impulse response, transfer function, constant coefficient differential equation.	8	2
3	Fourier Series & Fourier Transform	Fourier series representation of periodic signal. Fourier Transform, properties, Basic of Laplace Transform. Relation between Laplace transform and Fourier transform, Fourier transform application to LTI systems. Discrete time Fourier transform (DTFT), properties of DTFT.	8	3
4	Time and frequency characterization & Sampling	Magnitude- phase representation of Fourier transform, frequency response of LTI systems, Frequency domain characterization through multiplication of Fourier Transform of input signal and system frequency response. Sampling theorem, ideal sampling, flat top sampling, natural sampling, aliasing effect.	8	4
5	Z-Transform	Introduction to Z- transform, properties, inverse Z- transform, analysis and characterization of discrete LTI systems. Realization of discrete time systems: direct form (I and II).	8	5

Text Books:
1. Oppenheim, A.S Willsky and S. H Nawab/ Signals and Systems/PHI/Second Edition
2. Haykins/ Signals and Systems/Wiley India.
3. H.P.Psu/Signals and Systems Schaums outline/McGraw-Hill Education India.
4. B.P. Lathi, "Signal Processing and Linear Systems," Oxford University Press, 1998.
5. R.F. Ziemer, W.H. Tranter and D.R. Fannin, "Signals and Systems - Continuous and Discrete," 4th edition, Prentice Hall.
6. A. Anand Kumar, “Signals and Systems,” PHI 3rd edition, 2018.
Reference Books:
1. Kallappan Gopalan, Signals and Systems, Cengage Learning India/Second Edition.
2. Douglas K. Lindner, "Introduction to Signals and Systems," McGraw Hill International Edition: 1999.
3. V. Krishnaveni, A. Rajeswari, “Signals and Systems”, Wiley India Private Limited, 2012.
4. Robert A. Gabel, Richard A. Roberts, "Signals and Linear Systems," John Wiley and Sons, 1995.
5. J. Nagrath, S. N. Sharan, R. Ranjan, S. Kumar, "Signals and Systems," TMH New Delhi, 2001.
6. D. Ganesh Rao, K.N. Hari Bhat, K. Anitha Sheela, “Signal, Systems, and Stochastic Processes,” Cengage publication, 2018.
e-Learning Source:
https://ocw.mit.edu/courses/res-6-007-signals-and-systems-spring-2011/
https://onlinecourses.nptel.ac.in/noc20_ee15/preview

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)														
PO-PSO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PSO	PSO	PSO	PSO
CO	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4
CO1	3	3	2	3	1		1		1		3	3	2	3	
CO2	3	2	2	3		1					3	3	2	3	
CO3	3	2	2	3						1	3	3	2	3	
CO4	3	2	2	3	**1**			1			3	3	2	3	
CO5	3	3	2	3							3	3	2	3	

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

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

Department of Electronics & Communication Engineering, Integral University, Lucknow

Effective from Session: 2025-26							
Course Code	EC211	**Title of the Course**	Measurement and Sensors	**L**	**T**	**P**	**C**
Year	II Year	**Semester**	IV	3	0	2	4
Pre-Requisite	Basic Electronics	**Co-requisite**	Electronics Measurements				
Course Objectives	• To explain the basic concepts and definitions in measurement. • To describe the bridge configurations and their applications. • To explain the measurement of non-electrical quantity, their working principle and construction. • To elaborate the discussion about the importance of signal generators and analyzers in Measurement.						

