Integral University, Lucknow

Effective from Session: 2020-21							
Course Code	PY201	**Title of the Course**	Circuit Fundamentals and Basic Electronics	**L**	**T**	**P**	**C**
Year	**Second**	**Semester**	Third	**3**	**1**	**0**	**4**
Pre-Requisite	10+2 with Physics	**Co-requisite**					
Course Objectives	1. To understand the basic concepts of Growth and decay of currents through inductive resistances,RC and RLC and explain principle of operation for various AC bridges. 2. To understand the basic concepts of various semi-conductor material. 3. To learn the concept of BJT and feedback amplifier. 4. To understand the basic concepts of oscillators and op-amp. 5. To understand the basic concepts of modulation and learn the working of electronic instruments.						

Course Outcomes	
CO1	Student will be able to solve complex circuit using theorems. Student will be able to measure the passive component through bridges.
CO2	Student will be able to design power supply. Student will be able to differentiate the semiconductor.
CO3	Learn the signal amplification through BJT and how to increase the gain.
CO4	Design the different oscillator circuits for various frequencies Student will be able to design the mathematical operation using op-amp
CO5	Student will be able to 1. Use of different modulation and demodulation techniques used in analog communication 2. Identify and solve basic communication problems 3. Measure the voltage, phase and frequency using CRO 4. Measure the voltage, resistance,current and capacitance using multimeter.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Circuit Fundamentals	Growth and decay of currents through inductive resistances, charging and discharging in R.C. and R.L.C. circuits, Time constant, measurement of high resistance, A.C. Bridges, Maxwell's and Scherings Bridges, Wien Bridge, Thevenin, Norton and superposition theorems and their applications.	8	CO1
2	Theory of Semiconductor	Semiconductors, intrinsic and extrinsic semiconductors, n-type and p-type semiconductors, unbiased diode forward bias and reverse bias diodes, diode as a rectifier, diode characteristics, zener diode, avalanche and zener breakdown, power supplies, rectifier, bridge rectifier, capacitor input filter, voltage regulation, zener regulator.	8	CO2
3	Transistor Basics	Bipolar transistors, three doped regions, forward and reverse bias, DC alpha, DC beta transistor curves. Transistor biasing circuits: base bias, emitter bias and voltage divider bias, DC load line, Basic AC equivalent circuits, low frequency model, small signal amplifiers, common collector amplifiers, and common base amplifiers, current and voltage gain, R.C. coupled amplifier, gain, frequency response, equivalent circuit at low, medium, and high frequencies, feedback principles.	8	CO3
4	Oscillators and OPAMP	Input and output impedance, transistor as an oscillator, general discussion, and theory of Hartley oscillator only. Operational amplifier (black box approach) and its ideal characteristics, virtual ground, inverting and non-inverting amplifiers, adder, integrator, and differentiator	8	CO4
5	Modulation and Instrumentation	Elements of transmission and reception, basic principles of amplitude and frequency modulation and demodulation. Principle and design of linear multimeters and their application, cathode ray oscillograph and its simple applications.	8	CO5

Reference Books:

1. B. G. Streetman; "Solid State Electronic Devices", IInd Edition (Prentice Hall of India, New Delhi, 1986).
2. W.D. Stanley: "Electronic Devices, Circuits and Applications" (Prentice-Hall).
3. J.D. Ryder, "Electronics Fundamentals and Applications" 2nd Edition (Prentice-Hall of India, New Delhi, 1986).
4. Millman and A. Grabel, "Microelectronics", International Edition (McGraw Hill Book Company, New York, 1988).

e-Learning Source:

https://nptel.ac.in

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)										
PO-PSO CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	1	1				1	1		1	
CO2	3	1	1				1		1		
CO3	3	1	1				1	1		1	
CO4	3	1	1				1				
CO5	3	1	1				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: 2020-21							
Course Code	PY202	**Title of the Course**	**Kinetic Theory and Thermodynamics**	**L**	**T**	**P**	**C**
Year	**Second**	**Semester**	Third	**3**	**1**	**0**	**4**
Pre-Requisite	10+2 with Physics	**Co-requisite**					
Course Objectives	To provide the basic knowledge of ideal and real gases, thermodynamics of a system, basic principles and their applications, thermodynamic potentials, heat engine and theory of radiation and to give the students a thorough understanding of the kinetic theory of gases.						

Course Outcomes	
CO1	Students will gain an understanding of the basic properties of ideal and real gases like equation of state related to these gases.
CO2	Students will be able to develop a deep understanding of various transport phenomena in ideal and real gases and temperature dependence properties.
CO3	Students will be able to understand basic laws of thermodynamics methods and their effects, working of ideal and real engine.
CO4	Students will be able to develop a deep understanding of various thermodynamic potentials, effect and heat equation of various thermodynamic systems.
CO5	Students will be able to gain knowledge of theory of Radiation and basic laws of radiation.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Ideal and Real Gases	**Ideal Gas**: Kinetic model, deduction of Boyle's law, interpretation of temperature, estimation of r.m.s. speeds of molecules, Brownian motion, estimate of the Avogadro number, equipartition of energy, specific heat of monatomic gas, extension to di- and triatomic gases, adiabatic expansion of an ideal gas. **Real Gas:** Vander Waals gas, equation of state, nature of Van der Waals forces, comparison with experimental P-V curves, Joule expansion of ideal gas and of a Vander Waals gas, Joule coefficient.	8	CO1
2	Liquefaction of Gases and Transport phenomenon	**Liquefaction of gases:** Boyle temperature and inversion temperature, principle of regenerative cooling and of cascade cooling, liquefaction of hydrogen and helium gas, Refrigeration cycles, meaning of efficiency. **Transport phenomena in gases:** Molecular collisions mean free path and collision cross sections. Transport of mass, momentum and energy and interrelationship.	8	CO2
3	The Laws of Thermodynamics	The zeroth law, various indicator diagrams, work done by and on the system, first law of thermodynamics, internal energy as a state function and other applications, Reversible and irreversible changes, Carnot cycle and its efficiency, Carnot theorem and the second law of thermodynamics, different versions of the second law, Entropy, principle of increase of entropy, third law of thermodynamics, impossibility of attaining the absolute zero, Seebeck, Peltier and Thomson effect.	8	CO3
4	Thermodynamic Potentials	**Thermodynamic variables:** Extensive and intensive, Enthalpy, Gibbs, Helmholtz and internal energy functions. Maxwell's thermo dynamical relations & applications - Joule-Thompson Effect, Clausius-Clapeyron heat Equation, Expression for ($C_P - C_V$), C_P/C_V, TdS equations.	8	CO4
5	Theory of Radiation	Blackbody radiation, pure temperature dependence, Stefan-Boltzmann law, pressure of radiation, spectral distribution of Black body radiation. Wien's displacement law, Rayleigh-Jean's law, Planck's law the ultra-violet catastrophy.	8	CO5

