Integral University, Lucknow
Department of Mathematics & Statistics
Study & Evaluation Scheme of UG & PG Program with Statistics, Mathematics & Physics as per NEP 2020
w.e.f. Session 2022-23

Diploma in Science (Statistics, Mathematics, Physics) **Year: Second / Semester: Third (Odd Semester)**

S. N.	Course Code	Course Title	Theory / Practical	Course Type	Periods/ Per week			Continuous Assessment			End Semester Examination (ESE)	Subject Total	Total Credit Points	Attributes							United Nations Sustainable Development Goals (SDGs)
					Lecture (L)	Tutorial (T)	Practical (P)	Class Test (CT)	Teacher Assessment (TA)	Total				Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics	
1	B030301T/ MT228	Algebra & Mathematical Methods	Theory	Core Major (Compulsory)	4	2	0	15	10	25	75	100	06	✔		✔					
2	B010301T/ PY207	Electromagnetic Theory & Modern Optics	Theory		3	1	0	15	10	25	75	100	04	✔							
3	B060301T/ MT230	Theory of Estimation & Sampling Survey	Theory		3	1	0	15	10	25	75	100	04	✔		✔				✔	
4	B010302P/ PY208	Demonstrative Aspects of Electricity & Magnetism	Practical		0	0	4	15	10	25	75	100	02	✔		✔					
5	B060302P/ MT231	Sampling Survey Lab	Practical		0	0	4	15	10	25	75	100	02	✔		✔				✔	
6	I030302V/ MT234	Introduction to R	Theory+ Practical	Vocational	2	0	2	-	-	-	100	100	03	✔		✔					
7	Z030301	Human Values and Environment studies	Theory	Co-curricular (Compulsory)	2	0	0	15	10	25	75	100	02	✔	✔	✔		✔	✔	✔	
TOTAL					**14**	**4**	**10**	**90**	**60**	**150**	**550**	**700**	**23**								

Integral University, Lucknow

Department of Mathematics & Statistics

Study & Evaluation Scheme of UG & PG Program with Statistics, Mathematics & Physics as per NEP 2020

w.e.f. Session 2022-23

Diploma in Science (Statistics, Mathematics, Physics) **Year: Second / Semester: Fourth (Even Semester)**

S. N.	Course Code	Course Title	Theory / Practical	Course Type	Periods/ Per week			Continuous Assessment			End Semester Examination (ESE)	Subject Total	Total Credit Points	Attributes							United Nations Sustainable Development Goals (SDGs)
					Lecture (L)	Tutorial (T)	Practical (P)	Class Test (CT)	Teacher Assessment (TA)	Total				Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics	
1	B030401T/ MT229	Differential Equation & Mechanics	Theory	Core Major (Compulsory)	4	2	0	15	10	25	75	100	06	✔		✔					
2	B010401T/ PY209	Perspectives of Modern Physics & Basic Electronics	Theory		3	1	0	15	10	25	75	100	04	✔							
3	B060401T/ MT232	Testing of Hypothesis & Applied Statistics	Theory		3	1	0	15	10	25	75	100	04	✔		✔				✔	
4	B010402P/ PY210	Basic Electronics Instrumentation	Practical		0	0	4	15	10	25	75	100	02	✔		✔					
5	B060402P/ MT233	Test of Significance & Applied Statistics Lab	Practical		0	0	4	15	10	25	75	100	02	✔		✔				✔	
6	LN104T/ME231	Essential Professional Communication / Basic Manufacturing Process	Theory	Minor elective	3	1	0	15	10	25	75	100	04	✔	✔	✔			✔	✔	
7	I030402V/ MT235	Introduction to SPPSS	Theory+ Practical	Vocational	2	0	2	-	-	-	100	100	03	✔		✔					
8	Z040401	Physical Education and Yoga	Theory	Co-curricular (Compulsory)	2	0	0	15	10	25	75	100	02	✔	✔	✔		✔	✔	✔	
				TOTAL	**17**	**5**	**10**	**105**	**70**	**175**	**625**	**800**	**27**								

Integral University, Lucknow

Effective from Session: 2023-24							
Course Code	B030301T/ MT228	**Title of the Course**	Algebra & Mathematical Methods	**L**	**T**	**P**	**C**
Year	Second	**Semester**	Third	**6**	**0**	**0**	**6**
Pre-Requisite	Knowledge of Sets, Relations and Integrations	**Co-requisite**	None				
Course Objectives	The objective of the course is to develop the skills to apply the basic knowledge of Abstract Algebra, Integral Transform and Fourier Series. The course will further develop understanding the concepts of Jacobians, Functionals and their applications. The topics introduced will serve as basic tools for specialized studies in science field. After successfully completion of course, the student will able to explore subject knowledge into their respective dimensions.						

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, Integral Domain and their properties.
CO3	Students will be able to learn function of two variables, Jacobians and their related properties which enable them to check the validity of different kind of transformation from one co-ordinate system to other.
CO4	Develop an understanding of Laplace Transforms, Fourier Series and its applications.
CO5	Students will be able to understand functional, strong and weak variations and their applications.

Unit No.	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
I	Equivalence relations and partitions, Congruence modulo n, Definition of a group with examples and simple properties, Subgroups, Generators of a group, Cyclic groups.	**12**	1
II	Permutation groups, Even and odd permutations, The alternating group, Cayley's theorem, Direct products, Coset decomposition, Lagrange's theorem and its consequences, Fermat and Euler theorems.	**11**	1
III	Normal subgroups, Quotient groups, Homomorphism and isomorphism, Fundamental theorem of group homomorphism, Theorems on isomorphism.	**11**	1
IV	Rings, Subrings, Integral domains and fields, Characteristic of a ring, Ideal and quotient rings, Ring homomorphism, Field of quotient of an integral domain.	**11**	2
V	Limit and Continuity of functions of two variables, Differentiation of function of two variables, Necessary and sufficient condition for differentiability of functions two variables, Schwarz's and Young theorem, Taylor's theorem for functions of two variables with examples, Maxima and minima for functions of two variables, Lagrange multiplier method, Jacobians.	**12**	3
VI	Existence theorems for Laplace transforms, Linearity of Laplace transform and their properties, Laplace transform of the derivatives and integrals of a function, Convolution theorem, inverse Laplace transforms, Solution of the differential equations using Laplace transforms.	**11**	4
VII	Fourier series, Fourier expansion of piecewise monotonic functions, Half and full range expansions, Fourier transforms (finite and infinite), Fourier integral.	**11**	4
VIII	Calculus of variations-Variational problems with fixed boundaries- Euler's equation for functionals containing first order derivative and one independent variable, Extremals, Functionals dependent on higher order derivatives, Functionals dependent on more than one independent variable, Variational problems in parametric form.	**11**	5

Reference Books: Part-A

1. J.B. Fraleigh, A first course in Abstract Algebra, Addison-weley.
2. I. N. Herstein, Topics in Algebra, John Wiley & Sons.
3. Suggested digital plateform: NPTEL/SWAYAM/MOOCS.