Course Outcomes	
CO1	To understand the different measurement standards, systems and Errors in an electronic measurement system, transducers and their classification and different types of DC and AC bridges and high frequency measurement.
CO2	To understand the sensors and transducers in different field.
CO3	To understand the measurement of non-electrical quantities along with their basic construction and working principle.
CO4	To understand the measurement of Amplifier and Receiver Characteristics, principle and working of telemetry tracking and command.
CO5	To understand the different types of Biosensors.
CO6	To write and perform the experiment on the basic concept of different types of transducers and bridges.
CO7	To write and perform the experiment on the basic concept of telemetry system, wave analyzer and CRO.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Instrument and Measurement Systems:	Standards of Measurement of Mass, Length, Volume, Time and Frequency, Electrical Standards, Standards of Temperature and Luminous Intensity, IEEE standards, Engineering Analysis of Instrument Systems, Experimental Errors, Minimization of Errors, Frequency Response and Calibration of Instruments systems. Bridge Measurements: Wheatstone Bridge, Kelvin Bridge, Guarded Wheatstone Bridge, AC Bridges: Maxwell Bridge, Hay Bridge, Schering Bridge, Wien Bridge.	08	CO1
2	Introduction to sensors and transducers:	Need for sensors in the modern world. Different fields of sensors based on the stimuli -various schematics for active and passive sensors. Static and dynamic characteristics of sensors. High Frequency Measurements: RF Power and Voltage Measurements, RF Impedance Measurement, Q Meter, Digital Voltmeter, Time, Frequency and Phase Measurements, Measurement on CRO.	08	CO2
3	Measurement of Non-Electrical Quantities:	Measurement of Temperature: Resistance Thermometer, Thermocouple, IC Sensor, Radiation Method (Pyrometer) Measurements of Pressure, Fluid Flow, Force, Torque, Displacement, Velocity and Acceleration.	08	CO3
4	Measurement of Amplifier	Measurement of Amplifier and Receiver Characteristics, Data Distribution and Bus Structure, RS-232, IEEE488 Interface, PC Based Acquisition System, Data Transmission, Telemetry, Tracking and Command	08	CO4
5	Introduction to biosensor	General components of biosensor, Biomolecules in biosensors such as enzyme, DNA. Classification of biosensors based on principle: amperometric, potentiometric biosensors, optical, acoustic, piezoelectric, and calorimetric biosensors, scope of biosensors and its limitations.	08	CO5

Practical

S. No.	**Experiment No.**	**List of experiments**	**Contact Hrs.**	**Mapped CO**
1	Experiment No. 1	To study the working of a LVDT.	2	CO6
2	Experiment No. 2	To study the waveform synthesizer/analyzer.	2	CO6
3	Experiment No. 3	To study the working of strain gauge.	2	CO6
4	Experiment No. 4	To obtain value of unknown inductance using Maxwell's inductance	2	CO6
5	Experiment No. 5	To obtain value of unknown inductance using Hay's bridge.	2	CO6
6	Experiment No. 6	To obtain value of unknown capacitance using Schering's bridge.	2	CO7

7	Experiment No. 7	Measurement of accuracy and precision of analog and digital	2	CO7
8	Experiment No. 8	Measurement of phase difference and frequency using CRO.	2	CO7
9	Experiment No. 9	To study the working of a Crompton's potentiometer.	2	CO7
10	Experiment No. 10	To study the square wave generator	2	CO7

Text Books:

1. Helfric & Cooper/ Modern Electronic Instrumentation & Measurement Techniques/ PHI.
2. David A. Bell, "Electronic Instrumentation and Measurements", Oxford University Press
3. Sawhney A.K, "A Course in electrical and electronic measurements and instrumentation", Dhanpat Rai & Co (P) Ltd, Educational and Technical Publishers, 19th Revised edition 2011

Reference Books:

1. E.O. Doeblin/ Measurement Systems/ MC Graw Hill
2. Oliver & J.M. Cage/Electronic Measurement And Instrumentation/ MC Graw Hill.
3. Ranjan C.S./Instrumentation Devices & Systems / Tata MC Graw Hill.
4. Patranabis D, "Sensors and transducers", PHI, 2nd edition,2004.
5. R.S. Khanpur, "Handbook of Biomedical Instrumentation" Tata McGraw Hill
6. H.E. Thomas, "Handbook of Biomedical Instrumentation and Measurement" Restone Publishing Company

E- Learning:

1. https://nptel.ac.in/courses/108107142
2. https://archive.nptel.ac.in/courses/115/102/115102014/
3. https://nptel.ac.in/courses/115102014
4. https://archive.nptel.ac.in/courses/115/102/115102014/