Reference Books:

1. G. G. Agarwal and H.P. Sinha "Thermal Physics".
2. S. K. Agarwal and B.K. Agarwal "Thermal Physics".
3. M.W. Zemansky, "Heat and thermodynamics" (6th Edition McGraw Hill).

e-Learning Source:

1. https://www.youtube.com/watch?v=AKyJwI5jkjs
2. https://www.youtube.com/watch?v=ju7akwzEmAw
3. https://www.youtube.com/watch?v=4G_dLx4M76A

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)										
PO-PSO CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2	1			3	2	1	2	1	3
CO2	3	2	1			3	2	2	3	1	1
CO3	3	1	1			3	2	3	1	2	2
CO4	3	1				3	2	3	2	3	1
CO5	3	1	1			3	2	2	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: 2020-21							
Course Code	PY203	**Title of the Course**	**Electronics and Thermal Physics Lab**	**L**	**T**	**P**	**C**
Year	**Second**	**Semester**	Third	**0**	**0**	**6**	**3**
Pre-Requisite	10+2 with Physics	**Co-requisite**					
Course Objectives	The purpose of this undergraduate course is to impart practical knowledge of the electronics and thermal physics through different experiments related to its theoretical course.						

Course Outcomes	
CO1	To analyze the two basic semiconductor devices (PN Junction and Zener Diode) graphically.
CO2	To Study the characteristics of transistor in different configurations and its application as an amplifier and oscillator in a circuit.
CO3	To understand the functioning of different components used in a regulated power supply.
CO4	To evaluate the value of Stefan's constant for a body and also analyze the behaviour of a thermocouple.
CO5	To practically calculate the mechanical equivalent of heat of a substance in liquid state.

Experiment No.	**Title of the Experiment**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	RC Coupled Amplifier	To study the frequency response of RC coupled amplifier.	6	CO2
2	PN Junction Diode	To draw the characteristic of PN junction diode.	6	CO1
3	Transistor Characteristics	To study the characteristics of a transistor in CE, CB and CC configurations.	6	CO2
4	Regulated Power Supply	To study of Regulated Power Supply.	6	CO3
5	Hartley Oscillator	To calibrate an oscillator (Hartley/Phase shift) using CRO	6	CO2
6	Zener Diode	To draw the characteristic of a Zener diode.	6	CO1
7	Stefan's Constant	Determination of Stefan's constant.	6	CO4
8	Thermocouple	To study the characteristics of a thermocouple.	6	CO4
9	Callender and Barne's Method	To determine the mechanical equivalent of heat by Callender and Barne's constant flow method.	6	CO5
10	Joule's Calorimeter	To find the mechanical equivalent of heat using Joule's calorimeter.	6	CO5

Reference Books:

1. Practical Physics. by R. K. Shukla, New Age International Private Limited; Third edition.
2. B.Sc. Practical Physics by Harnam Singh and Hemme, S. Chand.
3. B. Sc. Practical Physics by CL Arora, S Chand & Company.
4. Practical Physics by Kumar P.R.S., Prentice Hall India Learning Private Limited

e-Learning Source:

1. https://youtu.be/SsR-MlQBqCg
2. https://youtu.be/3l0uZwxjRV4
3. https://youtu.be/0hJ2Hpm8oj8
4. https://youtu.be/00_lbv2LDS8

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)										
PO-PSO CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	3	2		2	1	1	1	2	1	3
CO2	2	2	3		3	2	2	2	3	1	1
CO3	3	3	2		2	1	1	3	1	2	2
CO4	1	2	3		1	2	2	3	2	3	1
CO5	3	1	1	1	2	3	2	2	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: 2020-21							
Course Code	**EC221**	**Title of the Course**	**LOGIC DEVELOPMENT AND PROGRAMMING**	**L**	**T**	**P**	**C**
Year	**Second**	**Semester**	**Third**	3	1	0	4
Pre-Requisite	NA	**Co-requisite**	NA				
Course Objectives	To provide basic understanding of logic development and its execution through programming languages. To provide the basic knowledge of current IT act, security system and concepts of banking systems and reservations.						

Course Outcomes	
CO1	Given a problem, students shall be able to identify various solutions in a step-by-step form through rigorous brainstorming, apply the principles of problem solving techniques to rule out the best solution, and formulate mathematical approaches to solve simple programs like factorial of a number, find prime numbers, etc
CO2	Understand the concepts of various data representations techniques and apply it encode data in different formats and develop codes of their own for data encryption.
CO3	For a given problem, student shall be able to analyze and evaluate solution in a compiler based IDE like turbo C++ and apply the concept of loops to simplify large chunks of programs and estimate the best solution. The student shall also be able to demonstrate the ability to correct, test and debug programs.
CO4	Students shall be able to apply the concept of hardware description language and develop VHDL codes for various combinational circuits and sequential circuits and the learners shall also be able to analyze the circuits using test waveforms
CO5	Understand the concept of IT Awareness and System Security, firewalls, antivirus, Cyber crimes and cyber law and apply the ethical use of computer and technology in Income Tax, Reservations and Banking

