Integral University, Lucknow

Department of Mathematics & Statistics

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

M. Sc. (Statistics) **Ist year / Ist Semester**

S. No.	Course code	Course Title	Type of Paper	Period Per hr/week/sem			Evaluation Scheme				Sub. Total	Credit	Total Credits	Attributes							United Nations Sustainable Development Goals (SDGs
				L	T	P	CT	TA	Total	ESE				Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics	
THEORIES																					
1	MT406	Real Analysis	Core	03	01	00	40	20	60	40	100	3:1:0	4	√		√					
2	MT410	Complex Analysis	Core	03	01	00	40	20	60	40	100	3:1:0	4	√		√					
3	MT422	Sample Surveys	Core	03	01	00	40	20	60	40	100	3:1:0	4	√		√				√	
4	MT423	Probability Theory	Core	03	01	00	40	20	60	40	100	3:1:0	4	√		√					
5	MT424	Reliability Theory	Core	03	01	00	40	20	60	40	100	3:1:0	4	√		√					
PRACTICAL																					
6	MT425	Sample Surveys and R – programming Lab	Core	00	00	06	40	20	60	40	100	0:0:3	3	√		√				√	
			Total	**15**	**05**	**06**	**240**	**120**	**360**	**240**	**600**	**23**	**23**								

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

Integral University, Lucknow

Effective from Session: 2022 - 23							
Course Code	MT406	**Title of the Course**	Real Analysis	**L**	**T**	**P**	**C**
Year	I	**Semester**	I	**3**	**1**	**0**	
Pre-Requisite	B. Sc. with Mathematics	**Co-requisite**					
Course Objectives	1. To familiarize students with various concepts of Real Analysis. 2. The course will help the student to understand sequence and Series of functions (convergent and uniform convergent), 3.The course will also develop an understanding of solving Riemann Stieltjes integral and Power series. 4. The course will further develop understanding the concepts of Cauchy criterion for uniform convergence.						

Course Outcomes	
CO1	Students will gain an understanding of countability of Sets, Lebesgue measure on the real line, Length of intervals. They will also learn about Cantor set, outer and inner Lebesgue measure, Lebesgue measurable sets and properties of measurable sets.
CO2	Students will be able to understand Sequence and Series of functions, Pointwise and uniform convergence, Cauchy criterion for uniform convergence. They will learn to define Weierstrass M test, Abel's and Dirichlet's test, for uniform convergence. Properties of uniformly convergent series of functions.
CO3	Students will create the own understanding of Weierstrass approximation theorem, some integrable functions, Definition and existence of Pointwise and uniform convergence, Properties and some important theorems on Riemann Stieltjes integral.
CO4	Students will be able to understand the concepts of Power series and radius of convergence and interval of convergence. Uniqueness theorem of power series. They will also learn about Abel's and Taylor's theorem, Riemann's theorem.
CO5	Students will create the own understanding of functions of several variables, partial derivatives and total derivatives. They will learn about Jacobian, chain rule, interchange of the order of differentiation & higher derivatives. Students will also be able to understand inverse function theorem and implicit function.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Real Numbers & measurable sets	Countability of Sets, Lebesgue measure on the real line, length of intervals, Cantor set. Outer and inner Lebesgue measure, Lebesgue measurable sets, properties of measurable sets.	8	1
2	convergence & uniform convergence	Sequence and Series of functions, pointwise and uniform convergence, Cauchy criterion for uniform convergence, Weierstrass M test, Abel's and Dirichlet's test for uniform convergence. Properties of uniformly convergent series of functions	8	2
3	Reimann Stieltjes integral	Weierstrass approximation theorem, some integrable functions. Definition and existence of Pointwise and uniform convergence, Properties and some important theorems on Riemann Stieltjes integral.	8	3
4	Power Series	Power Series, Radius of convergence and interval of convergence. Uniqueness theorem of power series, Abel's, Taylor's theorem and Riemann's theorem.	8	4
5	Partial and Total differentiations	Functions of several variables, properties of Jacobians. Partial derivatives, Total derivative, Jacobian, Chain rule, interchange of the order of differentiation, higher derivatives, inverse function theorem, implicit function theorem.	8	5

Reference Books:

1. W. Rudin: Principle of Mathematics Analysis
2. D. Somasundramand B.Choudhary: A First Course in Mathematical Analysis, Narosa, 199
3. S.C.Malik:Mathematical Analysis, Wiley Eastern, India
4. Jain,P.K. & GuptaV.P., Lebesgue measure and Integration,Willey Eastern Ltd., New Age Int. Ltd., New Delhi, (1994).

e-Learning Source:

https://www.youtube.com/watch?v=Xx7ULr79fy0&list=PLbMVogVj5nJSxFihV-ec4A3z_FOGPRCo-&index=4

https://www.youtube.com/watch?v=Xx7ULr79fy0&list=PLbMVogVj5nJSxFihV-ec4A3z_FOGPRCo-&index=4

https://www.youtube.com/watch?v=AqHxSRul-Ck

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

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	1	1	1	2	1	1	3	3	2	1	1
CO2	3	1	2	1	3	1	2	3	3	3	2	1
CO3	3	1	2	1	3	1	1	3	3	2	2	1
CO4	3	1	1	1	2	1	2	3	3	2	1	1
CO5	3	1	1	1	2	1	1	2	3	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: 2015 - 16							
Course Code	MT410	**Title of the Course**	Complex Analysis	**L**	**T**	**P**	**C**
Year	**I**	**Semester**	I	**3**	**1**	**0**	
Pre-Requisite	B.Sc. with Maths	**Co-requisite**					
Course Objectives	The purpose of this postgraduate course is to impart basic and key knowledge of complex analysis. By using the principal of pure and applied mathematics to obtain quantitative relations which are very important for higher studies. After successfully completion of course, the student will able explore subject into their respective dimensions						