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

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2		2		2	2					1	1	1
CO2	3	2	3	2		2		1		1			2	1	1
CO3	3	2	2	3	2		2		1	1		3	2	2	
CO4	3	2	2	2		1		1			1	3	1	2	
CO5	3	2	2		2		2	2			1	3	1	1	1
CO6	3		2			2		1				3	1		
CO7	2	2		1						1		2	2	1	

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

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

Department of Electronics & Communication Engineering, Integral University, Lucknow

Effective from Session: 2025-26							
Course Code	EC230	**Title of the Course**	Embedded C and Linux	**L**	**T**	**P**	**C**
Year	II	**Semester**	IV	3	0	2	4
Course Objectives	To discuss components of embedded systems, implement programs on embedded platforms, and develop familiarity with embedded development tools.						

Course Outcomes	
CO1	To provide a foundational understanding of what embedded systems are and their key components
CO2	To equip students with the necessary skills to develop software for embedded systems using the C programming language.
CO3	Students shall be able to understand and apply various communication protocols across networks
CO4	To learn how to connect and effectively manage the communication between external devices (like keyboards, monitors, scanners) and a computer's central processing unit (CPU), by understanding the necessary hardware and software protocols to transfer data seamlessly between them.
CO5	To learn how to connect and effectively manage the communication between external devices (like keyboards, monitors, scanners) and a computer's central processing unit (CPU), by understanding the necessary hardware and software protocols to transfer data seamlessly between them.
CO6	To provide students with a comprehensive understanding of the principles and techniques used in designing and implementing software applications on systems that require strict timing constraints
CO7	Students shall be able to understand the fundamental concepts of Linux operating systems

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction to embedded system	Block diagram of embedded system with hardware components, Characteristic of embedded system, Processor, power, memory, operating system, reliability, Classification of embedded system: small scale, medium scale, sophisticated, stand alone	08	CO1
2	Programming using Embedded C	Programming using Embedded C: Data Transfer, Arithmetic and Logical operations/ Decision control & looping, Timer/Counter programing with embedded C for Microcontroller, Serial communication programming with embedded C for Microcontroller, Interrupt control programming with embedded C for Microcontroller (8051 µc)	08	CO2
3	Communication standards and protocol	Modes of communication: Simplex, Duplex, Half Duplex, Serial, Parallel synchronous and asynchronous	08	CO3
4	Interfacing input and output devices	Interfacing of switches, keys, pushbuttons, Interfacing of LED, 7-segment display, Relays	08	CO4
5	Operating System	History of Linux OS, Linux File Systems (ext) and versions	08	CO5
Practical				
S. No.	**Experiment No**	**List of experiments**	**Contact Hrs.**	**Mapped CO**
1	Experiment 1	Identify and understand various hardware components used in an embedded system (Processor, Memory, Power, I/O Devices).	2	CO6
2	Experiment 2	Write a program to move data between registers and memory locations in the 8051 Microcontroller.	2	CO6
3	Experiment 3	Implement basic arithmetic (addition, subtraction, multiplication) and logical operations (AND, OR, XOR) in Embedded C.	2	CO6
4	Experiment 4	Write a program to implement conditional statements (if-else, switch-case) and loops (for, while, do-while).	2	CO6
5	Experiment 5	Use the 8051 microcontroller's timers to generate a time delay.	2	CO6
6	Experiment 6	Transmit and receive data using UART (Serial Communication) on the 8051.	2	CO7
7	Experiment 7	Demonstrate interrupt handling (External, Timer, and Serial Interrupts) on the 8051 Microcontroller.	2	CO7
8	Experiment 8	Write a program to demonstrate data transmission using serial and parallel communication.	2	CO7
9	Experiment 9	Interface and control LED and 7-segment display with the 8051 Microcontroller.	2	CO7
10	Experiment 10	Write a program to interface a relay module and control an external device using a switch.	2	CO7
Text Books:				

