Integral University, Lucknow
Department of Mathematics
Study and Evaluation Scheme(w.e.f 2020-21)

B. Sc. (Physics, Mathematics, Statistics) **II[nd] year / III[rd] Semester**

S. No.	Course code	Course Title	Type of Paper	Period Per hr/week/sem			Evaluation Scheme				Sub. Total	Credit	Total Credits	Attributes							SDG
				L	T	P	CT	TA	Total	ESE				Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics	
THEORIES																					
1	PY201	Circuit Fundamentals & Basic Electronics	Core	3	1	0	40	20	60	40	100	3:1:0	4	√		√					
2	PY202	Kinetic Theory & Thermodynamics	Core	3	1	0	40	20	60	40	100	3:1:0	4	√		√					
3	MT216	Sampling Techniques	Core	2	1	0	40	20	60	40	100	2:1:0	3	√		√				√	
4	MT217	Testing of Hypothesis	Core	3	1	0	40	20	60	40	100	3:1:0	4	√		√				√	
5	MT211	Numerical Computing	Core	3	1	0	40	20	60	40	100	3:1:0	4	√		√					
PRACTICAL																					
6	PY203	Electronics and Thermal Physics Lab	Practical	0	0	4	40	20	60	40	100	0:0:2	2	√		√					
7	MT218	Sampling Techniques Lab	Practical	0	0	4	40	20	60	40	100	0:0:2	2	√		√				√	
8	MT212	Numerical Computing Lab	Practical	0	0	4	40	20	60	40	100	0:0:2	2	√		√					
			Total	14	5	12	320	160	480	320	800	**25**	**25**								

CT = Class Test; **TA** = Teacher's Assessment,; **ESE** = End Semester Examination; **Sessional** = CT + TA; **Subject Total** = Sessional + ESE

Integral University, Lucknow

Effective from Session:							
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	Basic Electronics	**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	1
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	2
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	3
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	4
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	5

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).

5. Bollested, R. and Nashelksky, L. “Electronic Devices and Circuit Theory” (Prentice Hall).
e-Learning Source:
1. **https://nptel.ac.in**
2. **www.youtube.com**

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO4	PSO5	PSO6	PSO7
CO1	3	1	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**	
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 energyandinterrelationship.	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,TdSequations.	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 theultra-violetcatastrophy.	8	CO5

Reference Books:

G. G. Agarwal and H.P. Sinha "Thermal Physics".

S. K. Agarwal and B.K. Agarwal "Thermal Physics".

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: 2019-20							
Course Code	**MT216**	**Title of the Course**	**Sampling Techniques**	**L**	**T**	**P**	**C**
Year	**Second**	**Semester**	Third	**2**	**1**	**0**	**3**
Pre-Requisite	10+2 with Mathematics	**Co-requisite**					
Course Objectives	Understand the importance of sampling and how results from samples can be used to provide estimates of population characteristics such as the population mean the population standard deviation and / or the population proportion. Learn about a variety of sampling methods including stratified random sampling, cluster sampling, systematic sampling, convenience sampling and judgment sampling.						