Course Outcomes	
CO1	Find and interpret Analytic functions, Cauchy Riemann Equations, Harmonic function, velocity potential, Cauchy Integral Theorem and Cauchy integral formula
CO2	Evaluate and Interpret the Power series, Uniform convergence, Taylor's series, zeros of analytic functions, Laurent's series, Integration and differentiation of power series, multiplication and division of power series.
CO3	Describe and evaluate the Cauchy residue theorem, evaluation of real definite integration when function has no pole on real axis and pole lies on real axis, Integral involving many valued functions, contour
CO4	State and explain Conformal bilinear exponential and trigonometric transformations, special bilinear and Schwarz,-Christoffel transformations
CO5	State and explain the Weierstrass's theorem, principle of maximum modulus, Schwarz's lemma, Picard's theorem, Jensen inequality and formula, Hadamard's three circle theorem and as a convexity

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Unit-1**	Analytic functions, Cauchy Riemann Equations, Harmonic function, velocity potential, Milne's Thomson method, Cauchy Integral Theorem and Cauchy integral formula	8	1
2	**Unit-2**	Power series, Uniform convergence, Taylor's series, zeros of analytic functions, Laurent's series, Integration and differentiation of power series, multiplication and division of power series.	8	2
3	**Unit-3**	Cauchy residue theorem, evaluation of real definite integration when function has no pole on real axis and pole lies on real axis, Integral involving many valued function, rectangular contours	8	3
4	**Unit-4**	Conformal bilinear exponential and trigonometric transformations, special bilinear and Schwarz, -Christoffel transformations.	8	4
5	**Unit-5**	Weierstrass's theorem, principle of maximum modulus, Schwarz's lemma, Picard's theorem, Jensen inequality and formula, Hadamard's three circle theorem and as a convexity	8	5

Reference Books:

1. L. V. Alforse, Complex Analysis, McGraw-Hill Book Company
2. B. Chaudhary, The elements of Complex Analysis, Wiley Eastern
3. Shanti Narayan, Theory of Functions of a complex variable, S. Chand & Co.

e-Learning Source:

1. http://www.bhojvirtualuniversity.com/slm/mscmath1p4.pdf
2. http://web.math.ku.dk/noter/filer/koman-12.pdf
3. https://www.youtube.com/watch?v=YORGYJKDDN0

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

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	1	1	1	2	1	1	3	3	2	1	1
CO2	3	1	2	1	3	1	2	3	3	3	2	1
CO3	3	1	2	1	3	1	1	3	3	2	2	1
CO4	3	1	1	1	2	1	2	3	3	2	1	1
CO5	3	1	1	1	2	1	1	2	3	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: 2021 - 2022							
Course Code	MT422	**Title of the Course**	Sample surveys	**L**	**T**	**P**	**C**
Year	I	**Semester**	I	**3**	**1**	**0**	
Pre-Requisite	Concept of sampling Techniques	**Co-requisite**					
Course Objectives	The course objective is to learn the basic concept and importance of sampling and know 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 and also apply in real life situation.						

Course Outcomes	
CO1	Students will be able to understand the concept of Estimation of population mean, total, and proportion in simple random sampling and stratified random sampling, Estimation of gain due to stratification. Ratio and regression methods of estimation. Unbiased ratio type estimators. Optimality of ratio estimate. Separate and combined ratio and regression estimates in simple random sampling and stratified sampling and their comparisons
CO2	Students will be able to understand the concept of Cluster sampling and derive the Estimation of population mean and their variances based on cluster of equal and unequal sizes, variances in terms of intra-class correlation coefficient. Determination of optimum cluster size, varying probability sampling: Probability proportional to size (pps) sampling with and without replacement and related estimators of finite population mean.
CO3	Students will be able to understand the concept of Two stage sampling and derive the Estimation of population total and mean with equal and unequal first stage units (FSU), variances and their estimation. Optimum sampling and sub-sampling fractions (for equal FSU's only). Selection of FSU's with varying probabilities and with replacement only
CO4	Students will be able to understand the concept and derivations of Double Sampling: Need for double sampling, double sampling with ratio and regression method of estimation, double sampling for stratification.
CO5	Students will be able to understand the concept of Sources of errors in surveys: Sampling and non-sampling errors, various types of non -sampling errors and their sources. Estimation of mean and proportion in the presence of non-response, Optimum sampling fraction among non-respondents. Interpenetrating samples. Randomized response technique

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1		Students will be able to understand the concept of Estimation of population mean, total, and proportion in simple random sampling and stratified random sampling, Estimation of gain due to stratification. Ratio and regression methods of estimation. Unbiased ratio type estimators. Optimality of ratio estimate. Separate and combined ratio and regression estimates in simple random sampling and stratified sampling and their comparisons	08	1
2		Students will be able to understand the concept of Cluster sampling and derive the Estimation of population mean and their variances based on cluster of equal and unequal sizes, variances in terms of intra-class correlation coefficient. Determination of optimum cluster size, varying probability sampling: Probability proportional to size (pps) sampling with and without replacement and related estimators of finite population mean.	08	2
3		Students will be able to understand the concept of Two stage sampling and derive the Estimation of population total and mean with equal and unequal first stage units (FSU), variances and their estimation. Optimum sampling and sub-sampling fractions (for equal FSU's only). Selection of FSU's with varying probabilities and with replacement only	08	3
4		Students will be able to understand the concept and derivations of Double Sampling: Need for double sampling, double sampling with ratio and regression method of estimation, double sampling for stratification.	08	4
5		Students will be able to understand the concept of Sources of errors in surveys: Sampling and non-sampling errors, various types of non -sampling errors and their sources. Estimation of mean and proportion in the presence of non-response, Optimum sampling fraction among non-respondents. Interpenetrating samples. Randomized response technique	08	5

Reference Books:

Cochran, W.G., (1977): Sampling Techniques, 3rd edition, John Wiley.