1.	Philips A. Laplante, Real-Time System Design and Analysis, 3rd Edition, John Wiley & Sons, 2004
2.	Shibu K V, Introduction to Embedded System, 2nd Edition Paperback – 1 July 2017
3.	Himanshu B. Dave, Embedded Systems Concepts Design and Programming, Pearson Education India; First Edition (1 January 2015); Pearson India
Reference Books:	
4.	Ayala, Kenneth, 8051 Microcontroller Architecture Programming, EEE/Prentice Hall of India 2nd edition, New Delhi, 1 July 2004
5.	Christine Bresnahan, Richard Blum, Linux Essentials 2nd Edition, John Wiley & Sons, September 15, 2015
e-Learning Source:	
1.	https://ptolemy.berkeley.edu/books/leeseshia/releases/LeeSeshia_DigitalV2_2.pdf
2.	https://www.bogotobogo.com/cplusplus/files/embed/OReilly_Programming_Embedded_Systems_Second_edition_ebook.pdf
3.	https://www.youtube.com/watch?v=ROjZy1WbCIA

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

PO-PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	3					2					3	2			
CO2	3	2				2					3	2	1		
CO3	3		1		1	2					3	1			
CO4	3					1	1				3	2			
CO5	3										3	2			
CO6	3	2				2					3	2	1		
CO7	3		1		1	2					3	1			

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

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

Department of Electronics & Communication Engineering, Integral University, Lucknow

Effective from Session: 2025-26							
Course Code	EC283	**Title of the Course**	Electromagnetic Field & Antenna	**L**	**T**	**P**	**C**
Year	II	**Semester**	IV	3	0	0	3
Pre-Requisite	PY101	**Co-requisite**					
Course Objectives	• To understand the basic concepts of vector algebra with it's use in the electromagnetic field theory and study of electrostatic fields with its application. • To understand the concepts of magneto static fields with the associated laws and analyses the magneto static field applications in the electric instruments. • To understand the concept of EM wave with its propagation in different medium. Also understand the power, losses (attenuation and phase constant), intrinsic impedance and associated constants for the EM wave • To understand the concept of radiation, antenna definitions and significance of antenna parameters and • derivation and analysis of radiation characteristics of Hertzian dipole antennas. • To understand the concept of uniform and non-uniform arrays, radiation pattern of endfire, broadside, collinear and parasitic array and derivation and analysis of Array Factor, HPBW and BWFN of antenna arrays						

Course Outcomes	
CO1	Define and recognize different co-ordinate systems and techniques of vector calculus to understand different concepts of electrostatic field theory
CO2	Understand the concept of static magnetic field with associated parameters and use of these parameters in different electric devices.
CO3	Examine the phenomena of wave propagation in different media and its interfaces and in applications of microwave engineering.
CO4	Student will have the depth knowledge of principle of electromagnetic radiation, antenna characteristics, parameters and will be able to deduce the electric fields and magnetic fields radiated by a alternating current element /Hertzian dipole antenna
CO5	Student will be able to understand and design the concept of antenna array and will be able to do the analyze /recognize the radiation pattern.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction to Electromagnetic Fields	Vector Calculus, Co-Ordinate systems, Gradient, Divergence and curl, Gauss Theorem, Stoke's Theorem, Electric Field due to Point Charges, electrostatic Potential, Solution of Laplace and Poisson's equation in one dimension, methods of Images applied to plain boundaries, Electric flux Density, Boundary conditions, Electrostatic Energy, Electromagnetic Field Radiation: Radiation from an oscillating current element, short monopole and dipole, half wave dipole, Radiation Pattern, Power Radiated, Radiation Resistance	8	CO-1
2	Magneto-static Fields	Ampere law of force, Magnetic flux density, Ampere's circuital law, Boundary conditions, Faraday's Law, Energy stored in magnetic fields, Continuity equation, Displacement current, Maxwell's equations	8	CO-2
3	Time-Varying Fields	Plane wave equation and its solution in conducting and non-conducting media. Phasor notation, phase velocity, group velocity, Depth of penetration, conductors and dielectrics, Reflection and refraction of plane waves at plane boundaries, Poynting vectors, and Poynting theorem	8	CO-3
4	Antenna Terminology and Antenna Arrays	Antenna Terminology: Antenna theorems, Supervisions, Reciprocity, Isotropic Radiator, Directive gain, Power Gain, Efficiency, Effective Area, Effective Length, Bandwidth, Beam width & Polarization, Directional pattern, Directivities, Effective Length Antenna Impedance. Antenna Arrays: Uniform Linear Arrays, Broad side, End fire, Collinear, Parasitic arrays, Binomial arrays, Pattern multiplication.	8	CO-4
5	Practical Antenna	Practical Antenna: VLF, LF, & MF Transmitting antennas, Vertical Radiator, Effect of ground, Grounded Antennas, Grounding systems, Effect of Antenna Height, Antenna Top Loading and tuning, Antenna Array in MF Band. Antenna coupling at medium frequency	8	CO-5