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Problem Solving	Notion of algorithms, stepwise methodology of developing an algorithm, developing macros in spreadsheet.	10	1
2	Data Representation	Binary representation of integers and real numbers, 1's Complement, 2's Complement, Addition and subtraction of binary numbers, BCD, ASCII, Unicode.	8	2
3	Programming using C/ C++	Basic data types; constants and variables, arithmetic and logical expressions, inputoutput methods, control structures, procedural abstractions, strings and arrays, command line arguments, basic file handling, error handling	8	3
4	Introduction to hardware languages	VHDL, VERILOG (Introduction and basic programming).	8	4
5	General Awareness	IT Act, System Security (virus/firewall etc.) I-Tax, Reservations, Banking.	6	5

Reference Books:

1. Mano M Morris, Digital Logic and Computer Design, Pearson Education India
2. G.K.Kharate, Digital Electronics, Oxford University Press India.
3. Yashwant Kanitkar, Let Us C, BPB Publications

e-Learning Source:

1. Principles of Programming Languages (https://nptel.ac.in/courses/106102067)

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

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

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

Integral University, Lucknow

Effective from Session: 2020-21							
Course Code	**EC 222**	**Title of the Course**	**ELECTRONICS CIRCUITS**	**L**	**T**	**P**	**C**
Year	**Second**	**Semester**	**Third**	**3**	**1**	**0**	**4**
Pre-Requisite	10+2 Physics	**Co-requisite**					
Course Objectives	To understand the concepts of diodes, transistors, feedback, oscillators and their applications.						

CourseOutcomes	
CO1	Ability to calculate the depletion width, charge density, charge carrier life time, electric field intensity in the depletion width under the all three conditions (No bias, Forward bias & Reverse bias).
CO2	Ability to calculate the operation mode of the BJT in different biasing configuration.
CO3	Ability to draw the output characteristics of the different biasing configuration of the MSOFET and their applications.
CO4	Ability to design and calculate the different types of feedback networks.
CO5	Ability to design the different types of oscillators as per the requirements.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Diodes	PN Junction Diode- application oriented diode characteristics, simple dc circuit applications, space charge and the diode capacitances, switching characteristics, Tunnel diode, Varactor Diode, Photo diode.	8	CO1
2	Bipolar Junction Transistor	Early effect, Ebers-Moll Model, biasing the BJT for discrete circuit design, Bias compensation, small signal and low frequency analysis of BJT amplifier, Darlington pair, cascode amplifier, bootstrapping circuits. Classification of Amplifiers: Class A, B, C amplifiers, Coupling methods, Audio Amplifiers, Wide band amplifier, Power amplifier.	8	CO2
3	MOSFET	Review of device structure, operation & V- I characteristics, Ohmic and saturation region equations. Classification of MOS (NMOS, PMOS, CMOS, principle of working and comparison) MOSFET as an amplifier and switch, biasing of MOS amplifier circuit, MOS internal capacitance and high frequency model (CS configuration only).	8	CO3
4	Feedback Amplifiers	Basic concept of feedback, General Characteristics of negative feedback amplifiers, Classification of feedback, Voltage/Current shunt and series feedback, stability of feedback amplifiers.	8	CO4
5	Oscillators	Condition for oscillation, generalized form of oscillator circuit, The phase shift oscillator, Hartley & Colpitts oscillator, The Wein Bridge oscillator, Crystal oscillator, frequency stability. Regulated Power Supplies: Series/Shunt voltage regulator, Monolithic regulators, SMPS, UPS (block diagram).	8	CO5

Reference Books:

1. Millman &Halkias/ Integrated Electronics / McGraw-Hill Education India.
2. Shilling & Belove/ Electronic Circuit/ McGraw-Hill Education India.
3. Streetman, B.G. Banerjee, Sanjay/ Solid State Electronic Devices/ PHI.
4. Sedra, and Smith, / Microelectronic Circuits/ Oxford University Press India/ 5th Edition.

e-Learning Source:

1. https://archive.nptel.ac.in/courses/115/102/115102014/
2. https://nptel.ac.in/courses/108107142
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**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	3	3	3		3	1	1						1	2	2			
CO2		3	3	2	2	1							3		2	2		
CO3	3		3		2	1								2	1	3		
CO4		3	3	2	1										1	3		
CO5	3	3		2	1								2	2	1			

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

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

Integral University, Lucknow

Effective from Session: 2020-21							
Course Code	EC223	**Title of the Course**	Logic Development and Programming Lab	**L**	**T**	**P**	**C**
Year	Second	**Semester**	Third	**0**	**0**	**4**	**2**
Pre-Requisite	12th with Physics and Mathematics	**Co-requisite**	Knowledge of Programming				
Course Objectives	The course introduces students to the theoretical and practical knowledge of programming using C programming language as an implementation tool. It aims at providing students with understanding of programming essentials, pseudo codes and algorithms, data types, elementary control structures and functions used within the framework of imperative and structural programming paradigms.						

Course Outcomes	
CO1	Understand and describe the structure of a C program to explain, write, compile and execute programs using input and output statements.
CO2	Classify and write programs by applying the decision control statements and loop control statements using different operators.
CO3	Formulate, analyze and solve the problem by writing programs using pointers, arrays and strings.
CO4	Design object based programs by creating new data type using structure and union.
CO5	Design the VHDL code for the different combinational logic circuits