Reference Books: Part-B

1. T.M. Apostal, Mathematical Analysis, Person.
2. G.F. Simmons, Differential Equations with Application and Historical Notes, Tata -McGrawHill
3. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
4. Suggested digital plateform:NPTEL/SWAYAM/MOOCs

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	1	2	3	2	3	2	3
CO2	1	-	-	-	-	1	3	2	1	1	2	2
CO3	2	-	1	1	-	-	2	1	3	2	3	1
CO4	2	-	-	-	-	-	1	2	1	1	1	1
CO5	3	1	1	1	-	2	3	2	2	2	1	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: 2023-24							
Course Code	B030401T/MT229	**Title of the Course**	Differential Equations & Mechanics	**L**	**T**	**P**	**C**
Year	Second	**Semester**	Fourth	**6**	**0**	**0**	**6**
Pre-Requisite	Knowledge of Vector Algebra and Integrations	**Co-requisite**	None				
Course Objectives	The purpose of this undergraduate course is to impart basic and key knowledge of analytical solution of ordinary and partial differential equations in closed and infinite series form. The course will further help students to understanding and analysis of motion of a particle in three dimensions under different frame of references. The content of course has various applications. After successfully completion of course, the student will able explore subject into their respective dimensions.						

Course Outcomes

CO1	The students will learn various methods of solving ordinary differential equations of second order and their qualitative applications. They also study some special functions obtained from these equations.
CO2	Students will be able to learn the origin and solution of first order partial differential equations.
CO3	Students will be able to find the solution of second and higher order partial differential equations and their classifications.
CO4	Students will be able to understand forces in three dimensions and their equilibrium. They also study virtual work and develop the ability to know about catenary.
CO5	The students will learn about the motion in two and three dimensions in various mediums. They also understand Kepler's law of motion related to earth rotation.

Unit No.	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
I	Second order linear differential equations with constant and variable coefficients: Use of a known solution to find another, normal form, method of undetermined coefficient, variation of parameters,	**12**	1
II	Series solutions of differential equations, Power series method, Bessel, Legendre and Hypergeometric functions and their properties, recurrence and generating relations.	**11**	1
III	Origin of first order partial differential equation, Partial differential equations of the first order and degree one, Lagrange's solution, Partial differential equation of first order and degree greater than one, Charpit's method of solution, Surfaces orthogonal to the given system of surfaces.	**11**	2
IV	Origin of second order PDE, Solution of partial differential equations of the second and higher order with constant coefficients, Classification of linear partial differential equations of second order, Solution of second order partial differential equations with variable coefficients, Monge's method of solution.	**11**	3
V	Frame of reference, work energy principle, Forces in three dimensions, Poinsot's central axis, Wrenches, Null lines and planes.	**12**	4
VI	Virtual work, Stable and Unstable equilibrium, Catenary, Catenary of uniform strength.	**11**	4
VII	Velocities and accelerations along radial and transverse directions and along tangential and normal directions, Simple Harmonic motion, Motion under other law of forces. Elastic strings, Motion in resisting medium, Constrained motion, Motion on smooth and rough plane curves.	**11**	5
VIII	Motion of particles of varying mass, Rocket motion, Central orbit, Kepler's laws of motion, Motion of particle in three dimensions, Rotating frame of reference, Rotating earth, Acceleration in terms of different coordinates systems.	**11**	5

Suggested Readings(Part-A Differential Equations):

1. G.F. Simmons, Differential Equations with Application and Historical Notes, Tata –McGrawHill.
2. B. Rai, D.P. Choudhary & H. J. Freedman, A Course of Ordinary Differential Equations, Narosa
3. Ian N. Snedden, Elements of Partial Differential Equations, Dover Publication
4. L.E. Elsgolts, Differential Equation and Calculus of Variations, University Press of the Pacific.
5. Suggested digital plateform:NPTEL/SWAYAM/MOOCs

Suggested Readings(Part-B Mechanics):

1. R.C. Hibbeler, Engineering Mechanics-Statics, Prentics Hall Publishers
2. R.C. Hibbeler, Engineering Mechanics-Dynamics, Prentics Hall Publishers
3. A. Nelson, Engineering Mechanics Statics and Dynamics, Tata McGraw Hill
4. J.L. Synge & B.A. Griffith, Principles of Mechanics, Tata McGraw Hill
5. Suggested digital plateform:NPTEL/SWAYAM/MOOCs

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	1	-	1	-	-	3	3	2	3	2	1
CO2	1	1	-	-	-	1	1	2	1	1	2	2
CO3	3	-	-	-	1	-	1	1	3	2	3	1
CO4	1	-	-	1	-	1	2	2	2	1	1	2
CO5	2	1	1	-	-	-	3	2	1	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: 2023-24							
Course Code	B060301T/MT230	**Title of the Course**	Theory of Estimation & Sampling Survey	**L**	**T**	**P**	**C**
Year	Second	**Semester**	Third	**4**	**0**	**0**	**4**
Pre-Requisite	Descriptive statistics	**Co-requisite**					
Course Objectives	To introduce the concept of drawing samples under various sampling schemes also the different methods to estimate the unknown parameters of population						

Course Outcomes

CO1	Knowledge of the concept of Sampling distributions.
CO2	Ability to understand the difference between parameter & statistic and standard error & standard deviation.
CO3	Knowledge of the sampling distribution of the sum and mean & the concept of Point and Interval Estimation and discuss characteristics of a good estimator. Ability to understand the t, F and Chi-square distribution and to identify the main characteristics of these distributions.
CO4	Ability to understand and practice various methods of estimations of parameters & identify the situations where the various sampling techniques shall be used. Knowledge of various probability and non-probability sampling methods along with estimates of population parameters.
CO5	Knowledge of regression and ratio methods of estimation in simple random sampling.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction to Sampling Distribution	Sampling Distributions: The concept of sampling distribution, Parameter, Statistic and Standard error. The sampling distribution for the sum of independent random variables of Binomial, Poisson and Normal distribution.	7	1
2	Some Sampling Distributions	Central limit theorem, sampling distribution of Z. Sampling distribution of t, F and Chi-square without derivations, Simple properties of these distributions and their interrelationship	8	2
3	Point and Interval estimation	Point estimation: Characteristics of a good estimator: Unbiasedness, consistency, sufficiency and efficiency. Problems and examples, Interval estimation.	8	3
4	Estimation Methods	Method of Maximum Likelihood and properties of maximum likelihood estimators (without proof), Method of minimum Chi-square. Method of least squares and methods of moments for estimation of parameters	7	3
5	Introduction to Sampling techniques	Sampling vs. Complete enumeration: Sampling units and Sampling frame, Precision and efficiency of estimators, sampling and non sampling errors, Simple Random sampling with and without replacement, Estimation of population mean and proportion, Derivation of expression for variance of these estimators, Estimation of variances, Sample size determination.	6	4
6	Stratified random sampling	Stratified random sampling, Problem of allocation, proportional allocation, optimum allocation. Derivation of the expressions for the standard error of the usual estimators when these allocations are used, Gain in precision due to Stratification, Role of sampling cost in the sample allocation, Minimization of variance for fixed cost.	8	4
7	Systematic random sampling	Systematic Sampling: Estimation of Population mean and Population total, standard errors of these estimators. Two stage sampling with equal first stage units: Estimation of Population mean and its variance	8	4
8	Regression and ratio methods	Regression and ratio methods of estimation in simple random sampling, Cluster sampling with equal clusters, Estimators of population mean and their mean square errors.	8	5