Text Book:

1. M. N. O. Sadiku, "Elements of Electromagnetics", 4th Edition, Oxford University Press, India.

Reference Books:

1. Nathan Ida, "Engineering Electromagnetism", Second Edition, Springer India Private Limited. Rakesh Singh Kshetrimayum, "Electromagnetic Field Theory", Cengage Learning India Publication, First Edition, 2012.
2. 1. Jordan E. C. and Balmain K. G., Electromagnetic Waves and Radiating Systems, Prentice Hall, Reprint, 2010 2. Hayt Jr. William

H, Engineering Electromagnetics, McGraw Hill.
e-Learning Source:
1. https://nptel.ac.in/courses/108104087
2. https://nptel.ac.in/courses/108106073
3. https://nptel.ac.in/courses/115101005

PO- PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	3	3	1	1	2	1					1	3	3	3	2
CO2	3	3	1	1	2	1					1	3	3	3	2
CO3	3	3	1	1	2	1		2				3	3	3	2
CO4	3	3	1	1	2			2				3	3	3	2
CO5	3	3	2	1	2			2				3	3	3	2

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

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

Department of Electronics & Communication Engineering, Integral University, Lucknow

Effective from Session: 2025-26							
Course Code	EC256	**Title of the Course**	Mini Project	**L**	**T**	**P**	**C**
Year	II	**Semester**	IV	0	0	2	1
Pre-Requisite		**Co-requisite**					
Course Objectives	• Introduce students to basic electronic system design. • Enhance hands-on skills using tools like Proteus, Multisim, and breadboards. • Develop teamwork and communication through small-group project work. • Help students learn how to write project reports and give presentations.						

Course Outcomes	
CO1	Recall basic concepts of electronics and instrumentation relevant to prototype development.
CO2	Understand the working principles of components used in electronic circuits.
CO3	Apply theoretical knowledge to design and simulate basic electronic circuits.
CO4	Analyze errors and performance of small systems using measurement tools.
CO5	Design, build, and present a working prototype along with a technical report.

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)														
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	3		2		1					2	1	2	1		
CO2	3	1	2		1					2	1	1	2		
CO3	3	2	2	1	1					2	1	1	2		
CO4	3	2	1	2	1					2	2	1	1		
CO5	3	2	1	1	1					2	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: 2025-2026							
Course Code	BM226	**Title of the Course**	Human Values & Professional Ethics	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	**IV**	**2**	**0**	**0**	**0**
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	• To help students understand the importance of human values and ethics in professional and personal life. • To develop a sense of social and environmental responsibility. • To enhance decision-making capabilities based on moral values and professional ethics. • To create awareness about the ethical responsibilities of engineers towards society. • To equip students with tools to handle ethical dilemmas in the workplace effectively.						