Course Outcomes	
CO1	Able to define and describe Concepts of population, sample, parameter and statistic, sampling versus complete enumeration, sampling units and frame, advantages of sampling methods, bias, precision and accuracy, sampling and non-sampling errors, Probability and non-probability sampling.
CO2	Able to define and explain Simple random sampling: Simple random sampling (SRS) with and without replacement, use of random number table in selection of SRS, estimation of population mean and proportion, derivation of expression for variance of these estimates, estimates of variance. Determination of sample size.
CO3	Able to describe and derive Stratified random sampling: estimation of population mean & variance of the estimate of population mean of stratified random sampling, allocation of sample size, proportional allocation, optimum & Neyman allocation, comparison of stratified random sampling with simple random sampling.
CO4	To describe Systematic sampling: estimation of population mean and population total, standard errors of these estimators. Cluster sampling with equal cluster, estimation of population mean and their mean squared error.
CO5	To define Non probability sampling: Introduction to Convenience Sampling, Consecutive Sampling, Quota Sampling, Judgmental Sampling, and Snowball Sampling.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1		Introduction: Concepts of population, sample, parameter and statistic, sampling versus complete enumeration, sampling units and frame, advantages of sampling methods, bias, precision and accuracy, sampling and non-sampling errors, Probability and non-probability sampling.	6	1
2		Simple random sampling: Simple random sampling (SRS) with and without replacement, use of random number table in selection of SRS, estimation of population mean and proportion, derivation of expression for variance of these estimates, estimates of variance. Determination of sample size.	6	2
3		Stratified random sampling: estimation of population mean & variance of the estimate of population mean of stratified random sampling, allocation of sample size, proportional allocation, optimum & Neyman allocation, comparison of stratified random sampling with simple random sampling.	6	3
4		Systematic sampling: estimation of population mean and population total, standard errors of these estimators. Cluster sampling with equal cluster, estimation of population mean and their mean squared error.	6	4
5		Non probability sampling: Introduction to Convenience Sampling, Consecutive Sampling, Quota Sampling, Judgmental Sampling, Snowball Sampling..	6	5

Reference Books:

1. Sampling techniques: W.G. Cochran, Wiley
2. Sampling methodologies and applications: P.S.R.S. Rao, Chapman and Hall/CRC 2000
3. Elements of sampling theory and methods: Z. Govindrajalu, Prentice Hall, 1999.
4. Sampling: P. Mukhopadhyay, Prentice Hall of India, 1998.
5. Theory of sample surveys with applications: P.V.Sukhatme, B.V.Sukhatme, S. Sukhatme and C. Asok, IASRI, Delhi, 1984.
6. Sampling Techniques: Daroga Singh & Chaudhry, F.S New age International

e-Learning Source:

1. https://www.youtube.com/watch?v=be9e-Q-jC-0
2. https://www.youtube.com/watch?v=bQ5_PPRPjG4
3. https://www.youtube.com/watch?v=jauhoR7w1YM

	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	**2**	**3**	**3**	**2**	**3**	**2**	**3**	3	3	2	3	3
CO2	**2**	**2**	**3**	**3**	**2**	**2**	**2**	**2**	3	3	3	2
CO3	**2**	**3**	**3**	**2**	**3**	**2**	**3**	3	3	2	2	3
CO4	**3**	**3**	**2**	**3**	**3**	**2**	**2**	3	2	2	3	3
CO5	**2**	**2**	**3**	**2**	**2**	**3**	**2**	3	3	3	3	3

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

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

Integral University, Lucknow

Effective from Session: 2019-20							
Course Code	**MT217**	**Title of the Course**	**Descriptive Statistics**	**L**	**T**	**P**	**C**
Year	**Second**	**Semester**	Third	**3**	**1**	**0**	**4**
Pre-Requisite	10+2 with Mathematics	**Co-requisite**					
Course Objectives	To make the students understand the concept of hypothesis, concept of testing of hypothesis, large- and small-scale sample tests for ordinal and ratio scale data and concept of Analysis of Variance. Also to teach non-parametric tests to test the hypothesis.						

Course Outcomes	
CO1	Clear understanding of concepts of Null and Alternative hypothesis and its type. Critical region, errors in testing, confidence interval and MP and UMP test.
CO2	Students may learn to apply z-test for large samples. F, t and paired t tests for small samples.
CO3	Tests of proportions, tests of association and goodness-of-fit using Chi-square. Test for categorical data and Yates correction.
CO4	Application of one way and two way ANOVA, chi square test for variance, goodness of fit and independence of attributes.
CO5	To perform one sample and two sample non-parametric tests.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1		Statistical Hypothesis: Concepts of Null and alternative hypothesis, Simple and composite hypothesis, Degree of freedom, Critical Regions, Types of errors, Level of Significance, Size and power of the test, Confidence interval, Most powerful (MP) test, Neymann-Pearson Lemma, UMP test, Simple problems.	8	1
2		Testing of Significance, Large sample and small sample tests, Normal test for mean, variance, proportion and coefficient of correlation, Small sample tests based on t, F for testing mean and variance, Paired t test	8	2
3		Categorical data: Tests of proportions, tests of association and goodness-of-fit using Chi-square test, Yates' correction	8	3
4		Analysis of variance (ANOVA), concept and example, Explanation ANOVA for one way and two, Classifications, Procedures and inference, Chi Square test for Variance, Goodness of fit and independence of attributes.	8	4
5		Non-Parametric test: Test for randomness and test for goodness of fit. One sample tests: sign test, Wilcoxon signed rank tests. Two samples test: Run test, Kolmogorov-Smirnov's test, Median test and Mann-Whitney U test. Spearman's rank correlation test.	8	5