Reference Books:

1. Ferund J.E (2001) : Mathematical Statistics, Prentice Hall of India.
2. Goon, A.M., Gupta, M.K. & Dasgupta, B.: Fundamentals of Statistics, Vol. I. ,Kolkata, The World Press.
3. Gupta, S.C. and Kapoor, V.K.: Fundamentals of Mathematical Statistics (10^{th} ed.),Sultan Chand and Sons.
4. Hogg, R.V., McKean, J.W. & Craig, A.T: Introduction to Mathematical Statistics, Pearson.
5. Cochran, W.G.: Sampling Techniques. (Third Edition). John Wiley & Sons, New Delhi
6. DesRaj and Chandhok, P. (1998). Sample Survey Theory, Narosa Publishing house.

Suggestive digital platforms web link/platform: NPTEL/SWAYAM/MOOCS

www.simplilearn.com , www.qualtrics.com

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

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO4
CO1	3					1	3	3	2	3	2	3
CO2	3					2	1	3	3	2	2	3
CO3	3					3	3	3	3	3	2	2
CO4	3					3	1	3	2	2	3	3
CO5	3					3	1	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: 2023-24							
Course Code	B060302P/MT231	**Title of the Course**	Sampling Techniques Lab	**L**	**T**	**P**	**C**
Year	Second	**Semester**	Third	**0**	**0**	**4**	**2**
Pre-Requisite		**Co-requisite**					
Course Objectives	To introduce the practical approach to estimate the population parameter under various sampling schemes						

Course Outcomes

CO1	Ability to estimate population means and variance in simple random sampling.
CO2	Ability to deal with problems based on Stratified random sampling for population means (proportional and optimum allocation).
CO3	Ability to deal with problems based on Systematic random sampling and two stage sampling
CO4	Ability to deal with problems based on Ratio and regression estimation of population mean and total
CO5	Ability to deal with problems based on cluster sampling

Experiment No.	Title of the Experiment	Content of Experiment	Contact Hrs.	Mapped CO
1	Simple Random sampling	Problems based on estimation of population mean and variance in simple random sampling.	10	1
2	Stratified random sampling	Problems based on Stratified random sampling for population mean (proportional and optimum allocation).	10	2
3	Systematic random sampling	Problems based on Systematic random sampling	10	3
4	Two stage sampling	Problems based on two stage sampling	10	3
5	Ratio and regression method	Problems based on Ratio and regression estimation of population mean and total.	10	4
6	Cluster sampling	Problems based on cluster sampling	10	5

Reference Books:

Gupta, S.C. and Kapoor, V.K.: Fundamentals of Applied Statistics (10th ed.), Sultan Chand and Sons.

Cochran, W.G.: Sampling Techniques.

Sukhatme, P.V., Sukhatme, B.V., Sukhatme, S. and Asok, C.: Sampling Theory of Surveys with Applications.

e-Learning Source:

Suggestive digital platforms web link/platform: NPTEL/SWAYAM/MOOCS

www.simplilearn.com

www.qualtrics.com

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	3	3	3	3	3	3
CO2	3					2	2	3	2	3	3	2
CO3	3					3	3	3	2	2	2	3
CO4	3					3	2	3	2	2	3	2
CO5	3					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: 2023-24							
Course Code	B060401T/MT232	**Title of the Course**	Testing of Hypothesis & Applied Statistics	**L**	**T**	**P**	**C**
Year	Second	**Semester**	Fourth	**4**	**0**	**0**	**4**
Pre-Requisite		**Co-requisite**					
Course Objectives	To introduce the concepts of the parametric tests of various measures and interpret the result to predict the future events						

Course Outcomes

CO1	Knowledge of the terms like null and alternative hypotheses, two-tailed and one- tailed alternative hypotheses, significant and insignificant, level of significance and confidence, p value etc.
CO2	Ability to understand the concept of MP, UMP and UMPU tests
CO3	Ability to understand under what situations one would conduct the small sample and large sample tests (in case of one sample and two sample tests) and familiarity with different aspects of Applied Statistics and their use in real lifesituations.
CO4	Ability to understand the concept of Time series along with its different component & the concept of Index numbers and their applications along with different types ofIndex numbers. Familiarity with various demographic methods and different measures of mortalityand fertility & understand the concept of life table and its construction.
CO5	Knowledge to understand the concept of statistical quality control and different control charts for variables and attributes.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Statistical Hypothesis	StatisticalHypothesis (Simple and Composite), Testing of hypothesis. Type –I and Type – II errors, Significance level, p-values.	8	1
2	Tests for Statistical Hypothesis	Power of a test, Definitions of Most Powerful (MP), Uniformly Most Powerful (UMP) and Uniformly Most Powerful Unbiased (UMPU) tests.	8	2
3	Large Sample Tests	Test of significance: Large sample tests for (Attributes and Variables) proportions and means (i) for one sample (ii) for two samples Correlation coefficient in case of (a) p=p0 (b) p1=p2,	8	3
4	Small Sample Test	Small sample test based on t, F and Chi-square distributions.	6	3
5	Time Series	Introduction & Definition of Time Series, its different components, illustrations, additive and multiplicative models. Determination of trend by free hand curve, semi average method, moving average method, method of least squares, Analysis of Seasonal Component by Simple average method, Ratio to moving Average Ratio to Trend, Link relative method.	8	4
6	Index Number	Index number: definition, application of index number, price relative and quantity or volume relatives,link and chain relative, problem involved in computation of index number, use of averages, simple aggregative and weighted average method. Laspeyre's, Paasche's and Fisher's index number, time and factor reversal tests of index numbers, consumer price index.	7	4
7	Vital Statistics	Vital Statistics: Measurement of Fertility– Crude birth rate, general fertility rate, age-specific birth rate, total fertility rate, gross reproduction rate, net reproduction rate, standardized death rates Complete life table, its main features and construction.	8	4
8	Statistical Control Charts	Introduction to Statistical Quality Control, Process control, tools of statistical quality control, +3σ control limits, Principle underlying the construction of control charts. Control charts for variables, 'X' and 'R' charts, construction and interpretation, Control charts for attributes 'p' and 'c' charts, construction and interpretation	7	5