Des Raj and Chandak (1998): Sampling theory, Narosa.

Murthy, M.N. (1977): Sampling theory and methods. Statistical Publishing Society, Calcutta.

Sukhatme et al. (1984): Sampling theory of surveys with applications, Lowa state university press.

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=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	PO8	PSO1	PSO2	PSO3	PSO4
CO1	2	3	1	3	3	2	1	3	3	3	3	3
CO2	3	3	3	2	3	2	2	3	3	3	3	2
CO3	2	3	2	3	3	2	3	3	3	3	3	3
CO4	2	3	3	1	2	2	1	3	3	3	3	3
CO5	3	2	1	2	3	2	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: 2021 - 2022							
Course Code	MT423	**Title of the Course**	Probability Theory	**L**	**T**	**P**	**C**
Year	I	**Semester**	I	**3**	**1**	**0**	
Pre-Requisite	Basics of probability and its distribution	**Co-requisite**					
Course Objectives	The course objective is to learn the basic concept of probability theory and its applications for decision-making in economics, business, and other fields of sciences. Our everyday lives, as well as economic and business activities, are full of uncertainties and probability theory offers useful techniques for quantifying these uncertainties. The course is heavily oriented towards the formulation of mathematical concepts on probability and probability distributions and densities with practical applications.						

Course Outcomes	
CO1	Students will be able to understand the concept of Random experiment, sample space, Ring, field, sequences of sets, Inferior and superior limts of sequences of sets, Measure and probability measure, Lebesgue and Lebesgue-Stieltjes measure, Measurable and Borel measurable function, Integration of a measurable function w.r.to a measure, Monotone class, Monotone convergence theorem, Fatous lemma and dominated convergence theorem.
CO2	Students will be able to understand the concept of Random variable (r.v) and functions of random variable, Distribution function and its properties, Representation of distribution as a mixture of distributions, Heavy tailed distribution, Compound, truncated and mixture distributions.
CO3	Students will be able to understand the derivation to obtain the Mathematical expectation and moments, Probability generating function (PGF), moment generating function (MGF), and characteristic function (CF) and their interrelationships, Properties of CF.
CO4	Students will be able to understand the concept and applications of Discrete distributions: Uniform, Bernaulli, Binomial, Poisson, Geometric, Negative Binomial and Hyper geometric distribution, Convergence in probability and convergence in distribution.
CO5	Students will be able to understand the concept and applications of MGF and CF for continuous random variable, Inversion theorem, and continuity theorem. Examples of continuous distributions: Uniform, Normal, Exponential, Gamma, Beta, Weibull, Pareto, Laplace, Lognormal, Logistic and Log-Logistic distribution.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1		Students will be able to understand the concept of Random experiment, sample space, Ring, field, sequences of sets, Inferior and superior limts of sequences of sets, Measure and probability measure, Lebesgue and Lebesgue-Stieltjes measure, Measurable and Borel measurable function, Integration of a measurable function w.r.to a measure, Monotone class, Monotone convergence theorem, Fatous lemma and dominated convergence theorem	08	1
2		Students will be able to understand the concept of Random variable (r.v) and functions of random variable, Distribution function and its properties, Representation of distribution as a mixture of distributions, Heavy tailed distribution, Compound, truncated and mixture distributions	08	2
3		Students will be able to understand the derivation to obtain the Mathematical expectation and moments, Probability generating function (PGF), moment generating function (MGF), and characteristic function (CF) and their interrelationships, Properties of CF.	08	3
4		Students will be able to understand the concept and applications of Discrete distributions: Uniform, Bernaulli, Binomial, Poisson, Geometric, Negative Binomial and Hyper geometric distribution, Convergence in probability and convergence in distribution.	08	4
5		Students will be able to understand the concept and applications of MGF and CF for continuous random variable, Inversion theorem, continuity theorem. Examples of continuous distributions: Uniform, Normal, Exponential, Gamma, Beta, Weibull, Pareto, Laplace, Lognormal, Logistic and Log-Logistic distribution.	08	5

Reference Books:

Bhat, B. R (1981): Modern Probability Theory, Wiley Eastern Ltd., New Delhi.

Rohatgi, V. K. (1988): An Introduction to Probability and Mathematical Statistics, Wiley, Eastern Limited.