Reference Books:

1. Lehmann, F.L. (1986), Testing of Statistical Hypothesis (Student edition).
2. Hogg, R.V. and Craig, A.T. (1978), Introduction to Mathematical Statistics, Fourth edition, Colliar Macmillan Publishers.
3. Mood, A.M., Gray bill, F.F. and Boes, D.C. (1974), Introduction to the Theory of Statistics, Third Edition, McGraw Hill.
4. Rao, C.R. (1973), Linear Statistical Inference and its Applications, Revised edition, Wiley Eastern Ltd., New Delhi.
5. Goon, A.M., Gupta M.K. & Das Gupta, Fundamentals of statistics, Vol.-I & II (2005).

e-Learning Source:

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

https://www.youtube.com/watch?v=OQyX31iBm74

https://www.youtube.com/watch?v=M1bR2uK5jUc

https://www.youtube.com/watch?v=1HR1ccYV3zI

	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**	**2**	**1**	**3**	**1**	**3**	3	3	2	3	3
CO2	**2**	**1**	**2**	**1**	**3**	**1**	**2**	**2**	3	3	3	2
CO3	**3**	**1**	**2**	**1**	**3**	**1**	**3**	3	3	2	2	3
CO4	**3**	**1**	**2**	**1**	**3**	**1**	**3**	3	2	2	3	3
CO5	**3**	**1**	**2**	**1**	**3**	**1**	**3**	3	3	3	3	3

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

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

Integral University, Lucknow

Effective from Session: 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	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.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Exp-01**	To study the frequency response of RC coupled amplifier.	6	CO2
2	**Exp-02**	To draw the characteristic of PN junction diode.	6	CO1
3	**Exp-03**	To study the characteristics of a transistor in CE, CB and CC configurations.	6	CO2
4	**Exp-04**	To study of Regulated Power Supply.	6	CO3
5	**Exp-05**	To calibrate an oscillator (Hartley/Phase shift) using CRO	6	CO2
6	**Exp-06**	To draw the characteristic of a Zener diode.	6	CO1
7	**Exp-07**	Determination of Stefan's constant.	6	CO4
8	**Exp-08**	To study the characteristics of a thermocouple.	6	CO4
9	**Exp-09**	To determine the mechanical equivalent of heat by Callender and Barne's constant flow method.	6	CO5
10	**Exp-10**	To find the mechanical equivalent of heat using Joule's calorimeter.	6	CO5

Reference Books:

Practical Physics. by R. K. Shukla, New Age International Private Limited; Third edition.

B.Sc. Practical Physics by Harnam Singh and Hemme, S. Chand.

B. Sc. Practical Physics by CL Arora, S Chand & Company.

Practical Physics by Kumar P.R.S., Prentice Hall India Learning Private Limited

e-Learning Source:

https://youtu.be/SsR-MlQBqCg

https://youtu.be/3l0uZwxjRV4

https://youtu.be/0hJ2Hpm8oj8

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	PS04
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: 2019-20							
Course Code	**MT218**	**Title of the Course**	**Sampling Techniques Lab**	**L**	**T**	**P**	**C**
Year	**Second**	**Semester**	Third	**0**	**0**	**4**	**2**
Pre-Requisite	10+2 with Mathematics	**Co-requisite**					
Course Objectives	To teach students the practical implementation of different sampling techniques like SRSWR, SRSWOR, Stratified, Cluster, Systematic sampling.						