Reference Books:

1. Ferund, J.E.: Mathematical Statistics, Prentice Hall of India.
2. Freedman, D., Pisani, R. and Purves, R. : Statistics. 4th Edition. Norton & Comp.
3. Goon, A.M., Gupta, M.K. & Dasgupta, B.: Fundamentals of Statistics, Vol. I,Kolkata, The World Press.
4. Gupta, S.C. and Kapoor, V. K.: Fundamentals of Mathematical Statistics, Sultan Chand and Sons.
5. Hogg, R.V., McKean, J.W. & Craig, A.T.; Introduction to Mathematical Statistics, Pearson.
6. Croxton F.E., Cowden D.J. and Klein, S.: Applied General Statistics, Prentice Hall of India Pvt. Ltd.
7. Gupta, S.C. and Kapoor, V.K.: Fundamentals of Applied Statistics, SultanChand and Sons.
8. Montgomery D.C.: Introduction to Statistical Quality Control, Wiley IndiaPvt. Ltd.

e-Learning Source:

Suggestive digital platforms web link/platform: NPTEL/SWAYAM/MOOCS

www.ustat.toronto.edu , ecoursesonline.iaasri.res.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	PSO4
CO1	3					1	3	3	2	3	2	3
CO2	3					1	1	3	3	2	2	3
CO3	3					3	3	3	3	3	2	2
CO4	3					3	1	3	2	2	3	3
CO5	3					1	1	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: 2023-24							
Course Code	B060402P/MT233	**Title of the Course**	Tests of Significance and Applied Statistics Lab	**L**	**T**	**P**	**C**
Year	Second	**Semester**	Fourth	**0**	**0**	**4**	**2**
Pre-Requisite	Descriptive Statistics	**Co-requisite**					
Course Objectives	**Practical knowledge to conduct the parametric tests of various measures and interpret the result to predict the future events**						

Course Outcomes	
CO1	Students will be able to conduct test of significance based on t – test and Chi-square test.
CO2	Students will get the knowledge about Fisher's Z-transformation and its use in testing
CO3	Students will be able to deal with problems based on large sample tests.
CO4	Students will be able to deal with problems based on time series and calculation of its different components for forecasting.
CO5	Students will be able to deal with problems based on Index number.
CO6	Students will knowledge about measurement of mortality and fertility.
CO7	Students will be able to deal with problems based on life table.
CO8	Students will be able to understand the control charts for variables and attributes and draw inferences

Experiment No.	**Title of the Experiment**	**Content of Experiment**	**Contact Hrs.**	**Mapped CO**
1	t-test	Problems based on t-test.	5	1
2	F-test	Problems based on F-test.	5	1
3	Chi-square test	Problems based on Chi-square test..	5	1
4	Fisher's Z-transformation	Problems based on Fisher's Z-transformation and its use in testing	5	2
5	Power curve	Problems based on calculation of power curve.	5	2
6	Large sample tests	Problems based on large sample tests.	5	3
7	Time Series	Problems based on time series and its different components	5	4
8	Index number	Problems based on Index number.	5	5
9	Mortality and Fertility	Problems based on measurement of mortality and fertility.	5	6
10	Logistic curve	Problems based on logistic curve fitting.	5	6
11	Life table	Problems based on life table.	5	7
12	Control Charts	Problems based on control charts for variables and attributes	5	8

Reference Books:

Gupta, S.C. and Kapoor, V.K.: Fundamentals of Applied Statistics (10th ed.), Sultan Chand and Sons.

Lehmann, E.L.: Elements of Large-sample Theory.

Ferguson, T.S.: A course in Large Sample Theory

Bhende, A.A. and Kanitkar, T.: Principles of Population Studies

e-Learning Source:

Suggestive digital platforms web link/platform: NPTEL/SWAYAM/MOOCS

www.ustat.toronto.edu

ecoursesonline.iaasri.res.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	PSO5
CO1	3					1	3	3	3	3	3	3
CO2	3					1	2	3	2	3	3	2
CO3	3					3	3	3	2	2	2	1
CO4	3					3	2	3	2	2	3	2
CO5	3					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**

IntegralUniversity,Lucknow

Effective from Session: 2023-24							
Course Code	I030302V/MT234	**Title of the Course**	Introduction to R	**L**	**T**	**P**	**C**
Year	Second	**Semester**	Third	2	0	2	3
Pre-Requisite	Basic usage of a Windows PC or a Mac	**Co-requisite**					
Course Objectives	To make the students understand the basic concept and application of R software used for statistical analysis and better computing abilities.						

Course Outcomes	
CO1	Students will be able to understand the Introduction to R-language and using different operator in R.
CO2	Students will be able to understand the naming an object in R, creating and operating different functions in R
CO3	Students will be able to understand the character vectors, matrices, arrays, data frame and programming fundamentals in R
CO4	Students will be able to understand graphics in R
CO5	Students will be able to understand the descriptive statistics and summary of the data.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction	Introduction to R-Language, What is R?, Creating a Vector in R-c(), Arithmetic Operations on Vectors , Concept of Recycling	8	1
2	Data Entry	Naming an Object in R, The Functions; Seq() and Rep(),Logical Operators- TRUE(1), FALSE(0), Missing Values- NA	7	2
3	Character Vector	Character Vector- "," and Paste Function, Factor Vector and Ordering of Vectors, Matrices and Arrays.	7	3
4	Programming Fundamentals	Data Frame, Creating functions in R. Programming Fundamentals: Logical operators, conditional statements (if, else, else if statements in R), While loops, For loops, repeat loops.	8	3
5	Graphics	Graphics with R, Dot Chart, Pie Chart, Histogram (Hist()), Scatter Plot (Plot()) and Curve().	8	4
6	Descriptive Statistics	Obtaining Descriptive Statistics from R, Defining New Functions, Defining a Function for Standard Error of Mean, Descriptive Statistics of a Data Vector-describe(), Extension of describe() function for Data Frame	7	5

Reference Books:

1. Sandeep Rakshit, R for Beginner's, McGraw Hill Education-2017
2. Tilman M. Davies: The book of R, A first course in programming in Statistics, William Pollock, No starch Press, Inc
3. Gareth James, An Introduction to Statistical Learning with Application of R, Springer. 2022
4. Mark Gardener, Beginning R: The Statistical Programming Language, Wiley.
5. S. G. Purohit, Statistics Using R, Second Edition, Narosa.