C. R. Rao: Linear statistical inference and its applications, John Wiley and sons Inc.

Halmous. Paul. R: Measure Theory, Springer.

e-Learning Source:

https://www.youtube.com/watch?v=UnzbuqgU2LE

https://www.khanacademy.org/math/ap-statistics/random-variables

https://www.mathtutordvd.com

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)											
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	2	3	3	2	3	2	2	3	3	3	3	3
CO2	3	2	3	2	2	2	2	3	3	3	3	2
CO3	3	3	2	2	3	3	2	3	3	3	3	3
CO4	2	3	3	3	3	2	1	3	3	3	3	2
CO5	2	2	3	3	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: 2021 - 2022							
Course Code	MT 424	**Title of the Course**	Reliability Theory	**L**	**T**	**P**	**C**
Year	I	**Semester**	I	**3**	**1**	**0**	
Pre-Requisite	Basics of reliability	**Co-requisite**					
Course Objectives	The course objective is to learn the basic concept of Reliability theory and its applications for decision-Making in the field of sciences and engineering.						

Course Outcomes	
CO1	Students will be able to understand the concept of Reliability function, hazard rate function, pdf in the form of Hazard function, Reliability function and mean time to failure distribution (MTTF) with DFR and IFR.
CO2	Students will be able to understand the Applications of exponential, normal and lognormal, Weibull and gamma distributions in reliability theory. Memory Loss property of exponential distribution.
CO3	Students will be able to understand the derivation to obtain Life cycle curves and probability distribution in modeling reliability, Reliability of the system with independent limit connected in (a) series (b) parallel and (c) k out of n systems.
CO4	Students will be able to understand the procedure of Reliability and mean life estimation based on failures time from (i) Complete data (ii) Censored data with and without replacement of failed items following exponential distribution [N C r], [N B r], [N B T], [N C(r, T)], [N B(r T)], [N C T].
CO5	Students will be able to understand the concept and applications of Accelerated testing: types of acceleration and stress loading. Life stress relationships. Arrhenius – lognormal, Arrhenius-Weibull, Arrhenius-exponential models, Power-Weibull and power exponential models.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1		Definition of Reliability function, hazard rate function, pdf in the form of Hazard function, Reliability function and mean time to failure distribution (MTTF) with DFR and IFR.	08	1
2		Applications of exponential, normal and lognormal, Weibull and gamma distributions in reliability theory. Memory Loss Cases property of exponential distribution.	08	2
3		Life cycle curves and probability distribution in modeling reliability, Reliability of the system with independent limit connected in (a) series (b) parallel and (c) k out of n systems.	08	3
4		Reliability and mean life estimation based on failures time from (i) Complete data (ii) Censored data with and without replacement of failed items following exponential distribution [N C r], [N B r], [N B T], [N C(r, T)], [N B(r T)], [N C T].	08	4
5		Accelerated testing: types of acceleration and stress loading. Life stress relationships. Arrhenius – lognormal, Arrhenius-Weibull, Arrhenius-exponential models, Power-Weibull and power exponential models.	08	5

Reference Books:

Sinha, S.K. (1980): Reliability and life testing, Wiley, Eastern Ltd.

Nelson, W. (1989): Accelerated Testing, Wiley.

Zacks, S.O.: Introduction to reliability analysis, probability models and statistical, Springer Verlag

e-Learning Source:

https://www.youtube.com/watch?v=xnAuIbiLS8Y

https://www.youtube.com/watch?v=VFNaLRNo-DI

https://www.youtube.com/watch?v=kU32nAniKBk

https://www.youtube.com/watch?v=6CLEWA2WNqM

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)											
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	2	3	1	2	2	3	2	3	3	3	3	3
CO2	3	3	2	2	1	3	3	3	3	3	3	2
CO3	2	2	1	2	3	3	2	3	3	3	3	3
CO4	3	3	1	3	2	3	3	3	3	3	3	2
CO5	2	3	2	3	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: 2021 - 2022							
Course Code	MT425	**Title of the Course**	Sample survey and R programming Lab	**L**	**T**	**P**	**C**
Year	I	**Semester**	I	**0**	**0**	**4**	
Pre-Requisite		**Co-requisite**					
Course Objectives	To teach students the practical implementation of sampling theory, Ratio and regression method of estimation. To make students able to work out all practical using R-Softwre.						

Course Outcomes	
CO1	After successful completion of Practical 1, students will be able to make use of simple random sampling.
CO2	After successful completion of Practical 2, students will be able to make use of stratified random sampling.
CO3	After successful completion of Practical 3 and 5, students will be able to make use of cluster sampling and two stage sampling.
CO4	After successful completion of Practical 4, students will be able to apply concept of ratio regression method for estimation.
CO5	After successful completion of Practical 6, students will be able to use of R Software to workout sampling problems.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Practical 1	Practical based on Simple Random Sampling		CO1
2	Practical 2	Practical based on Stratified Random Sampling		CO2
3	Practical 3	Practical based on Cluster Sampling		CO3
4	Practical 4	Practical based on Ratio and regression method		CO4
5	Practical 5	Two stage sampling		CO3
6	Practical 6	Analysis by R programming		CO5

Reference Books:

Cochran, W.G., (1977): Sampling Techniques, 3rd edition, John Wiley.

Des Raj and Chandak (1998): Sampling theory, Narosa.

Murthy, M.N. (1977): Sampling theory and methods. Statistical Publishing Society, Calcutta.