Course Outcomes	
CO1	After successful completion of Practical 1 & 2, students will be able to obtain mean and variance of simple random sampling.
CO2	After successful completion of Practical 3 & 4, students will be able obtain mean and variance of stratified random sampling under Neyman Allocation.
CO3	After successful completion of Practical 5 & 6, students will be able obtain mean and variance stratified random sampling under Proportional Allocation.
CO4	After successful completion of Practical 7, students will be able obtain mean and variance of cluster sampling.
CO5	After successful completion of Practical 8 & 9, students will be able obtain mean and variance of systematic sampling.

Experiment No.	**Title of the Experiment**	**Content of Experiment**	**Contact Hrs.**	**Mapped CO**
1		Finding an estimate of the population mean under Simple random sampling	4	1
2		Finding an estimate of Variance of the population under Simple random sampling	4	1
3		Finding an estimate of the population mean under Stratified sampling using Neyman allocation	4	2
4		Finding an estimate of the population variance under Stratified sampling using Neyman allocation	4	2
5		Finding an estimate of the population mean under Stratified sampling using Proportional allocation	4	3
6		Finding an estimate of the population variance under Stratified sampling using Proportional allocation.	4	3
7		Finding an estimate of the Variance of the population under cluster sampling	4	4
8		Finding an estimate of the population mean under Systematic Sampling	6	5
9		Finding an estimate of the population variance under Systematic Sampling	6	5

Reference Books:

1. Cochran, W.G., (1977): Sampling Techniques, 3rd edition, John Wiley.
2. Des Raj and Chandak (1998): Sampling theory, Narosa.
3. Murthy, M.N. (1977): Sampling theory and methods. Statistical Publishing Society, Calcutta.
4. Sukhatme et al. (1984): Sampling theory of surveys with applications, Lowa state university press
5. Singh, D. and Chaudary, F.S. (1986): Theory and analysis of sample survey designs. New age international publishers.

e-Learning Source:

https://www.youtube.com/watch?v=OTVk28caCxw

https://www.youtube.com/watch?v=be9e-Q-jC-0

https://www.youtube.com/watch?v=bQ5_PPRPjG4

https://www.youtube.com/watch?v=jauhoR7w1YM

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

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

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

Integral University, Lucknow

Effective from Session: 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

Department of Mathematics

Study and Evaluation Scheme(w.e.f 2020-21)

B. Sc. (Physics, Mathematics, Statistics) **II[nd] year / IV[th] Semester**

S. No.	Course code	Course Title	Type of Paper	Period Per hr/week/sem			Evaluation Scheme				Sub. Total	Credit	Total Credits	Attributes							SDG
				L	T	P	CT	TA	Total	ESE				Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics	
THEORIES																					
1	PY204	Electricity & Magnetism	Core	3	1	0	40	20	60	40	100	3:1:0	4	√		√		√			
2	MT219	Design of Experiments (DOE)	Core	3	1	0	40	20	60	40	100	3:1:0	4	√		√				√	
3	MT220	Statistical Quality Control (SQC)	Core	3	1	0	40	20	60	40	100	3:1:0	4	√		√				√	
4	MT213	Tensor Analysis	Core	3	1	0	40	20	60	40	100	3:1:0	4	√		√					
5	MT214	Abstract Algebra	Core	3	1	0	40	20	60	40	100	3:1:0	4	√		√					
PRACTICAL																					
6	PY205	Electricity & Magnetism Lab	Practical	0	0	6	40	20	60	40	100	0:0:3	3	√		√					
7	MT221	Design of Experiments & Statistical Quality Control Lab	Practical	0	0	4	40	20	60	40	100	0:0:2	2	√		√				√	
			TOTAL	15	5	10	280	140	420	280	700	25	25								

CT = Class Test; **TA** = Teacher's Assessment,; **ESE** = End Semester Examination; **Sessional** = CT + TA; **Subject Total** = Sessional + ESE

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:

Berkeley Physics Course; Electricity and Magnetism, Ed. E.M. Purcell (McGraw Hill).