Experiment No.	**Title of the Experiment**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Factorial Number Program**	**(a)** Write a program in C/C++ to display the factorial of a number if n<8. **(b)** Write a program in C/C++ to display the factorial of a number if n>8.	4	CO1
2	**Palindrome Program**	Write a program in C/C++ to accept a number display the same reverse and also check if it is a palindrome number	4	CO1
3	**Prime Number Program**	Write a program in C/C++ to display all prime numbers between 0 and 100.	4	CO2
4	**Display Pattern Program**	Write a program in C/C++ to display the fallowing pattern: * 1 * * 1 2 * * * 1 2 3 * * * * 1 2 3 4	4	CO2
5	**Simple Calculator Program**	Write a program menu drive program to make a simple calculator using switch case.	4	CO3
6	**Sorting in Ascending Order Program**	Write a program in C/C++ to accept 'n' numbers in an array and sort them in ascending order.	4	CO3
7	**Sum of Matrix Program**	Write a program in C/C++ to accept two matrices of order m * n and display their sum of in another matrix.	4	CO4
8	**Product of Matrix Program**	Write a program in C/C++ to accept two matrices of order n * n and display their product.	4	CO4
9	**VHDL Code for different Logic Gates**	Write a VHDL code on Xilinx for AND Gate, OR Gate, NOT Gate & XOR Gate, also simulate the same with test waveforms to verify its truth table.	4	CO5
10	**VHDL Code for Half and Full Adder**	Write a VHDL code on Xilinx for half adder and full adder & simulate the same with test waveforms to verify its Truth Tables.	4	CO5

Reference Books:

1. Brian W. Kernighan Dennis M. Ritchie, The C Programming Language, Prentice Hall of India.
2. E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill.
3. R. G. Dromey, How to Solve it by Computer, Prentice-Hall of India

e-Learning Source:

PDS notes @IIT KGP

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)										
PO-PSO CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2	1		3	1	1	1		1	3
CO2	3	1	1		2	2	3	2		1	3
CO3	3	2	2		3	3	2	3		2	3
CO4	3	2	1		1	2	3	3		3	3
CO5	3	2	1		3	1	2	2		1	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: 2020-21							
Course Code	MT211	**Title of the Course**	**NUMERICAL COMPUTING**	**L**	**T**	**P**	**C**
Year	**Second**	**Semester**	Third	3	1	0	**4**
Pre-Requisite	10+2 with Mathematics	**Co-requisite**					
Course Objectives	The course is aimed to develop the skills in mathematics especially in Numerical Computing which is necessary for grooming them into successful science graduate. The topics introduced will serve as basic tools for specialized studies in science field.						

Course Outcomes	
CO1	Apply numerical methods to find the solution of algebraic and transcendental equations using different methods under different conditions, and numerical solution of system of algebraic equations
CO2	Apply different interpolation methods and finite difference concepts
CO3	Apply central interpolation methods and interpolation techniques for unequal intervals
CO4	Work out numerical differentiation and integration whenever and wherever routine methods are not applicable.
CO5	Work numerically on the ordinary differential equations using different method through the theory of finite differences.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1		**Solution of Algebraic and Transcendental Equations:** Bisection Method, Method of False Position, Iteration Method, Secant Method, Newton-Raphson's Method and their convergence. **Linear System of Equations:** LU decomposition Method, Gauss- Seidel Method.	8	1
2		**Finite Differences:** Forward and Backward Difference Operators, Difference Table, Shift and Averaging operators, Relation between Operators, Factorial polynomials. **Interpolation:** Polynomial interpolation, Newton-Gregory forward and backward interpolation formulae.	8	2
3		**Central Interpolation:** Gauss forward and backward formula, Stirling's, Bessel's and Laplace-Everett's formulae. **Interpolation for Unequal Intervals:** Lagrange's interpolation formula, divided differences and Newton's divided difference interpolation formula.	8	3
4		**Numerical Differentiation and Integration:** Numerical differentiation and errors in Numerical differentiation, Newton-Cotes formula, Trapezoidal rule, Simpson's rule, Boole's, Weddle's and Euler Maclaurin's formulae.	8	4
5		**Numerical Solutions of Ordinary Differential Equations:** Picard's and Taylor's Series, Euler's Method, Runge-Kutta fourth order Method, Solution of Boundary value problem by finite difference Method .	8	5

Reference Books:

1. Qazi Shoeb Ahmad, Zubair Khan and Shadab Ahmad Khan, Numerical and Statistical Techniques, Ane Books India, 2015**.**
2. M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, 7th Ed., New Age International Publishers, 2007.
3. Numerical Methods by P. Kandasamy, S. Chand Publication, New Delhi.
4. Introduction to Numerical Analysis, by S.S. Sastry, Prentice Hall of India.

e-Learning Source:

1. https://www.youtube.com/watch?v=_f_Pu7t9eP8
2. https://www.youtube.com/watch?v=3B3lGO7wERE
3. https://www.youtube.com/watch?v=1g0G_kjA560&list=PLq-Gm0yRYwTguDcfylj1ZicXxzdZCAr5S&index=4
4. https://www.youtube.com/watch?v=K193avJMCd4&list=PLq-Gm0yRYwTguDcfylj1ZicXxzdZCAr5S&index=5

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

PO-PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	1	3	3	3	1	3	2	1	3
CO2	3	2	2	1	2	2	2	2	3	1	2	2
CO3	3	2	3	1	3	2	3	1	2	2	2	3
CO4	3	2	3	1	3	3	2	3	1	2	1	2
CO5	3	2	1	1	3	2	1	2	1	3	2	1

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

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

Integral University, Lucknow

Effective from Session: 2020-21							
Course Code	**MT212**	**Title of the Course**	**Numerical Technique Lab**	**L**	**T**	**P**	**C**
Year	**Second**	**Semester**	**Third**	**0**	**0**	**4**	**2**
Pre-Requisite	10+2 with Mathematics	**Co-requisite**					
Course Objectives	1. The aim of this course is to introduce and develop basic concepts of C to apply in the programming for Numerical methods. 2. This course is aimed to provide an understanding to write a program of the numerical solutions of algebraic and transcendental equations, Interpolation, Solution of differential equations and numerical Integration in C.						