Sukhatme et al. (1984): Sampling theory of surveys with applications, Lowa state university press

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	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	2	1	1	3	3	3	3	3	3
CO2	2	1	2	1	2	1	2	3	3	3	3	2
CO3	3	2	1	1	2	1	3	2	3	3	3	2
CO4	2	1	2	1	2	1	2	3	3	3	3	2
CO5	3	1	2	2	2	1	2	2	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

Department of Mathematics & Statistics

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

M. Sc. (Statistics) **Ist year / IInd Semester**

S. No.	Course code	Course Title	Type of Paper	Period Per hr/week/sem			Evaluation Scheme				Sub. Total	Credit	Total Credits	Attributes							United Nations Sustainable Development Goals (SDGs
				L	T	P	CT	TA	Total	ESE				Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics	
THEORIES																					
1	MT416	Linear Algebra	Core	03	01	00	40	20	60	40	100	3:1:0	4	√		√					
2	MT427	Linear Models & Regression Analysis	Core	03	01	00	40	20	60	40	100	3:1:0	4	√		√					
3	MT428	Design & Analysis of Experiments	Core	03	01	00	40	20	60	40	100	3:1:0	4	√		√					
4	MT429	Statistical Inference-I	Core	03	01	00	40	20	60	40	100	3:1:0	4	√		√					
5	MT430	Non-Parametric & Order Statistics	Core	03	01	00	40	20	60	40	100	3:1:0	4	√		√					
PRACTICAL																					
6	MT431	Data Analytics with SPSS	**Core**	00	00	06	40	20	60	40	100	0:0:3	3	√		√				√	
			Total	**15**	**05**	**06**	**240**	**120**	**360**	**240**	**600**	**23**	**23**								

Integral University, Lucknow

Effective from Session: 2018 - 19							
Course Code	MT416	**Title of the Course**	Linear algebra	**L**	**T**	**P**	**C**
Year	**I**	**Semester**	II	**3**	**1**	**0**	
Pre-Requisite	B.Sc. with Mathematics	**Co-requisite**					
Course Objectives	This course enables the students to understand the basic ideas of vector algebra, linear dependent and independent set and basis. Students of the course should master properties of matrices including how to use them to solve linear systems of equations and how they are used in linear transformations between vector spaces.						

Course Outcomes	
CO1	Students will be able to explain the concept of vector spaces and linear dependency of vectors.
CO2	Students will be able to describe basis, rank of matrices and direct sum of vector spaces.
CO3	Students will be an understanding of linear operators, their properties and algebra of transformations.
CO4	Students will be able to describe Matrix representation of a linear transformation and their applications.
CO5	Students will be able to explain eigen values, change of basis and diagonalization.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Unit 1**	Vector spaces, subspaces, examples, Linear dependence and independence, Spanning set, Linear span, Row space of matrix.	8	1
2	**Unit 2**	Basis and dimension, Application to matrices, Rank of matrices, Direct sums and complements, Quotient spaces.	8	2
3	**Unit 3**	Students will be an understanding of linear operators, their properties and algebra of transformations.	8	3
4	**Unit 4**	Students will be able to describe Matrix representation of a linear transformation and their applications.	8	4
5	**Unit 5**	Students will be able to explain eigen values, change of basis and diagonalization.	8	5

Reference Books:

1. Hoffman & Kunze: Linear Algebra
2. V Krishnamurthy: An introduction to linear algebra
3. Schaum's Outline Series: Linear Algebra

e-Learning Source:

1. https://nptel.ac.in/courses/111/105/111105112/
2. https://nptel.ac.in/courses/111/101/111101115/
3. https://nptel.ac.in/courses/111/106/111106135/

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)											
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	3	1	2	3	1	2	3	3	2	1	1
CO2	3	2	2	2	2	1	3	3	3	3	2	1
CO3	3	2	2	2	2	1	2	2	3	2	2	1
CO4	3	2	2	2	2	1	2	3	3	2	1	1
CO5	3	2	1	2	3	1	2	3	3	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: 2021 - 2022							
Course Code	MT 427	**Title of the Course**	Linear Models & Regression Analysis	**L**	**T**	**P**	**C**
Year	I	**Semester**	II	**3**	**1**	**0**	
Pre-Requisite	Simple regression	**Co-requisite**					
Course Objectives	The course objective is to introduce basic and advance concepts of general linear model, and its application areas like design of experiments, econometrics, survival analysis and demography						

Course Outcomes	
CO1	Students will be able to understand the concept of Gauss-Markov Set-up, Normal equations and Least square estimates. Variance and Covariances of least square estimates, estimation of error variance, least square estimates with restrictions on parameters. Simultaneous estimates of linear parametric functions.
CO2	Students will be able to understand the simple linear regression, multiple regressions, fitting of polynomials and use of orthogonal polynomials, selecting the best regression equation: Stepwise regression, backward elimination
CO3	Students will be able to understand the concept of Test of hypotheses for one and more than one linear parametric functions. Confidence intervals and regions, Analysis of variance, multiple comparison tests due to Tukey and Scheffe
CO4	Students will be able to understand the procedure of Residuals and their plots Tests for departure from assumptions such as fitness of the model normality, homogeneity of variances and detection of outliers, Remedies
CO5	Students will be able to understand the concept and applications of Multicollinearity, Ridge regression and Principal Component regression, subset selection of explanatory variables,Mallow's Cp statistic, Introduction to logistic regression

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1		Gauss-Markov Set-up, Normal equations and Least square estimates. Variance and Covariances of least square estimates, estimation of error variance, least square estimates with restrictions on parameters. Simultaneous estimates of linear parametric functions.	08	1
2		simple linear regression, multiple regressions, fitting of polynomials and use of orthogonal polynomials, selecting the best regression equation: Stepwise regression, backward elimination	08	2
3		Test of hypotheses for one and more than one linear parametric functions. Confidence intervals and regions, Analysis of variance, multiple comparison tests due to Tukey and Scheffe	08	3
4		Residuals and their plots Tests for departure from assumptions such as fitness of the model normality, homogeneity of variances and detection of outliers, Remedies	08	4
5		Multicollinearity Ridge regression and Principal Component regression, subset selection of explanatory variables,Mallow's Cp statistic, Introduction to logistic regression	08	5

Reference Books:

Cook, R.D. and Weisberg, S.: Residual and Influence in Regression. Chapman and Hall.