D. J. Griffith; "Introduction to Electrodynamics" (Prentice-Hall ofIndia).

Reitz and Milford; "Electricity and Magnetism (Addison-Wesley).

S. Mahajan and A. A. Rangwala; "Electricity and Magnetism" (Tata McGraw-Hill).

M. Portis; "Electromagnetic Fields".

Pugh and Pugh; "Principles of Electricity and Magnetism" (Addison-Welsley).

Panofsky and Phillips; "Classical Electricity and Magnetism" (India BookHouse),

S. S. Atwood; "Electricity and Magnetism" (Dover).

e-Learning Source:

https://nptel.ac.in/courses/115104088/

http://library.iul.ac.in/ELibrary.aspx

https://www.youtube.com/watch?v=XJYY4jlwZzo

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	PS04
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: 2019-20							
Course Code	**MT219**	**Title of the Course**	**Design of Experiments**	**L**	**T**	**P**	**C**
Year	**Second**	**Semester**	Fourth	**3**	**1**	**0**	**4**
Pre-Requisite		**Co-requisite**					
Course Objectives	The course objective is to learn how to plan, design and conduct experiments efficiently and effectively, and analyze the resulting data to obtain objective conclusions. Both design and statistical analysis issues are discussed. Particular attention will be paid to: understanding the process of designing an experiment including factorial and fractional factorial designs; examining how a factorial design allows cost reduction, increases efficiency of experimentation, and reveals the essential nature of a process.						

Course Outcomes	
CO1	To define and describe Experimental designs: Role, historical perspective, terminology, experimental error, basic principles, uniformity trials, fertility contour maps, choice of size and shape of plots and blocks
CO2	To define and explain basic designs: Completely Randomized Design (CRD), Randomized Block Design (RBD), Latin Square Design (LSD) – layout, model and statistical analysis, analysis with one missing observation
CO3	To describe and analysis Factorial experiments: advantages, notations and concepts, 2^2, 2^3, factorial experiments, design and analysis.
CO4	To describe and analysis Fractional factorial experiments: Construction of one-half and one-quarter fractions of 2^n ($n \leq 5$) factorial experiments, principle of confounding (concepts only)
CO5	To describe and analysis 3^2 factorial experiment, need and analysis of split – plot design (two factors only-main plot treatment with RBD layout)

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1		Experimental designs: Role, historical perspective, terminology, experimental error, basic principles, uniformity trials, fertility contour maps, choice of size and shape of plots and blocks	8	1
2		Basic designs: Completely Randomized Design (CRD), Randomized Block Design (RBD), Latin Square Design (LSD) – layout, model and statistical analysis, analysis with one missing observation.	8	2
3		Factorial experiments: advantages, notations and concepts, 2^2, 2^3, factorial experiments, design and analysis.	8	3
4		Fractional factorial experiments: Construction of one-half and one-quarter fractions of 2^n($n \leq 5$) factorial experiments, principle of confounding (concepts only)	8	4
5		3^2factorial experiment, need and analysis of split – plot design (two factors only-main plot treatment with RBD layout)	8	5

Reference Books:

1. Cochran, W.G. and Cox, G.M. (1959): Experimental Design. Asia Publishing House.
2. Das, M.N. and Giri, N.C. (1986): Design and Analysis of Experiments. Wiley Eastern Ltd.
3. Goon, A.M., Gupta, M.K. and Dasgupta, B. (2005): Fundamentals of Statistics. Vol. II, 8thEdn. World Press, Kolkata.
4. Kempthorne, O. (1965): The Design and Analysis of Experiments. John Wiley.
5. Montgomery, D. C. (2008): Design and Analysis of Experiments, John Wiley.
6. Casella G. (2008): Statistical Design, Springer

e-Learning Source:

https://www.moresteam.com/toolbox/design-of-experiments.cfm

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

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

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	**2**	**3**	**3**	**3**	**3**	**2**	**2**	3	3	2	3	3
CO2	**3**	**3**	**3**	**2**	**3**	**2**	**2**	**2**	3	3	3	2
CO3	**3**	**2**	**2**	**2**	**2**	**2**	**2**	3	3	2	2	3
CO4	**3**	**2**	**3**	**2**	**3**	**3**	**3**	3	2	2	3	3
CO5	**3**	**2**	**2**	**2**	**3**	**2**	**2**	3	3	3	3	3