Course Outcomes	
CO1	Understand the basic concepts of C- language for computer programming.
CO2	Able to write a program in C for numerical solutions of algebraic and transcendental equations.
CO3	Able to write a program in C for interpolation.
CO4	Able to write a program in C for numerical solution of ODE.
CO5	Able to write a program in C for numerical integration.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1		Write a program in C for numerical solutions of algebraic and transcendental equations using Bisection Method.	4	1
2		Write a program in C for numerical solutions of algebraic and transcendental equations using False Position Method.	4	1
3		Write a program in C for numerical solutions of algebraic and transcendental equations using Iteration Method.	4	2
4		Write a program in C for numerical solutions of algebraic and transcendental equations using Iteration Method.	4	2
5		Write a program in C for numerical solutions of algebraic and transcendental equations using Newton Raphson Method.	4	3
6		Write a program in C for interpolation by Newton-Gregory Forward interpolation formula.	4	3
7		Write a program in C for interpolation by Lagrange's interpolation formula.	4	4
8		Write a program in C for numerical integration using Trapezoidal rule.	4	4
9		Write a program in C for numerical integration using Simpson's rules.	4	5
10		Write a program in C for numerical solution of O.D.E. using Euler's Method.	4	5

Reference Books:

1. Programming in ANSI C fifth edition by E. Balagurusamy, Tata Mc Graw Hill, Education private limited, New Delhi.
2. Computer Based Numerical Techniques by Santosh Kumar, S. Chand & company, NewDelhi.
3. Computer Based Numerical & Statistical Techniques by Dr. Manish Goyal, University Science Press, New Delhi.
4. Programming in ANSI C fifth edition by E. Balagurusamy, Tata Mc Graw Hill, Education private limited, New Delhi.

e-Learning Source:

1. https://www.youtube.com/watch?v=3j0c_FhOt5U
2. https://www.youtube.com/watch?v=FliKUWUVrEI
3. https://www.youtube.com/watch?v=7eHuQXMCOvA
4. https://www.youtube.com/watch?v=3j0c_FhOt5U

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

PO-PSO CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	**3**	**1**	**1**	**1**	**2**	**1**	**1**	**1**	**3**	**2**	**1**	**3**
CO2	**3**	**1**	**2**	**1**	**3**	**1**	**2**	**2**	**3**	**1**	**2**	**2**
CO3	**3**	**1**	**2**	**1**	**3**	**1**	**1**	**1**	**2**	**2**	**2**	**3**
CO4	**3**	**2**	**1**	**1**	**2**	**1**	**2**	**3**	**1**	**2**	**1**	**2**
CO5	**3**	**1**	**1**	**1**	**2**	**1**	**1**	**2**	**1**	**3**	**2**	**1**

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

Integral University, Lucknow

Effective from Session: 2020-21							
Course Code	PY204	**Title of the Course**	**Electricity and Magnetism**	**L**	**T**	**P**	**C**
Year	**Second**	**Semester**	Fourth	**3**	**1**	**0**	**4**
Pre-Requisite	10+2 with Physics	**Co-requisite**					
Course Objectives	The purpose of this undergraduate course is to impart basic and key knowledge of electricity and magnetism. By using the principles of physics and mathematics, student will be able to obtain quantitative relations which are very important for higher studies. After successful completion, of course, the student will able explore subject into their respective dimensions.						

Course Outcomes	
CO1	To learn basic mathematical tools with their physical significance as a prerequisite for the course.
CO2	To understand and explain the principles/methods of evaluation of electric field, potential due to charge distribution and apply them to practical systems.
CO3	To learn the principles and methods of evaluation of magnetic field and scalar magnetic potential due to due to current or magnetic dipoles. Thereby apply them to analyse magnetic properties of dia, para and ferromagnetic materials.
CO4	To describe the principles of electromagnetic induction and study the devices based upon, to investigate their experimental working.
CO5	To formulate Maxwell's equations and apply them to investigate the propagation of electromagnetic waves in free space, dielectric and conducting medium.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Vector Analysis & Electrostatics I	Review of vector algebra (Scalar and Vector product), gradient, divergence, Curl and their physical significance, vector integration, electrostatic field, electric flux, Coulomb's law, electric field and potentials, Field due to a uniform charged sphere, derivations of Poisson and Laplace Equations with applications,Uniqueness theorem.	8	CO1
2	Electrostatics II	Gauss law and its application: The Field of a conductor, electric dipole, field and potential due to an electric dipole, Dipole approximation for an arbitrary charge distribution, method of electrical images, electric quadruple, field due to a quadruple, electrostatic energy of a charged uniform sphere, energy of a condenser.	8	CO2
3	Magnetostatics and Magnetic Properties of Materials	Magnetic field and force of a current, Magnetic Induction and Biot-Savart Law, Lorentz Force, Vector and Scalar Magnetic potentials, Magnetic Dipole, Magnetomotive force and Ampere's Circuital theorem and its applications to calculate magnetic field due to wire carrying current and solenoid. Intensity of magnetization and magnetic susceptibility, Properties of Dia, Para and Ferromagnetic materials, Curie temperature, Hysteresis and its experimental determination	8	CO3
4	Electromagnetic Induction	Faraday's laws of electromagnetic induction, Lenz's law, self-inductance (L) of single coil, mutual inductance (M) of two coils, Energy stored in magnetic field. Motion of electron in changing magnetic field, Betatron, Magnetic energy, induced magnetic field (Time varying electric field), theory and working of moving coil ballistic galvanometer.	8	CO4
5	Maxwell's Equations and Electromagnetic Waves	Idea of displacement current and Maxwell's modification of Ampere's law, Integral and differential forms of Maxwell's equations and their physical significance, skin effect. The wave:(equation satisfied by E and B, plane electromagnetic waves in vacuum), Poynting vector, reflection at a plane boundary of dielectrics, EM waves in a conducting medium, reflection and refraction by the ionosphere.	8	CO5

Reference Books:

1. Berkeley Physics Course; Electricity and Magnetism, Ed. E.M. Purcell (McGraw Hill).
2. D. J. Griffith; "Introduction to Electrodynamics" (Prentice-Hall ofIndia).
3. Reitz and Milford; "Electricity and Magnetism (Addison-Wesley).
4. S. Mahajan and A. A. Rangwala; "Electricity and Magnetism" (Tata McGraw-Hill).
5. M. Portis; "Electromagnetic Fields".
6. Pugh and Pugh; "Principles of Electricity and Magnetism" (Addison-Welsley).
7. Panofsky and Phillips; "Classical Electricity and Magnetism" (India BookHouse),
8. S. S. Atwood; "Electricity and Magnetism" (Dover).