Draper, N.R.and Smith, H.: Applied Regression Analysis, Wiley.

Gunst, F. and Mason, R.L.: Regression analysis and its Applications - A Data Oriented Aproach. Marcel and Dekker.

Montgomery D.C., Peck E.A. and Vining G.G.: Introduction to Linear Regression Analysis. Wiley.

Weisberg, S.: Applied Linear Regression. Wiley.

e-Learning Source:

https://www.youtube.com/watch?v=m88h75F3Rl8

https://www.youtube.com/watch?v=zPG4NjIkCjc

https://www.youtube.com/watch?v=owI7zxCqNY0

https://www.youtube.com/watch?v=lzGKRSvs5HM

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)											
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	1	1	1	2	3	3	3	3	3	2	2
CO2	3	1	1	1	1	3	3	3	3	3	3	3
CO3	3	1	1	2	1	3	3	3	3	3	3	2
CO4	3	3	1	3	2	3	3	3	3	3	3	3
CO5	3	2	1	1	2	3	3	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: 2021 - 2022							
Course Code	MT 428	**Title of the Course**	Design & Analysis of Experiments	**L**	**T**	**P**	**C**
Year	I	**Semester**	II	**3**	**1**	**0**	
Pre-Requisite	Analysis of variance	**Co-requisite**					
Course Objectives	The course objective is to learn the the concept of Design of experiment and its basic principles and perform the basic symmetric designs CRD, RBD and LSD with and without missing observations. Also learn the concept of factorial experiments and their practical applications.						

Course Outcomes	
CO1	Students will be able to understand the concept of Analysis of variance and multiple comparisons tests, principles of design of experiments and relative efficiency. Fixed, mixed and random effects models; Variance components estimation - study of various methods; Tests for variance components; Basic designs-CRD, RBD, LSD and their analyses, Orthogonality of classification in two-way lay-outs. Missing plot technique - general theory and applications.
CO2	Students will be able to understand. General factorial experiments – symmetric and asymmetric factorials, study of 2n and 3n factorial experiments in randomized blocks, complete and partial confounding; Fractional replications for symmetric factorials.
CO3	Students will be able to understand the concept of General block design: Criteria for connectedness, incomplete block designs, balanced incomplete block designs, simple lattice designs
CO4	Students will be able to understand the procedure of Nested and split plot designs – Two stage nested designs, split plot designs, strip plot designs, strip-split designs, Analysis of covariance for CRD and RBD with one, two covariates; clinical trials, longitudinal data, treatment- control designs
CO5	Students will be able to understand the concept and applications of Response surface designs: Response surface areas, first and second order designs, blocking in response surfaces, optimal designs for response surfaces.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1		Analysis of variance and multiple comparisons tests, principles of design of experiments and relative efficiency. Fixed, mixed and random effects models; Variance components estimation - study of various methods; Tests for variance components; Basic designs-CRD, RBD, LSD and their analyses, Orthogonality of classification in two-way lay-outs. Missing plot technique - general theory and applications.	08	1
2		General factorial experiments – symmetric and asymmetric factorials, study of 2n and 3n factorial experiments in randomized blocks, complete and partial confounding; Fractional replications for symmetric factorials.	08	2
3		General block design: Criteria for connectedness, incomplete block designs, balanced incomplete block designs, simple lattice designs.	08	3
4		Nested and split plot designs – Two stage nested designs, split plot designs, strip plot designs, strip-split designs, Analysis of covariance for CRD and RBD with one, two covariates; clinical trials, longitudinal data, treatment- control designs.	08	4
5		Response surface designs: Response surface areas, first and second order designs, blocking in response surfaces, optimal designs for response surfaces.	08	5

Reference Books:

Wu C.F.J and Hamada. M.: Experiments, Planning, Analysis and Optimization, Wiley

Montgomery D. C.: Design and Analysis of Experiments, Wiley

Oehlert. G. W.: A First course in Design and Analysis of Experiments. University of Minnesota

Casella, G.: Statistical Design. Springer

Khuri, A. and Cornell. M. Response Surface Methodology. Marcel Dekker

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	PO8	PSO1	PSO2	PSO3	PSO4
CO1	2	3	1	2	2	3	3	2	3	3	3	2
CO2	3	2	1	2	1	3	3	3	3	3	3	2
CO3	2	2	1	2	3	3	2	3	3	3	3	2
CO4	3	3	1	3	2	3	3	3	3	3	3	2
CO5	2	2	1	3	2	3	3	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: 2021 - 2022							
Course Code	MT 429	**Title of the Course**	Statistical Inference-I	**L**	**T**	**P**	**C**
Year	I	**Semester**	II	**3**	**1**	**0**	
Pre-Requisite	Simple regression	**Co-requisite**					
Course Objectives	To introduce the concepts of statistical inference and its applications in real data analysis including sample surveys, design of experiments, and econometrics.						