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

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

Integral University, Lucknow

Effective from Session: 2019-20							
Course Code	**MT220**	**Title of the Course**	**Statistical Quality Control**	**L**	**T**	**P**	**C**
Year	**Second**	**Semester**	Fourth	**3**	**1**	**0**	**4**
Pre-Requisite	10+2 with Mathematics	**Co-requisite**					
Course Objectives	To make the students understand the process and product control, sampling plans for the product to maintain the outgoing quality of the product.						

Course Outcomes	
CO1	Clear understanding of concepts process and product quality control, its historical perspective. Construction of control limits
CO2	Understand the control charts for process control using different methods under different attributes.
CO3	Understand Product Control using single, double and sequential sampling plans
CO4	Understand six sigma, Lean manufacturing and organizational structure
CO5	Detailed understanding of SPRT, OC and ASN curves

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1		Quality: Definition, dimensions of quality, historical perspective of statistical quality control. Quality System and standards: Introduction to ISO quality standards. Quality Registration. Statistical Process Control - Seven tools of SPC, chance and assignable Causes of quality variation Statistical Control Charts- Construction and Statistical basis of 3-σ Control charts	8	1
2		Control chart for variables: $\overline{X}$ $\overline{X}$ & R-chart. Control charts for attributes np-chart, p-chart and c-chart. Comparison between control charts for variables and attributes, estimation of process capability.	8	2
3		Acceptance sampling plan Principles of acceptance sampling plans Single and Double sampling plan their OC. AQL LTPD. AOQ. AOL ASN functions, uses and interpretation of Dodge and Romig's sampling inspection plan tables	8	3
4		Introduction to Six Sigma, Overview of Six Sigma, Lean Manufacturing and Total Quality Management (TQM), Organizational Structure and Six Sigma training plans. Selection Criteria for Six- Sigma roles and training plans.	8	4
5		Sequential sampling plan procedure estimation of parameters - OC and ASN curves, comparison between single and double sampling plan.	8	5

Reference Books:

1. Lehmann, F.L.(1986), Testing of Statistical Hypothesis (Student edition).
2. Hogg, R.V. and Craig, A.T. (1978), Introduction to Mathematical Statistics, Fourth edition, Colliar Macmillan Publishers.
3. Mood, A.M., Gray bill, F.F. and Boes, D.C.(1974), Introduction to the Theory of Statistics, Third Edition, McGraw Hill.
4. Rao, C.R. (1973), Linear Statistical Inference and its Applications, Revised edition, Wiley Eastern Ltd., New Delhi.
5. Goon, A.M., Gupta M.K. & Das Gupta, Fundamentals of statistics, Vol.-I & II (2005).

e-Learning Source:

https://www.youtube.com/watch?v=S7PAyQMRmAc

https://www.youtube.com/channel/UCocNOUZ5B1xToXCihKIoX7g

https://www.youtube.com/watch?v=7EKLINTDIdo

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
CO 1	**3**	**2**	**2**	**1**	**3**	**1**	**3**	3	3	2	3	3
CO 2	**2**	**1**	**2**	**1**	**3**	**1**	**2**	**2**	3	3	3	2
CO 3	**3**	**1**	**2**	**1**	**3**	**1**	**3**	3	3	2	2	3
CO 4	**2**	**1**	**2**	**1**	**3**	**1**	**3**	3	2	2	3	3
CO 5	**3**	**1**	**2**	**1**	**3**	**1**	**3**	3	3	3	3	3