e-Learning Source:

1. https://nptel.ac.in/courses/115104088/
2. http://library.iul.ac.in/ELibrary.aspx
3. https://www.youtube.com/watch?v=XJYY4jlwZzo
4. https://www.youtube.com/user/imperialcollegevideo/search?query=eric+laithwaite

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)										
PO-PSO CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2	1		2	1	1	1	2	1	3
CO2	2	3	1		2	2	3	2	3	1	1
CO3	3	1	2		2	1	1	3	1	2	2
CO4	2	2	3		1	3	2	3	2	3	1
CO5	3	1	2		2	1	1	2	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: 2020-21							
Course Code	PY205	**Title of the Course**	**Electricity and Magnetism Lab**	**L**	**T**	**P**	**C**
Year	**Second**	**Semester**	Fourth	**0**	**0**	**6**	**3**
Pre-Requisite	10+2 with Physics	**Co-requisite**					
Course Objectives	The purpose of this undergraduate course is to impart practical knowledge/measurements in electricity and magnetism through different experiments related to its theoretical course.						

Course Outcomes	
CO1	Determine the energy band gap of a given semiconductor.
CO2	Measurement of high and low resistance and capacitance of a capacitor.
CO3	Determine the coefficient of self and mutual inductance between two given coils.
CO4	Study the characteristics of Ballistic Galvanometer.
CO5	Measurement of capacity of capacitor and study the characteristic of a choke

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	B.G. Characteristics	Study of characteristics of a ballistic Galvanometer.	6	CO1
2	Carey-Foster Bridge	Measurement of low resistance by Carey-Foster Bridge	6	CO2
3	Inductance using Impedance	Measurement of inductance using impedance at different frequencies.	6	CO3
4	Energy Band Gap	Determination of energy band gap of a semiconductor using p-n junction diode.	6	CO1
5	'R' by Leakage	To measure high Resistance by the method of Leakage of a condenser.	6	CO2
6	Mutual Induction	To determine the coefficient of Mutual Inductance between two coils.	6	CO3
7	Self Induction	To determine the coefficient of Self Inductance of a single coil.	6	CO3
8	Absolute Method	To determine the capacity of condenser by absolute method.	6	CO5
9	Study of Choke Coil	To study of characteristic of a choke.	6	CO5
10	Anderson Bridge	Measurement of inductance by Anderson's bridge.	6	CO3

Reference Books:

1. Practical Physics by R. K. Shukla, New Age International Private Limited; Third edition.
2. B. Sc. Practical Physics by Harnam Singh and Hemme, S. Chand.
3. B. Sc. Practical Physics by CL Arora, S Chand & Company.
4. Practical Physics by Kumar P.R.S., Prentice Hall India Learning Private Limited

e-Learning Source:

1. https://www.exploratorium.edu/snacks/subject/electricity-and-magnetism
2. https://ocw.mit.edu/courses/physics/8-02-physics-ii-electricity-and-magnetism-spring-2007/experiments/
3. www.youtube.com
4. http://www.rossnazirullah.com/BSc/BSc.htm

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

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

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

Integral University, Lucknow

Effective from Session: 2020-21							
Course Code	EC224	**Title of the Course**	Signal Processing	**L**	**T**	**P**	**C**
Year	**Second**	**Semester**	Fourth	**3**	**1**	**0**	**4**
Pre-Requisite	10+2 with Physics and Mathematics	**Co-requisite**	Basic knowledge of Fourier and Laplace transformation				
Course Objectives	**To Familiarize Signals and Systems behavior to signals.**						

Course Outcomes	
CO1	Realization of the basic principles of signal processing systems.
CO2	Analysis techniques and system performance evaluation
CO3	Perceptions of the LTI system to understand more practical systems.
CO4	Correlation between analog world and digital processing principles.
CO5	Comprehensive conclusions from solutions

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Signals and systems	Fundamentals of signals, classification, Basic Signals, plotting, modelling, operations on signals, on dependant and indepenantvariables, Convolution of signals, discrete and continuous, System, properties, LTI systems, Differential and Difference equation for systems, system solution system response.	8	CO1
2	Fourier analysis	Fourier series representation of periodic signals, Fourier Transform of aperiodic signals, common signal FT, properties, Frequency and phase response of LTI systems, Frequency selective systems - filter aspects, Filter approximation - Butterworth LP.	8	CO2
3	Sampling and discretization	Sampling benefits, considerations,sampling of continuous signals, alliasing and plotting of sampled signals,natural sampling, pulse sampling, types,sampling rate change, up sampling, discrete time processing of continuous signal.	8	CO3
4	FFT and applications	Introduction to discrete time fourier transform, DTFT applications, FR and PR of DTFT of signals, introduction to DFT, computation of simple signals, FFT computation examples, FFT: Algorithms, FIR filter, fourier series approximation method, basic examples, IIR filters, bilinear transformation, examples.	8	CO4
5	Discrete LTI systems	Introduction to z-transform of discrete signals,z-transform computation of signals, inverse z-transform, simple examples, applications,LTI system characterization,system response to discrete inputs, examples,introduction to one sided z transform,system response with initial condition	8	CO5

Reference Books:

1. Signals & Systems by Alan V. Oppenheim, Alan S. Willsky, S. Hamid Nawab, 2nd Edition, Pearson Publications
2. Signals and Systems by A. Anand Kumar, 3rd Edition, Prentice Hall India Publications
3. Signals and Systems by Simon Haykin and Barry Van Veen, 2nd Edition, Wiley India Publications

e-Learning Source:

1. https://archive.nptel.ac.in/courses/117/105/117105149/
2. https://archive.nptel.ac.in/courses/108/106/108106163/
3. https://archive.nptel.ac.in/courses/108/104/108104100/

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
PO-PSO CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO4**	**PSO5**	**PSO6**	**PSO7**
CO1	3	3	2	1	1	1	1	2	1	3	3	3	3	2			1	
CO2	3	3	3	2	1	1	1	1	2	3	3	2	3	2			1	
CO3	2	3	1	2	1	1	2	2	1	3	3	3	3	3	2		2	
CO4	2	2	1	3	2	2	3	1	2	3	2	2	3	3	3		2	1
CO5	3	1	2	2	2	2	1	1	3	3	2	2	3	3	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: 2020-21							
Course Code	**EC 225**	**Title of the Course**	**Analog & Digital Communication**	**L**	**T**	**P**	**C**
Year	**Second**	**Semester**	Fourth	**3**	**1**	**0**	**4**
Pre-Requisite	10+2 with Physics	**Co-requisite**					
Course Objectives	1. To Understand basic elements of a communication system. 2. To understand the concept of analysis of baseband signals in time domain and in frequency domain. 3. To understand the various analog and digital modulation and demodulation techniques. 4. To analyze the performance of modulation and demodulation techniques in various transmission environments.						

Course Outcomes	
CO1	Understand the different blocks in communication system & amplitude modulation schemes with their advantages, disadvantages and applications.
CO2	Use of different modulation and demodulation techniques used in angle modulation.
CO3	Use of different modulation and demodulation techniques in pulse code modulation.
CO4	knowledge of statistical theory of digital communication and explain the different schemes of keying.
CO5	knowledge of signals and system and evaluate the performance of digital communication system in the presence of noise and describe the error control codes like block code, cyclic code.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Block diagram of an electronic communication system	Block diagram of an electronic communication system, need for modulation, concept of channels and base-band signals. Amplitude modulation: modulation index, frequency spectrum, generation of AM (balanced modulator), Amplitude Demodulation (diode detector) Other forms of AM: Double side band suppressed carrier (DSBSC), Single side band suppressed carrier (SSBSC), Vestigial Side Band modulation (VSB). Super Heterodyne Receiver.	8	CO1
2	Angle Modulation	Frequency and Phase modulation, modulation index and frequency spectrum, Generation of FM (direct and indirect methods), FM detector (slope detector). Noise: External noise, Internal Noise, Noise Figure, Calculation of Noise Resistance. Pulse Analog Modulation: Introduction on Pulse Amplitude Modulation (PAM), Pulse Width Modulation (PWM) and Pulse Position Modulation (PPM).	8	CO2
3	Pulse Code Modulation	Need for digital transmission, Companding, Coding, Bit Error Rate, Quantization noise, Differential Pulse Code Modulation (DPCM), Delta Modulation (DM), Adaptive Delta Modulation (ADM). Time Division Multiplexing (TDM).	8	CO3
4	Digital Carrier Modulation Techniques	Block diagram of digital transmission and reception. Information capacity, Bit Rate, Baud Rate. Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), Phase Shift Keying (PSK), Binary Phase Shift Keying (BPSK) and Quadrature Phase Shift Keying (QPSK).	8	CO4
5	Error Control Coding	Concept on Linear Block Code, Cyclic Code and Convolutional Code. Multiple Access Techniques: Concept of Frequency Division Multiple Access (FDMA), Code Division Multiple Access (CDMA).	8	CO5

Reference Books:

1. Simon Haykin/Communication System/ Wiley India.
2. BP Lathi/Modern Analog Digital communication/Oxford University Press India.
3. Taub & Schilling/ Principles of communication System/McGraw-Hill Education India.
4. J. F. Kennedy/Electronic communication System/McGraw-Hill Education India.

e-Learning Source:

1. https://nptel.ac.in/courses/117105143
2. https://nptel.ac.in/courses/117101051
3. https://nptel.ac.in/courses/117105077
4. https://nptel.ac.in/courses/108102120

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

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	2		2		2						1	3	2	1		
CO2			1		3	2							3	1	1	2		
CO3		2		1	1		2						3	2	1	3		
CO4	3		1		2	2							3	2	2	3		
CO5	3	1		2	3	1							3	2				

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

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

Integral University, Lucknow

Effective from Session: 2020-21							
Course Code	EC 226	**Title of the Course**	**Analog & Digital Communication Lab**	**L**	**T**	**P**	**C**
Year	**Second**	**Semester**	Fourth	**0**	**0**	**4**	**2**
Pre-Requisite	10+2 with Physics	**Co-requisite**					
Course Objectives	The purpose of this undergraduate course is to impart practical knowledge of various modulation and demodulation schemes used in analog and digital data transmission.						

Course Outcomes	
CO1	The ability to design analog modulation circuits as amplitude, frequency and phase modulation.
CO2	The ability to design various pulse modulation techniques as PAM, PPM, PWM.
CO3	The ability to design pass delta modulation techniques with desired specifications.
CO4	The ability to design pulse code modulation systems and techniques with desired specifications.
CO5	The ability to design the multiplexing schemes in communication.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Exp-01**	Generation of Amplitude Modulation and its Demodulation	4	CO1
2	**Exp-02**	Generation of of Frequency Modulation/ Demodulation	4	CO1
3	**Exp-03**	Study of Single Side Band Modulation/ Demodulation	4	CO2
4	**Exp-04**	Study of Pulse Amplitude Modulation	4	CO2
5	**Exp-05**	Study of Pulse Width Modulation.	4	CO3
6	**Exp-06**	Study of Pulse Position Modulation.	4	CO3
7	**Exp-07**	Study of Delta Modulation.	4	CO4
8	**Exp-08**	Study of Pulse Code Modulation.	4	CO4
9	**Exp-09**	Study of Frequency Shift Keying.	4	CO5
10	**Exp-10**	Study of Time Division Multiplexing.	4	CO5

Reference Books:

1. Analog and Digital Communications - Theory and Lab Work by Ajay Gandhi.
2. B.Sc. Practical Physics by Harnam Singh and Hemne, S. Chand.
3. Practical Physics by Kumar P.R.S., Prentice Hall India Learning Private Limited

e-Learning Source:

1. https://cloud.scilab.in/
2. Virtual labs
3. www.youtube.com
4. http://www.rossnazirullah.com/BSc/BSc.html.