Course Outcomes	
CO1	Students will be able to understand the concept of Criterion of a good estimator: unbiased, consistency, efficiency and sufficiency. Minimal sufficient statistics, Exponential and Pitman family of distributions, complete sufficient statistic, Rao-Blackwell theorem, Lehmann-Scheffe theorem
CO2	Students will be able to understand the Cramer-Rao lower bound,Method of moment estimators, Maximum likelihood estimator (MLE), its small and large sample properties, Method of Minimum Chi square, Method of Least Squares, CAN and BAN estimators
CO3	Students will be able to understand the concept of Randomized and Non-randomized tests, Most Powerful (MP) test, Uniformly Most Powerful (UMP) and Uniformly Most Powerful Unbiased (UMPU) tests, UMP tests for monotone likelihood ratio (MLR) family of distributions
CO4	Students will be able to understand the procedure of Likelihood ratio test (LRT) with its asymptotic distribution, Similar tests with Neyman structure, Ancillary statistic and Basu' s theorem. Construction of similar and UMPU tests through Neyman structure
CO5	Students will be able to understand the concept and applications of Interval estimation, confidence level, construction of confidence intervals using pivots, shortest expected length confidence interval, uniformly most accurate one sided confidence interval and its relation to UMP test for one sided null against one sided alternative hypothesis

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1		Criterion of a good estimator: unbiased, consistency, efficiency and sufficiency. Minimal sufficient statistics, Exponential and Pitman family of distributions, complete sufficient statistic, Rao-Blackwell theorem, Lehmann-Scheffe theorem	08	1
2		Cramer-Rao lower bound,Method of moment estimators, Maximum likelihood estimator (MLE), its small and large sample properties, Method of Minimum Chi square, Method of Least Squares, CAN and BAN estimators	08	2
3		Randomized and Non-randomized tests, Most Powerful (MP) test, Uniformly Most Powerful (UMP) and Uniformly Most Powerful Unbiased (UMPU) tests, UMP tests for monotone likelihood ratio (MLR) family of distributions	08	3
4		Likelihood ratio test (LRT) with its asymptotic distribution, Similar tests with Neyman structure, Ancillary statistic and Basu' s theorem. Construction of similar and UMPU tests through Neyman structure	08	4
5		Interval estimation, confidence level, construction of confidence intervals using pivots, shortest expected length confidence interval, uniformly most accurate one sided confidence interval and its relation to UMP test for one sided null against one sided alternative hypothesis	08	5

Reference Books:

Lehmann, E.L., Casella, G.: Theory of Point Estimation, Springer.

Lehmann, E.L., Romano, J.P., Casella, G.: Testing Statistical Hypothesis, Springer.

Rao, C.R.: Linear Statistical Inference and its Applications, Wiley.

Rohatgi, VK and Saleh, A.K.: An introduction to probability and statistics, John Wiley

Kale, B. K.: A First Course on Parametric Inference, Narosa Publishing House.

CasellaG. and Berger R.L.: Statistical Inference, Duxbury.

e-Learning Source:

https://www.youtube.com/watch?v=tFRXsngz4UQ

https://www.youtube.com/watch?v=wyu7uUbVYYM

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

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)											
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	2	1	2	1	1	2	3	3	3	3	3	3
CO2	2	1	2	1	1	3	3	3	3	3	3	2
CO3	3	1	1	2	1	3	3	3	3	3	3	2
CO4	3	3	1	3	2	3	3	3	3	3	3	3
CO5	3	2	1	1	2	3	3	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: 2021 - 2022							
Course Code	MT 430	**Title of the Course**	Non Parametric & Order Statistics	**L**	**T**	**P**	**C**
Year	I	**Semester**	II	**3**	**1**	**0**	
Pre-Requisite	Probability distribution	**Co-requisite**					
Course Objectives	The objective is to introduce the concepts and applications of Non Parametric & Order Statistics						

Course Outcomes	
CO1	Students will be able to understand the concept of Order Statistics: Discrete & continuous joint and marginal distribution of order statistics, distribution of range, distribution of censored sample, example based on continuous distributions.
CO2	Students will be able to understand the Moments of order statistics, Large sample approximations to mean and variance of order statistics. Asymptotic distributions of order statistics, Recurrence relations and identities for moments of order statistics, Distribution-free bounds for moments of order statistics and of the range
CO3	Students will be able to understand the concept of Non-parametric location tests: One sample problem: Sign test, signed rank test, Kolmogrov-Smirnov test, Test of independence (run test). Two sample problem: Wilcoxon-Mann-Whitney test, Median test, Kolmogrov-Smirnov test
CO4	Students will be able to understand the procedure of Non-parametric scale tests: Ansari-Bradely test, Mood test, Kendall's Tau test, test of randomness, consistency of tests and ARE
CO5	Students will be able to understand the concept of Limit distribution of k-th order statistics. Extreme value laws and their properties; asymptotic joint distribution of extreme order statistics, asymptotic distribution of central order statistic

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1		Order Statistics: Discrete & continuous joint and marginal distribution of order statistics, distribution of range, distribution of censored sample, example based on continuous distributions.	08	1
2		the Moments of order statistics, Large sample approximations to mean and variance of order statistics. Asymptotic distributions of order statistics, Recurrence relations and identities for moments of order statistics, Distribution-free bounds for moments of order statistics and of the range	08	2
3		Non-parametric location tests: One sample problem: Sign test, signed rank test, Kolmogrov-Smirnov test, Test of independence (run test). Two sample problem: Wilcoxon-Mann-Whitney test, Median test, Kolmogrov-Smirnov test	08	3
4		Non-parametric scale tests: Ansari-Bradely test, Mood test, Kendall's Tau test, test of randomness, consistency of tests and ARE	08	4
5		Limit distribution of k-th order statistics. Extreme value laws and their properties; asymptotic joint distribution of extreme order statistics, asymptotic distribution of central order statistic	08	5

Reference Books:

Gibbons, J. D. and Chakraborti, S.: Nonparametric Statistical Inference, CRC Press.