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

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

Integral University, Lucknow

Effective from Session: 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**

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	**Exp-01**	Study of characteristics of a ballistic Galvanometer.	6	CO1
2	**Exp-02**	Measurement of low resistance by Carey-Foster Bridge	6	CO2
3	**Exp-03**	Measurement of inductance using impedance at different frequencies.	6	CO3
4	**Exp-04**	Determination of energy band gap of a semiconductor using p-n junction diode.	6	CO1
5	**Exp-05**	To measure high Resistance by the method of Leakage of a condenser.	6	CO2
6	**Exp-06**	To determine the coefficient of Mutual Inductance between two coils.	6	CO3
7	**Exp-07**	To determine the coefficient of Self Inductance of a single coil.	6	CO3
8	**Exp-08**	To determine the capacity of condenser by absolute method.	6	CO5
9	**Exp-09**	To study of characteristic of a choke.	6	CO5
10	**Exp-10**	Measurement of inductance by Anderson's bridge.	6	CO3

Reference Books:

Practical Physics. by R. K. Shukla, New Age International Private Limited; Third edition.

B. Sc . Practical Physics by Harnam Singh and Hemme, S. Chand.

B. Sc. Practical Physics by CL Arora, S Chand & Company.

Practical Physics by Kumar P.R.S., Prentice Hall India Learning Private Limited

e-Learning Source:

https://www.exploratorium.edu/snacks/subject/electricity-and-magnetism

https://ocw.mit.edu/courses/physics/8-02-physics-ii-electricity-and-magnetism-spring-2007/experiments/

www.youtube.com

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	PS04
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: 2019-20							
Course Code	**MT221**	**Title of the Course**	**Design of Experiments & SQC Lab**	**L**	**T**	**P**	**C**
Year	**Second**	**Semester**	Fourth	**0**	**0**	**4**	**2**
Pre-Requisite	10+2 with Mathematics	**Co-requisite**					
Course Objectives	To make the students understand the process and product control, sampling plans for the product to maintain the outgoing quality of the product.						

Course Outcomes	
CO1	After successful completion of Practical 1, students will be able to make design for homogeneous field of experiments.
CO2	After successful completion of Practical 2, students will be able to make design for either vertically or horizontally homogeneous field of experiment.
CO3	After successful completion of Practical 3, students will be able to make design for both vertically and horizontally heterogeneous field of experiment.
CO4	After successful completion of Practical 4, students will be able to make design for various levels of treatments.
CO5	After successful completion of Practical 5, and 6, students will be able to perform process control for quantitative characteristics of product.

Experiment No.	**Title of the Experiment**	**Content of Experiment**	**Contact Hrs.**	**Mapped CO**
1		Practical based on Completely Randomized Design (CRD)	4	1
2		Practical based on Randomized Block Design (RBD)	4	2
3		Practical based on Latin Square Design (LSD)	8	3
4		Practical based on factorial experiments 2^2 & 2^3	8	4
5		Practical based on $\overline{X}$ & R control charts	8	5
6		Practical based on "np", "p" & "c" control charts	8	6

Reference Books:

1. Lehmann, F.L.(1986), Testing of Statistical Hypothesis (Student edition).
2. Hogg, R.V. and Craig, A.T. (1978), Introduction to Mathematical Statistics, Fourth edition, Colliar Macmillan Publishers.
3. Mood, A.M., Gray bill, F.F. and Boes, D.C.(1974), Introduction to the Theory of Statistics, Third Edition, McGraw Hill.
4. Rao, C.R. (1973), Linear Statistical Inference and its Applications, Revised edition, Wiley Eastern Ltd., New Delhi.
5. Goon, A.M., Gupta M.K. & Das Gupta, Fundamentals of statistics, Vol.-I & II (2005).

e-Learning Source:

https://www.youtube.com/watch?v=S7PAyQMRmAc

https://www.youtube.com/channel/UCocNOUZ5B1xToXCihKIoX7g

https://www.youtube.com/watch?v=7EKLINTDIdo

https://www.youtube.com/channel/UCaKzlWMr9DaP7hfxa_6tUBw

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

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

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