e-Learning Source:

1. https://nptel.ac.in/courses/111104146
2. https://www.digimat.in/nptel/courses/video/111104100/L01.html
3. https://nptel.ac.in/courses/111104147
4. https://www.youtube.com/watch?v=nx-H2xog2d4
5. https://nptel.ac.in/courses/111104100

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	3	3	3	3	2
CO2	2					1	3	3	3	2	2	3
CO3	3					2	3	3	2	3	3	3
CO4	2					2	3	3	2	2	3	2
CO5	3					1	3	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: 2023-24							
Course Code	I030402V/MT235	**Title of the Course**	Introduction to SPSS	**L**	**T**	**P**	**C**
Year	Second	**Semester**	Fourth	2	0	2	3
Pre-Requisite	Basic usage of a Windows PC or a Mac	**Co-requisite**					
Course Objectives	To make the students understand the Statistical Package for Social Sciences (SPSS) software to perform statistics program gives a large amount of basic statistical functionality; some include frequencies, cross-tabulation, bivariate statistics, etc.						

Course Outcomes

CO1	Students will be able to understand the Basic Statistics: Meaning and Definition and Introduction of primary and secondary source of data and method of their collection.
CO2	Students will be able to understand the Basic of SPSS, entry data file, opening menu and dialogue boxes, creating data file and entering data.
CO3	Students will be able to understand the construction of different graphs in SPSS.
CO4	Students will be able to understand to find the descriptive measures (Univariate and Bivariate) by SPSS.
CO5	Students will be able to understand the hypothesis testing by SPSS.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction	Basic Statistics: Meaning and definitions of Statistics, data and variables, quantitative and qualitative variables, Scales of Measurements (Nominal, Ordinal, Interval & Ratio), primary and secondary sources of data, methods of data collection, classification of data.	7	1
2	Data Entry	Introduction to SPSS, working with data file, SPSS windows, Menu & Dialogue boxes, creating data file and entering data, defining the variables, modifying data file & import file.	8	2
3	Graphs	Construction of graphs by SPSS: Bar diagram, Histogram, frequency curve, Ogive curve, Pie chart and Box plot.	7	3
4	Univariate Measures	Descriptive (Univariate) measures by SPSS: Mean, Median, Mode & Partition values. Dispersion and its measures: Range, Quartiles deviation, Standard deviation & Variance. Measures of Skewness & Kurtosis	7	4
5	Bivariate Measures	Descriptive (Bivariate) measures by SPSS: Correlation & Scatter diagram, Karl Pearson's Coefficient of correlation, Spearman's Coefficient of Rank correlation, Regression equations and regression coefficients, Coefficient of determination.	8	4
6	Hypothesis Testing	Hypothesis testing by SPSS: Hypothesis, Null & Alternative hypothesis, Level of significance, Confidence level and Degrees of freedom, Normality test, testing of hypothesis based on t-test, Chi-square test, Analysis of variance (ANOVA), Reliability test (Cronbach's alpha), Non parametric test.	8	5

Reference Books:

1. John MacInnes, An Introduction to Secondary Data Analysis with IBM SPSS Statistics, Sage 2017
2. Marija Norusis, The SPSS Guide to Data Analysis, 1991.
3. Stephen A. Sweet, and Karen Grace-Martin, Data Analysis with SPSS: A First Course in Applied Statistics, 4th Edition, Pearson. 2012
4. Pallant, Julie SPSS Survival Manual, 4th Ed, McGraw-Hill, 2010.
5. Cronk, Brian, How to Use SPSS: A Step-By-Step Guide to Analysis and Interpretation, 5th Ed. 2008

e-Learning Source:

1. https://www.youtube.com/watch?v=ZpwZS3XnEZA
2. https://nptel.ac.in/courses/110107113
3. https://www.youtube.com/watch?v=_zFBUfZEBWQ
4. https://www.youtube.com/watch?v=-UF2k0PTw5w
5. https://www.youtube.com/watch?v=6rgwgwv8qdA

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	3	3	3	3	2
CO2	2					1	3	3	3	2	2	3
CO3	3					2	3	3	2	3	3	3
CO4	2					1	3	3	2	2	3	2
CO5	3					2	3	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: 2023-24							
Course Code	B010301T/PY207	**Title of the Course**	**Electromagnetic Theory and Modern Optics**	**L**	**T**	**P**	**C**
Year	**Second**	**Semester**	Third	**4**	**0**	**0**	**4**
Pre-Requisite	10+2 with Physics	**Co-requisite**	Passed B.Sc. 1st Year				
Course Objectives	This course aims to give students the competence in the Electromagnetic Theory and Modern Optics. At the end of the course the students are expected to have hands on experience in modeling, implementation and calculation of physical quantities of relevance and also their applications in various fields.						

Course Outcomes	
CO1	To get a better understanding of electrical and magnetic phenomenon in daily life.
CO2	To troubleshoot simple problems related to electrical devices.
CO3	Comprehend the powerful applications of ballistic galvanometer.
CO4	Study the fundamental physics behind reflection and refraction of light (electromagnetic waves).
CO5	Study the working and applications of Michelson and Fabry-Perot interferometers.
CO6	Recognize the difference between Fresnel's and Fraunhofer's class of diffraction.
CO7	Comprehend the use of polarimeters.
CO8	Study the characteristics and uses of lasers.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Electrostatics**	Electric charge & charge densities, electric force between two charges. General expression for Electric field in terms of volume charge density (divergence & curl of Electric field), general expression for Electric potential in terms of volume charge density and Gauss law (applications included). Study of electric dipole. Electric fields in matter, polarization, auxiliary field **D** (Electric displacement), electric susceptibility and permittivity.	8	CO1, 2
2	**Magnetostatics**	Electric current & current densities, magnetic force between two current elements. General expression for Magnetic field in terms of volume current density (divergence and curl of Magnetic field), General expression for Magnetic potential in terms of volume current density and Ampere's circuital law (applications included). Study of magnetic dipole (Gilbert & Ampere model). Magnetic fields in matter, magnetisation, auxiliary field **H**, magnetic susceptibility and permeability.	8	CO1, 2
3	**Time Varying Electric Fields**	Faraday's laws of electromagnetic induction and Lenz's law. Displacement current, equation of continuity and Maxwell-Ampere's circuital law. Self and mutual induction (applications included). Derivation and physical significance of Maxwell's equations. Theory and working of moving coil ballistic galvanometer (applications included).	7	CO3, 4
4	**Electromagnetic Waves**	Electromagnetic energy density and Poynting vector. Plane electromagnetic waves in linear infinite dielectrics, homogeneous & inhomogeneous plane waves and dispersive & non-dispersive media. Reflection and refraction of homogeneous plane electromagnetic waves, law of reflection, Snell's law, Fresnel's formulae (only for normal incidence & optical frequencies) and Stoke's law.	7	CO3, 4
5	**Interference**	Conditions for interference and spatial & temporal coherence. Division of Wavefront - Fresnel's Biprism and Lloyd's Mirror. Division of Amplitude - Parallel thin film, wedge shaped film and Newton's Ring experiment. Interferometer - Michelson and Fabry-Perot.	8	CO5
6	**Diffraction**	Distinction between interference and diffraction. Fresnel's and Fraunhofer's class of diffraction. Fresnel's Half Period Zones and Zone plate. Fraunhofer diffraction at a single slit, n slits and Diffracting Grating. Resolving Power of Optical Instruments - Rayleigh's criterion and resolving power of telescope, microscope & grating.	8	CO6
7	**Polarization**	Polarisation by dichronic crystals, birefringence, Nicol prism, retardation plates and Babinet's compensator. Analysis of polarized light. Optical Rotation - Fresnel's explanation of optical rotation and Half Shade & Biquartz polarimeters.	7	CO7
8	**Lasers**	Characteristics and uses of Lasers. Quantitative analysis of Spatial and Temporal coherence. Conditions for Laser action and Einstein's coefficients. Three and four level laser systems. (Qualitative discussion).	7	CO8