Hogg, R. V., McKean, J. and Craig, A. T.: Introduction to Mathematical Statistics, Pearson

Arnold, B. C., Balakrishnan, N. and Nagaraja H. N.: A First Course in Order Statistics, John Wiley & Sons.

Randles, R. H. and Wolfe, D. A.: Introduction to the Theory of Nonparametric Statistics, Krieger.

Galambos, J.: The Asymptotic Theory of Extreme Order Statistics, Wiley.

e-Learning Source:

https://www.youtube.com/watch?v=gDtkGqLD1R0

https://www.youtube.com/watch?v=gEa8XbPnT-k

https://www.coursera.org/lecture/inferential-statistics/6-01-non-parametric-tests-why-and-when-7GQkp

http://www.bristol.ac.uk/medical-school/media/rms/red/rank_based_non_parametric_tests.html

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)											
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1	2	1	2	3	2	3	3	3	2
CO2	2	1	2	1	1	3	2	3	3	3	3	3
CO3	3	1	2	1	1	2	3	3	3	3	3	3
CO4	3	3	1	3	2	3	3	3	3	3	3	2
CO5	3	2	1	1	2	3	3	3	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: 2021 - 2022							
Course Code	MT 431	**Title of the Course**	Data Analytics with SPSS	**L**	**T**	**P**	**C**
Year	I	**Semester**	II	**0**	**0**	**6**	
Pre-Requisite		**Co-requisite**					
Course Objectives	The objective is to train the students in statistical data analysis using SPSS software package in real life problems						

Course Outcomes	
CO1	Students will be practically able to understand the concept of Introduction to SPSS: Layout of SPSS, data editor window, data files, import and export of data files, defining variables, data and variable views, entry, recoding, computing new variables, selection of cases, splitting and merging of files, working with multiple data sources.
CO2	Students will be practically able to understand the Analyzing Data, Frequencies, descriptive statistics, percentile ranks for a single/multiple variables, Measures of central tendency for single/multiple groups, standard scores, bar charts, histograms, pie chart, scatter plots and box plots, Summarize, Means, OLAP Curves.
CO3	Students will be practically able to understand the concept of Pearson correlation coefficient, Spearman correlation coefficient, Partial Correlation, Distances, simple linear regression, multiple linear regression. Testing of Hypothesis: Parametric tests; Single sample t test, Independent samples t test, paired t test.
CO4	Students will be practically able to understand the procedure of One way ANOVA, Factorial ANOVA, Repeated Measures ANOVA, Analysis of Covariance, multiple comparison test. *Cronbach's alpha* test, Test – retest Reliability
CO5	Students will be practically able to understand the concept of Nonparametric tests; chi square goodness of fit, chi square test for independence, run test for randomness, Kruskal Wallis Test Sign Test, Mann Whitney U test, Wilcoxon signed-rank test sign test for location, median test, Kolmogorov-Smirnov test - one and two sample problems

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1		Introduction to SPSS: Layout of SPSS, data editor window, data files, import and export of data files, defining variables, data and variable views, entry, recoding, computing new variables, selection of cases, splitting and merging of files, working with multiple data sources.	08	1
2		Analyzing Data, Frequencies, descriptive statistics, percentile ranks for a single/multiple variables, Measures of central tendency for single/multiple groups, standard scores, bar charts, histograms, pie chart, scatter plots and box plots, Summarize, Means, OLAP Curves.	08	2
3		Pearson correlation coefficient, Spearman correlation coefficient, Partial Correlation, Distances, simple linear regression, multiple linear regression. Testing of Hypothesis: Parametric tests; Single sample t test, Independent samples t test, paired t test.	08	3
4		One way ANOVA, Factorial ANOVA, Repeated Measures ANOVA, Analysis of Covariance, multiple comparison test. *Cronbach's alpha* test, Test – retest Reliability	08	4
5		Nonparametric tests; chi square goodness of fit, chi square test for independence, run test for randomness, Kruskal Wallis Test Sign Test, Mann Whitney U test, Wilcoxon signed-rank test sign test for location, median test, Kolmogorov-Smirnov test - one and two sample problems	08	5

Reference Books:

John MacInnes, An Introduction to Secondary Data Analysis with IBM SPSS Statistics, Sage.

MarijaNorusis, The SPSS Guide to Data Analysis.

Stephen A. Sweet, and Karen Grace-Martin, Data Analysis with SPSS: A First Course in Applied Statistics, Pearson.

Pallant, Julie,SPSS Survival Manual, McGraw-Hill.

Cronk, Brian, How to Use SPSS: A Step-By-Step Guide to Analysis and Interpretation, Pyrczak Publishing

Landau S. and Everitt B.S., A handbook of Statistical Analysis using SPSS, Chapman & Hall.

Cleophas T.J. and Zwinderman A.H., SPSS for Starters, Springer

e-Learning Source:

https://www.youtube.com/watch?v=U18BD4jqz5g

https://www.youtube.com/watch?v=TZPyOJ8tFcI

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	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	1	1	1	1	2	3	3	3	3	3	3
CO2	2	1	1	1	1	1	2	3	3	3	3	3
CO3	3	1	1	1	1	1	3	3	3	3	3	3
CO4	3	1	1	1	2	1	3	3	3	3	3	3
CO5	3	1	1	1	1	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**