Course Outcomes	
CO1	Develop an understanding of human values, morals, and ethics for professional and personal growth.
CO2	Analyze and apply ethical reasoning in decision-making for professional and social well-being.
CO3	Demonstrate awareness of environmental, social, and sustainability responsibilities in engineering practices.
CO4	Identify ethical dilemmas and implement professional ethics in engineering projects.
CO5	Develop skills for effective communication, teamwork, and leadership while adhering to ethical values.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction to Human Values	Definition, Types of Values, Morals, Ethics, and Character, Need for Ethics in Engineering. Value Education, Self-Exploration. Natural Acceptance and Experiential Validation, Continuous Happiness and Prosperity, Right understanding, Understanding Happiness and Prosperity correctly.	6	CO1
2	Introduction to Ethical Concept	Definition of industrial ethics and values, Ethical rules of industrial worker. Values and Value Judgments. Moral Rights and Moral rules, Moral character and responsibilities. Privacy, Confidentiality, Intellectual Property and the Law. Ethics as Law.	6	CO2
3	Corporate Social Responsibility & Sustainability	The basis and scope of Professional Responsibility, Professions and Norms of Professional Conduct, Ethical Standards versus Profession, Culpable mistakes, the Autonomy of professions and codes of ethics. Employee status and Professionalism. Central Professional Role of Engineers in Society, Ethical Theories, Decision Making Frameworks, Conflicts of Interest Environmental and Social Responsibilities, Sustainability, Safety, and Risk Assessment	6	CO3
4	Ethical Dilemmas and Case Studies	Senses of 'Engineering Ethics', variety of moral issues, types of inquiry, moral dilemmas, moral autonomy, Kohlberg's theory, Gilligan's theory, Valuing Time, Case Studies on Professional Ethics, Corporate Misconduct, Whistleblowing	6	CO4
5	Communication and A Glimpse of Life Stories on Leadership with Ethics	Effective Communication, Teamwork, Leadership, and Ethical Conduct. Environmental ethics, computer ethics, weapons development, engineers as managers consulting engineers, engineers as expert witnesses and advisors, moral leadership. Life story of Prophet Mohammad, Mahatma Gandhi, Swami Vivekanand, Marie Curie and Steve Jobs.	6	CO5

Reference Books:

- R. R. Gaur, R. Sangal, G. P. Bagaria, "A Foundation Course in Human Values and Professional Ethics," Excel Books, 2010.
- Govindarajan M., Natarajan S., Senthil Kumar V. S., "Engineering Ethics (Includes Human Values)," PHI Learning, 2013.
- Charles D. Fleddermann, "Engineering Ethics," Pearson Education, 4th Edition, 2012.
- Mike W. Martin, Roland Schinzinger, "Ethics in Engineering," McGraw Hill, 4th Edition, 2013.
- R.S. Naagarazan, "Professional Ethics and Human Values," New Age International, 2006.

e-Learning Source:

https://www.youtube.com/watch?v=XiN8iqJGb48&list=PLFW6lRTa1g83uYgRiZEy_F4pzedPNWpew

https://www.youtube.com/watch?v=vS31O3XfH_0&list=PLyVhmjhvTvDYR2K4FgFYuK2gfUibZG8YA

https://www.youtube.com/watch?v=8gpzLafYPcA

https://www.youtube.com/watch?v=xXyatU-l07w

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

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

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

Department of Electronics & Communication Engineering, Integral University, Lucknow

Effective from Session: 2025-26							
Course Code	EC257	**Title of the Course**	Solar Engineering	**L**	**T**	**P**	**C**
Year	II	**Semester**	IV	**3**	**0**	**0**	**3**
Pre-Requisite		**Co-requisite**					
Course Objectives	• Build the student strong background in the field of Solar Engineering • To understand the basic concept of different types of radiation concepts of • To learn the basic concept of solar system, SPV and Solar cell. • A student will be able to consider solar energy as a means of self-employment and source of income.						

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	Student shall be able understand and how solar panels can be apply it in various field like agriculture, industrial and communication applications.
CO5	Student shall be able understand entrepreneurial skills, and career pathways in the growing green job sector.

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	1
2	Solar Electric conversion	Solar Electric (Direct) conversion, Optical properties of semiconductor, Theory of photovoltaic diode heterogeneous junction, Schottky Diode	8	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	3
4	Solar Module	Silicon solar module, solar panel, concentrating system, Agriculture, domestic, Industrial and telecommunication application	8	4
5	Career Opportunities in Solar Engineering	Introduction to Green Jobs, Key Government Schemes for Skill-Based Green Jobs, Skill India Mission – Green Skill Development Program (GSDP), National Solar Mission – Solar Energy Training & Entrepreneurship, Unnat Jyoti by Affordable LEDs for All (UJALA) – Energy Efficiency Jobs, National Electric Mobility Mission (FAME Scheme) – EV Manufacturing & Maintenance Skills, Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) – Eco-Friendly Employment Opportunities, Startup India & Make in India – Support for Green Startups	8	5

Text 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

Reference Book:

1. 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

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

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

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

Integral University, Lucknow
Department of Electronics & Communication Engineering

Effective from Session:							
Course Code	EC258	**Title of the Course**	Wind Engineering	**L**	**T**	**P**	**C**
Year	II	**Semester**	IV	**3**	**0**	**0**	**3**
Pre-Requisite		**Co-requisite**					
Course Objectives	• Students will understand the basic concepts of wind turbine and types of wind energy conversion systems. • Students will understand the fundamentals of site selection and evaluation of wind speed characteristics. • Students will understand the basics of power electronics components and their classification. • Students will be able to understand the concepts of grid connection and operations of different types of generators. • 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.	8	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.	8	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	8	3
4	**Materials Management**	Grid connected and self-excited induction Generator operation. Constant voltage, Constant frequency Generators. Variable Voltage Variable frequency generation	8	4
5	**Quality Assurance**	Hybrid energy systems: Diesel Generation and Photo-voltaic System. Wind Diesel hybrid system. Wind photo-voltaic system.	8	5

Text/Reference Books:

1. S. N. Bhadra, D. Kastha & S. Banerjee, Wind Electrical Systems, Oxford University Press India, First Edition.
2. Spera, D.A., Wind Turbine Technology: Fundamental concepts of Wind Turbine Engineering, ASME Press, 1994.
3. Duffie, A and Beckmann, W. A., Solar Engineering of Thermal Processes, John Wiley, 1991.
4. 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	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2		1	1					1	3	2	1	
CO2	3	3	3	2	1	1			1		1	3	3	1	
CO3	3	3	3		1	1						2	2	1	
CO4	3	3	3	2	1							3	3		1
CO5	3	3	2	2	2	1						2	2		

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

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

Department of Electronics & Communication Engineering, Integral University, Lucknow

Effective from Session: 2025-26							
Course Code	EC259	**Title of the Course**	Quality Control, Assurance & Reliability	**L**	**T**	**P**	**C**
Year	II	**Semester**	IV	3	0	0	3
Pre-Requisite		**Co-requisite**					
Course Objectives	1. This course presents an exposition to the modern thoughts on quality and related practices. The principles and techniques for quality control, based on statistical methods and the procedures for quality assurance are covered. 2. Tools for quality engineering and quality management are dealt in detail. Concepts of reliability and methods to improve product and systems reliability are also covered. 3. The course is tailored to enable students to become successful managers in a sustained manner, thereby provide support to the business houses in their never ending quest for quality.						

Course Outcomes	
CO1	Understand the modern concepts, principles, and practices of quality and their role in business success.
CO2	Apply statistical methods and techniques for quality control in real-world scenarios.
CO3	Implement quality assurance practices and processes to meet business and customer needs.
CO4	Utilize tools and techniques for quality engineering and management to address industrial challenges.
CO5	Evaluate and enhance product and system reliability using established reliability engineering methods.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Philosophy and Fundamentals	Evolution of quality control, Quality, Quality assurance, Responsibility for quality, Total quality systems, Quality cost, Quality and productivity, Service industries and characteristics, Model for service quality, Deming's philosophy, Crosby's philosophy, Juran's philosophy, Management commitment, QFD, Innovative adoption and performance evaluation, Tools for continuous improvement, international standards.	8	1
2	Statistical Foundations and Methods of Quality Improvement	Descriptive statistics, Probability distributions, Inferential statistics, Concepts in sampling, Frequency distributions and Histograms, Run charts, Stem and leaf plots, Pareto diagram, Cause-and-effect diagram, Normal probability plot, Scatter diagrams, Multivariable charts.	8	2
3	Statistical Process Control-I	Causes of variation, Statistical basis for control charts, Selection of rational samples, Analysis of patterns, Selection of characteristics for investigation, Control chart for mean and range, Control chart for mean and standard deviation, Other control charts.	8	3
4	Statistical Process Control-II	Charts for proportion nonconforming, Charts for number of nonconformities, Chart for number of nonconformities per unit, Chart for demerits per unit, Process capability analysis, Process capability indices, procedures for setting tolerances on assemblies and components.	8	4
5	Reliability	Introduction to reliability, System reliability, Reliability and life testing plans.	8	5

Text Books:

1.Mitra A., Fundamentals of Quality Control and Improvement, Pearson Education, 2nd Edition, 2001.