Reference Books:

1. D.J. Griffiths, "Introduction to Electrodynamics", Prentice-Hall of India Private Limited, 2002, 3e
2. E.M. Purcell, "Electricity and Magnetism (In SI Units): Berkeley Physics Course Vol 2", McGraw Hill, 2017,2e
3. Richard P. Feynman, Robert B. Leighton, Matthew Sands, "The Feynman Lectures on Physics - Vol. 2",Pearson Education Limited, 2012
4. D.C. Tayal, "Electricity and Magnetism", Himalaya Publishing House Pvt. Ltd., 2019, 4e
5. Francis A. Jenkins, Harvey E. White, "Fundamentals of Optics", McGraw Hill, 2017, 4e
6. Samuel Tolansky, "An Introduction to Interferometry", John Wiley & Sons Inc., 1973, 2e
7. A. Ghatak, "Optics", McGraw Hill, 2017, 6e

e-Learning Source:

1. MIT Open Learning - Massachusetts Institute of Technology, https://openlearning.mit.edu/
2. National Programme on Technology Enhanced Learning (NPTEL), https://www.youtube.com/user/nptelhrd
3. Uttar Pradesh Higher Education Digital Library, http://heecontent.upsdc.gov.in/SearchContent.aspx
4. Swayam Prabha - DTH Channel, https://www.swayamprabha.gov.in/index.php/program/current_he/8

	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**	-	-	-	-	**3**	**2**	-	**1**	**2**
CO2	**3**	**2**	-	-	-	-	**3**	**3**	-	**1**	**2**
CO3	**3**	**2**	-	-	-	-	**3**	**3**	-	**2**	**2**
CO4	**3**	**2**	-	-	-	**1**	**3**	**3**	-	**3**	**2**
CO5	**3**	**2**	-	-	-	-	**3**	**3**	-	**3**	**2**
CO6	**3**	**2**	-	-	-	-	**3**	**2**	-	**1**	**2**
CO7	**3**	**2**	-	-	-	-	**3**	**3**	-	**1**	**2**
CO8	**3**	**2**	-	-	-	-	**3**	**3**	-	**2**	**2**

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

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

Integral University, Lucknow

Effective from Session: 2023-24							
Course Code	B010302P/PY208	**Title of the Course**	Demonstrative Aspects of Electricity & Magnetism	**L**	**T**	**P**	**C**
Year	Second	**Semester**	Third	**0**	**0**	**4**	**2**
Pre-Requisite	10+2 with Physics	**Co-requisite**	Passed B.Sc. 1st Year				
Course Objectives	The purpose of this undergraduate course is to impart practical knowledge/measurements in the field of electricity and magnetism mechanics through different experiments related to its theoretical course.						

Course Outcomes	
CO1	Students will understand the effect of distance on the intensity of magnetic field
CO2	Student will learn to find the various parameters of a ballistic galvanometer
CO3	Students will learn the methods to find the values of high and low resistances and also how to find the self inductance of a coil
CO4	Students will learn the method to compare the capacitance and also about how to find specific resistance
CO5	Students will learn the methods to find the magnetic moment and earth's magnetic field components

Experiment No.	**Title of the Experiment**	**Aim of the Experiment (*Offline)**	**Contact Hrs.**	**Mapped CO**
1	Single Coil	Variation of magnetic field along the axis of single coil	6	CO1
2	Helmholtz Coil	Variation of magnetic field along the axis of Helmholtz coil	6	CO1
3	B.G. Parameter	Ballistic Galvanometer: Ballistic constant, current sensitivity and voltage sensitivity	6	CO2
4	Leakage Method	Ballistic Galvanometer: High resistance by Leakage method	6	CO3
5	Kelvin's Double Bridge Method	Ballistic Galvanometer: Low resistance by Kelvin's double bridge method	6	CO3
6	Rayleigh's Method	Ballistic Galvanometer: Self inductance of a coil by Rayleigh's method	6	CO3
7	Capacitance Comparison	Ballistic Galvanometer: Comparison of capacitances	6	CO4
8	Carey Foster Bridge	Carey Foster Bridge: Resistance per unit length and low resistance	6	CO4
9	Magnetometer	Deflection and Vibration Magnetometer: Magnetic moment of a magnet and horizontal component of earth's magnetic field	6	CO5
10	Earth Inductor	Earth Inductor: Horizontal component of earth's magnetic field	6	CO5
Experiment No.	**Title of the Experiment**	**Aim of the Experiment (*Online Virtual Lab)**	**Contact Hrs.**	**Mapped CO**
1	Tangent galvanometer	To determine the reduction factor of the given tangent galvanometer (K). To find out the horizontal component of earth's magnetic field (Bh).	--	--
2	Magnetic field along the axis of a circular coil carrying current	To study the variation of magnetic field with distance along the axis of a circular coil carrying current.	--	--
3	Deflection magnetometer	To find the horizontal intensity of earth's magnetic field at a place and moment of the bar magnet.	--	--
4	Van de Graff generator	To Know about Van de Graff generator	--	--
5	Barkhausen effect	To experience the sound produced according to the magnetization of the rod while the magnet is getting nearer to the rod.	--	--
6	Temperature coefficient of resistance	To identify the change in resistivity of the resistor according to the change in temperature	--	--
7	Anderson's bridge	To find the inductance of a coil using Anderson's Bridge	--	--
8	Quincke's method	To determine the volume magnetic susceptibilities of paramagnetic liquids.	--	--

Reference Books:

1. B.L. Worsnop, H.T. Flint, "Advanced Practical Physics for Students", Methuen & Co., Ltd., London, 1962, 9e
2. S. Panigrahi, B. Mallick, "Engineering Practical Physics", Cengage Learning India Pvt. Ltd., 2015, 1e
3. R.K. Agrawal, G. Jain, R. Sharma, "Practical Physics", Krishna Prakashan Media (Pvt.) Ltd., Meerut, 2019
4. S.L. Gupta, V. Kumar, "Practical Physics", Pragati Prakashan, Meerut, 2014, 2e

e-Learning Source:

1. Virtual Labs at Amrita Vishwa Vidyapeetham, https://vlab.amrita.edu/?sub=1&brch=74
2. Digital Platforms /Web Links of other virtual labs may be suggested / added to this lists by individual Universities.