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

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

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

Integral University, Lucknow

Effective from Session: 2017-18							
Course Code	MT213	**Title of the Course**	**Tensor Analysis**	**L**	**T**	**P**	**C**
Year	**Second**	**Semester**	Third	3	1	0	4
Pre-Requisite	10+2 with Mathematics	**Co-requisite**					
Course Objectives	The purpose of this undergraduate course is to impart basic and key knowledge of tensors and their types & properties. Students will also be able to apply addition, subtraction, multiplication on tensors. After successful completion of course, the student will be able to explore subject into their respective dimensions.						

Course Outcomes	
CO1	Students will be able to understand Vector Spaces, dual spaces, tensor product of vector spaces, and also about transformation formulae for tensors.
CO2	Students will gain an understand of Tensors and their types: Contravariant and covariant vectors and tensors, mixed tensors, Symmetric and skewsymmetric tensors, Associated tensors, Reciprocal tensors.
CO3	Students will be able to learn and implement Algebra of tensors, Contraction and inner product. They will also study about Quotient law & Riemannian metric tensor
CO4	Students will create the own understanding of Christoffel Symbols. They will learn covariant differentiation of tensors and also study about Gradient, divergence and curl in tensor notation.
CO5	Students will gain an understanding of The fundamental theorem of local Riemannian geometry, Differential operators, curvature tensor, Geodesics, geodesics coordinate system, geometrical interpretation of the curvature tensor.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1		Vector Spaces, dual spaces, tensor product of vector spaces, transformation formulae.	8	1
2		Tensor, Contravariant and covariant vectors and tensors, mixed tensors, Symmetric and skewsymmetric tensors, Associated tensors	8	2
3		Algebra of tensors, Contraction and inner product, Quotient law, Reciprocal tensors, Riemannian metric tensor	8	3
4		Christoffel Symbols, covariant differentiation, Gradient, divergence and curl in tensor notation.	8	4
5		The fundamental theorem of local Riemannian geometry, Differential operators, curvature tensor, Geodesics, geodesics coordinate system, geometrical interpretation of the curvature tensor.	8	5

Reference Books:

1. Tensor Calculus, Zafar Ahsan, Anamaya Publication, New Delhi.
2. Differential Geometry of manifolds, U. C. De & A. A. Shaikh, Narosa Publishing House Pvt. Ltd, 2007.
3. Schaum's Outlines of Tensor Calculus.
4. Tensor Calculus & Riemannian Geometry, D.C. Agarwal, Krishna Publications

e-Learning Source:

1. https://cosmolearning.org/video-lectures
2. https://content.kopykitab.com/ebooks/2016/02/5649/sample/sample_5649.pdf
3. https://www.win.tue.nl/casa/education/AntWiskDict/_3/e.%20Algebra,%20Meetkunde%20en%20Discrete%20Wiskunde/TENSOR--Dictaat-2004-Partial%20Translation.pdf
4. https://cosmolearning.org/video-lectures

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

PO-PSO CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	2	2	1	1	1	2	1	3	2	1	3
CO2	3	1	2	1	1	1	2	2	3	1	2	2
CO3	3	1	2	1	1	1	2	1	2	2	2	3
CO4	3	1	2	1	1	1	2	3	1	2	1	2
CO5	3	1	2	1	1	1	2	2	1	3	2	1

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

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

Integral University, Lucknow

Effective from Session: 2017-18							
Course Code	MT214	**Title of the Course**	**Abstract Algebra**	**L**	**T**	**P**	**C**
Year	**Second**	**Semester**	Third	3	1	0	4
Pre-Requisite	10+2 with Mathematics	**Co-requisite**					
Course Objectives	The objective is to introduce the basic concept to the subject of algebra. The course deals with the some algebraic structures namely groups, rings, fields and some related structures. Abstract algebra enables students to build mathematical thinking and skill.						

Course Outcomes	
CO1	Students will be able to explain the fundamental concept of Group and its well behaved subsets.
CO2	Students will be able to describe fundamental properties of Ring and its related structures.
CO3	Students will be an understanding of Elementary row operations and their applications to solution of a system of linear equations.
CO4	Students will be able to describe Vector spaces and its properties.
CO5	Students will be able to explain Linear transformation and its properties as well as applications.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1		Group, homomorphism, isomorphism, conjugacy relation, normalizer, centre of group.	8	1
2		Ring, ring homomorphism, ideals, integral domain, introduction to field.	8	2
3		Elementary row operations and row-reduced echelon form, inverse of a matrix through elementary row operation, solution of a system of linear equations.	8	3
4		Vector spaces, Subspaces, Span of a set, Linear dependence and independence, Dimension and basis.	8	4
5		Linear transformation and their matrix representation, rank nullity theorem.	8	5

Reference Books:

1. University Algebra by N.S. Gopalakrishnan,New Age International publishing house, New Delhi.
2. Modern Algebra by Surjeet Singh, Vikas Publishing House Pvt. Ltd., New Delhi.
3. An introduction to Linear Algebra by V. Krishnamurthy, V.P. Mainra & J. L. Arora, East West Press Pvt. Ltd., New Delhi.

e-Learning Source:

1. https://nptel.ac.in/courses/111/105/111105112/
2. https://nptel.ac.in/courses/111/101/111101115/

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

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	1	2	3	1	3	1	3	2	1	3
CO2	3	2	2	2	3	1	2	2	3	1	2	2
CO3	3	2	2	2	2	1	2	1	2	2	2	3
CO4	3	2	2	2	2	1	3	3	1	2	1	2
CO5	3	2	1	2	3	1	2	2	1	3	2	1

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

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