Reference Books:

1. Gryna, F. M., Chua, R. C. H. and Defeo, J. A., Juran's Quality Planning and Analysis for Enterprise Quality, Tata McGraw Hill, 5th Edition, 2007.

2.Montgomery, D. C., Introduction to Statistical Quality Control, John Wiley & Sons, 4th Edition, 2003.

3.Kapur, K. and Lamberson, L., Introduction to Reliability Engineering, John Wiley & Sons, 2nd Edition, 1989.

4.Montgomery, D.C., Design and Analysis of Experiments, John Wiley & Sons, 3rd Edition, 2000.

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

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

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

Department of Electronics & Communication Engineering, Integral University, Lucknow

Effective from Session: 2025-26							
Course Code	EC260	**Title of the Course**	Critical Thinking, Problem Solving, and Innovation	**L**	**T**	**P**	**C**
Year	II	**Semester**	IV	3	0	0	3
Pre-Requisite		**Co-requisite**					
Course Objectives	• Develop students' ability to think critically and independently. • Introduce design thinking as a human-centered problem-solving methodology. • Encourage innovation and creativity in engineering contexts. • Provide tools for evaluating arguments, identifying fallacies, and effective decision-making.						

Course Outcomes	
CO1	Understand the fundamentals of critical thinking and identify emotional, social, and cognitive barriers that hinder rational and open-minded thinking.
CO2	Evaluate arguments using logical reasoning, identify common fallacies, and apply structured critical analysis to real-world and technical problems.
CO3	Apply design thinking principles such as empathy, ideation, and prototyping to solve user-centric problems in engineering contexts.
CO4	Demonstrate creativity and innovation by using idea-generation tools and analyzing real-world applications in the field of Electronics and Communication.
CO5	Integrate critical and design thinking in collaborative projects, communicate solutions effectively, and reflect on the learning process for improvement.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction to Critical Thinking	What is Critical Thinking? Obstacles to Critical Thinking (ego, conformity, self-deception), Emotions vs. Reason in Thinking, The Role of Open-mindedness, Developing Intellectual Humility	8	1
2	Evaluating Arguments and Reasoning Logically	Identifying and Evaluating Arguments, Deductive vs. Inductive Reasoning, Common Logical Fallacies, Using Evidence and Identifying Bias, Constructing Well-reasoned Positions	8	2
3	Introduction to Design Thinking Process	Definition and History of Design Thinking, Empathy and Problem Identification, Ideation and Brainstorming Techniques, Prototyping and Iterative Thinking, Human-Centered Design	8	3
4	Innovation in Engineering and ECE Contexts	What is Innovation? Types of Innovation, Creativity Techniques (SCAMPER, Mind Mapping, TRIZ basics), Case Studies in ECE Innovations (IoT, Embedded Systems, Wireless Technologies), Barriers to Innovation and How to Overcome Them, Ethical Considerations in Innovation	8	4
5	Applying Critical and Design Thinking in Real-World Projects	Integrating Critical Thinking with Design Thinking, Project-Based Problem Solving, Collaborative Thinking and Team Innovation, Pitching and Communicating Ideas, Reflective Thinking and Continuous Improvement	8	5

Text Books:

1. Ruggiero, V. R. (2022). Beyond Feelings: A Guide to Critical Thinking (10th ed.). Cengage Learning India Pvt. Ltd.

Reference Books:

1. Kelley, T., & Kelley, D. (2013). Creative Confidence. Crown Business.
2. Brown, T. (2009). Change by Design. Harper Business.
3. Facione, P. A. (2015). Critical Thinking: What It Is and Why It Counts. Insight Assessment.

PO-PSO CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	3	1	1	2	1					1	3	3	3	2
CO2	3	3	1	1	2	1					1	3	3	3	2
CO3	3	3	1	1	2	1		2				3	3	3	2
CO4	3	3	1	1	2			2				3	3	3	2
CO5	3	3	2	1	2			2				3	3	3	2

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

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