*** A student has to perform at least 7 experiments from the Offline Experiment List and 3 from the Online Virtual Lab Experiment List / Link.**

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

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

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

Integral University, Lucknow

Effective from Session: 2023-24							
Course Code	B010401T/PY209	**Title of the Course**	Perspectives of Modern Physics & Basic Electronics	**L**	**T**	**P**	**C**
Year	Second	**Semester**	Fourth	**4**	**0**	**0**	**4**
Pre-Requisite	10+2 with Physics	**Co-requisite**	Passed B.Sc. 1st Year				
Course Objectives	This course aims to give students the competence in the Electromagnetic Theory and Modern Optics. At the end of the course the students are expected to have hands on experience in modeling, implementation and calculation of physical quantities of relevance and also their applications in various fields.						

Course Outcomes	
CO1	Recognize the difference between the structure of space & time in Newtonian & Relativistic mechanics.
CO2	Understand the physical significance of consequences of Lorentz transformation equations.
CO3	Comprehend the wave-particle duality.
CO4	Develop an understanding of the foundational aspects of Quantum Mechanics.
CO5	Study the comparison between various biasing techniques.
CO6	Study the classification of amplifiers.
CO7	Comprehend the use of feedback and oscillators.
CO8	Comprehend the theory and working of optical fibers along with its applications.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Relativity-Experimental Background**	Structure of space & time in Newtonian mechanics and inertial & non-inertial frames. Galilean transformations. Newtonian relativity. Galilean transformation and Electromagnetism. Attempts to locate the Absolute Frame: Michelson-Morley experiment and significance of the null result. Einstein's postulates of special theory of relativity.	7	CO1, 2
2	**Relativity-Relativistic Kinematics**	Structure of space & time in Relativistic mechanics and derivation of Lorentz transformation equations (4-vector formulation included). Consequences of Lorentz Transformation Equations (derivations & examples included): Transformation of Simultaneity (Relativity of simultaneity); Transformation of Length (Length contraction); Transformation of Time (Time dilation); Transformation of Velocity (Relativistic velocity addition); Transformation of Acceleration; Transformation of Mass (Variation of mass with velocity). Relation between Energy & Mass (Einstein's mass & energy relation) and Energy & Momentum.	8	CO1, 2
3	**Inadequacies of Classical Mechanics**	Particle Properties of Waves: Spectrum of Black Body radiation, Photoelectric effect, Compton effect and their explanations based on Max Planck's Quantum hypothesis. Wave Properties of Particles: Louis de Broglie's hypothesis of matter waves and their experimental verification by Davisson-Germer's experiment and Thomson's experiment.	8	CO3, 4
4	**Introduction to Quantum Mechanics**	Matter Waves: Mathematical representation, Wavelength, Concept of Wave group, Group (particle) velocity, Phase (wave) velocity and relation between Group & Phase velocities. Wave Function: Functional form, Normalisation of wave function, Orthogonal & Orthonormal wave functions and Probabilistic interpretation of wave function based on Born Rule.	7	CO3, 4
5	**Transistor Biasing**	Faithful amplification & need for biasing. Stability Factors and its calculation for transistor biasing circuits for CE configuration: Fixed Bias (Base Resistor Method), Emitter Bias (Fixed Bias with Emitter Resistor), Collector to Base Bias (Base Bias with Collector Feedback) &, Voltage Divider Bias. Discussion of Emitter-Follower configuration.	7	CO5
6	**Amplifiers**	Classification of amplifiers based on Mode of operation (Class A, B, AB, C & D), Stages (single & multi stage, cascade & cascode connections), Coupling methods (RC, Transformer, Direct & LC couplings), Nature of amplification (Voltage & Power amplification) and Frequency capabilities (AF, IF, RF & VF). Theory & working of RC coupled voltage amplifier (Uses of various resistors & capacitors, and Frequency response) and Transformer coupled power amplifier (calculation of Power, Effect of temperature, Use of heat sink & Power dissipation). Calculation of Amplifier Efficiency (power efficiency) for Class A Series-Fed, Class A Transformer Coupled, Class B Series-Fed and Class B Transformer Coupled amplifiers.	7	CO6
7	**Feedback and Oscillators**	**Feedback Circuits:** Effects of positive and negative feedback. Voltage Series, Voltage Shunt, Current Series and Current Shunt feedback connection types and their uses for specific amplifiers. Estimation of Input Impedance, Output Impedance, Gain, Stability, Distortion, Noise and Band Width for Voltage Series negative feedback and their comparison between different negative feedback connection types. **Oscillator Circuits:** Use of positive feedback for oscillator operation. Barkhausen criterion for self- sustained oscillations. Feedback factor and frequency of oscillation for RC Phase Shift oscillator and Wein Bridge oscillator. Qualitative discussion of Reactive Network feedback oscillators (Tuned oscillator circuits): Hartley & Colpitt oscillators.	8	CO7
8	**Introduction to Fiber Optics**	Basics of Fiber Optics, step index fiber, graded index fiber, light propagation through an optical fiber, acceptance angle & numerical aperture, qualitative discussion of fiber losses and applications of optical fibers.	8	CO8

Reference Books:

1. A. Beiser, Shobhit Mahajan, "Concepts of Modern Physics: Special Indian Edition", McGraw Hill, 2009, 6e
2. John R. Taylor, Chris D. Zafiratos, Michael A.Dubson, "Modern Physics for Scientists and Engineers",Prentice-Hall of India Private Limited, 2003, 2e
3. R.A. Serway, C.J. Moses, and C.A. Moyer, "Modern Physics", Cengage Learning India Pvt. Ltd, 2004, 3e
4. R. Resnick, "Introduction to Special Relativity", Wiley India Private Limited, 2007
5. R. Murugeshan, Kiruthiga Sivaprasath, "Modern Physics", S. Chand Publishing, 2019, 18e
6. R.L. Boylestad, L. Nashelsky, "Electronic Devices and Circuit Theory", Prentice-Hall of India Pvt. Ltd., 2015, 11e
7. J. Millman, C.C. Halkias, Satyabrata Jit, "Electronic Devices and Circuits", McGraw Hill, 2015, 4e
8. B.G. Streetman, S.K. Banerjee, "Solid State Electronic Devices", Pearson Education India, 2015, 7e
9. J.D. Ryder, "Electronic Fundamentals and Applications", Prentice-Hall of India Private Limited, 1975, 5e
10. John M. Senior, "Optical Fiber Communications: Principles and Practice", Pearson Education Limited, 2010, 3e
11. John Wilson, John Hawkes, "Optoelectronics: Principles and Practice", Pearson Education Limited, 2018, 3e
12. S.L. Gupta, V. Kumar, "Hand Book of Electronics", Pragati Prakashan, Meerut, 2016, 43e

e-Learning Source:

1. MIT Open Learning - Massachusetts Institute of Technology, https://openlearning.mit.edu/
2. National Programme on Technology Enhanced Learning (NPTEL), https://www.youtube.com/user/nptelhrd
3. Uttar Pradesh Higher Education Digital Library, http://heecontent.upsdc.gov.in/SearchContent.aspx
4. Swayam Prabha - DTH Channel, https://www.swayamprabha.gov.in/index.php/program/current_he/8

	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	-	-	-	-	3	2	2	1	2
CO2	3	2	-	-	-	-	3	3	2	1	2
CO3	3	2	-	-	-	-	3	3	2	2	2
CO4	3	2	-	-	-	-	3	3	2	3	2
CO5	3	2	-	-	-	-	3	3	2	3	2
CO6	3	2	-	-	-	-	3	2	2	1	2
CO7	3	2	-	-	-	-	3	3	2	1	2
CO8	3	2	-	-	-	-	3	3	2	2	2

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

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

Integral University, Lucknow

Effective from Session: 2023-24							
Course Code	B010402P/PY210	**Title of the Course**	Basic Electronics Instrumentation	**L**	**T**	**P**	**C**
Year	Second	**Semester**	Fourth	**0**	**0**	**4**	**2**
Pre-Requisite	10+2 with Physics	**Co-requisite**	Passed B.Sc. 1st Year				
Course Objectives	The purpose of this undergraduate course is to impart practical knowledge/measurements in the field of electricity and magnetism mechanics through different experiments related to its theoretical course.						

Course Outcomes	
CO1	Students will learn about different transistor biasing and will also be able to do a Comparative Study of CE, CB and CC amplifier
CO2	Student will learn about Clipper, Clamper and Emitter Follower circuits
CO3	Students will learn about the Single Stage RC coupled and Transformer Coupled amplifier
CO4	Students will learn about the Schmitt Trigger circuit
CO5	Students will learn about the Hartley and Wein Bridge oscillator

Experiment No.	**Title of the Experiment**	**Aim of the Experiment (*Offline)**	**Contact Hrs.**	**Mapped CO**
1	Biasing Stability	To study the Transistor Bias Stability	6	CO1
2	CE, CB and CC amplifier	To do a Comparative Study of CE, CB and CC amplifier	6	CO1
3	Clipper Clamper	To study the Clippers and Clampers circuits	6	CO2
4	Emitter follower	To Study the Emitter Follower circuit	6	CO3
5	RC Coupled Amplifier	To study the Frequency response of single stage RC coupled amplifier	6	CO3
6	Transformer Coupled Amplifier	To study the Frequency response of single stage Transformer coupled amplifier	6	CO3
7	Negative Feedback RC Coupled Amplifier	To study the Effect of negative feedback on frequency response of RC coupled amplifier	6	CO3
8	Schmitt Trigger	To study the Schmitt Trigger Circuit	6	CO4
9	Hartley Oscillator	To study the Hartley oscillator	6	CO5
10	Wein Bridge Oscillator	To study the Wein Bridge oscillator	6	CO5
Experiment No.	**Title of the Experiment**	**Aim of the Experiment (*Online Virtual Lab)**	**Contact Hrs.**	**Mapped CO**
1	Diode as Clippers	Diode as Clippers	--	--
2	Diode as Clampers	Diode as Clampers	--	--
3	BJT as switch and Load Lines	BJT as switch and Load Lines	--	--
4	RC frequency response	RC frequency response	--	--
5	Hartley oscillator	Hartley oscillator	--	--
6	Colpitt oscillator	Colpitt oscillator	--	--
7	Fiber Optic Analog and Digital Link	Fiber Optic Analog and Digital Link	--	--
8	Fiber Optic Bi-directional Communication	Fiber Optic Bi-directional Communication	--	--
9	Wavelength Division Multiplexing	Wavelength Division Multiplexing	--	--
10	Measurement of Bending Losses in Optical Fiber	Measurement of Bending Losses in Optical Fiber	--	--
11	Measurement of Numerical Aperture	Measurement of Numerical Aperture	--	--
12	Study of LED and Detector Characteristics	Study of LED and Detector Characteristics	--	--

Reference Books:

1. R.L. Boylestad, L. Nashelsky, "Electronic Devices and Circuit Theory", Prentice-Hall of India Pvt. Ltd., 2015, 11e
2. J. Millman, C.C. Halkias, Satyabrata Jit, "Electronic Devices and Circuits", McGraw Hill, 2015, 4e
3. B.G. Streetman, S.K. Banerjee, "Solid State Electronic Devices", Pearson Education India, 2015, 7e
4. J.D. Ryder, "Electronic Fundamentals and Applications", Prentice-Hall of India Private Limited, 1975, 5e
5. John M. Senior, "Optical Fiber Communications: Principles and Practice", Pearson Education Limited, 2010, 3e
6. John Wilson, John Hawkes, "Optoelectronics: Principles and Practice", Pearson Education Limited, 2018, 3e
7. S.L. Gupta, V. Kumar, "Hand Book of Electronics", Pragati Prakashan, Meerut, 2016, 43e

e-Learning Source:

1. Virtual Labs at Amrita Vishwa Vidyapeetham, https://vlab.amrita.edu/?sub=1&brch=74
2. Virtual Labs at Amrita Vishwa Vidyapeetham https://vlab.amrita.edu/index.php?sub=1&brch=201
3. Virtual Labs an initiative of MHRD Govt. of India http://vlabs.iitkgp.ac.in/psac/#
4. Virtual Labs an initiative of MHRD Govt. of Indiahttp://vlabs.iitkgp.ac.in/be/#
5. Digital Platforms /Web Links of other virtual labs may be suggested / added to this lists by individual Universities.

*** A student has to perform at least 7 experiments from the Offline Experiment List and 3 from the Online Virtual Lab Experiment List / Link.**

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

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

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