FACULTY OF SCIENCES

SYLLABUS

FOR

B.Sc. (Hons.) MATHEMATICS
(Credit Based Evaluation & Grading System)
(FOR OLD STUDENTS)
(Semester : III-IV)

Examinations: 2019-20

GURU NANAK DEV UNIVERSITY
AMRITSAR

(ii) Subject to change in the syllabi at any time.
Please visit the University website time to time.

B.Sc. (Hons.) Mathematics (Semester System)
(Credit Based Evaluation & Grading System)

Scheme

Note : All Theory Papers having Mid Semester Marks : 20 & End Semester Marks : 80. Total Marks will be 100.

Semester III

Course No.	C/E/I	Course Title	Hrs/ Week	L-T-P
MTL221	C	Calculus III	4	3-1-0
MTL222	C	Ordinary Differential Equations & Special Functions	4	3-1-0
MTL223	C	Probability Theory	4	3-1-0
MTL 224	C	Analytical Trigonometry	4	1-1-0
MTL 225	C	Python Programming	4	3-0-1
*ESL220	C	Environmental Studies (Compulsory)	4	4-0-0
I-1	I	ID Course	4	4-0-0

***Note : Credits will not be included in the total.**

Semester IV

Course No.	C/E/I	Course Title	Hrs/ Week	L-T-P
MTL251	C	Vector Calculus	4	3-1-0
MTL252	C	Linear Algebra	4	3-1-0
MTL253	C	Group Theory	4	3-1-0
MTL 254	C	Statistical Methods	4	3-1-0
MTL 255	C	R Programming	4	3-0-1
I-2	I	ID Course	4	4-0-0

Note : PSL-053 ID Course Human Rights & Constitutional Duties (Compulsory ID Paper). Students can opt. this paper in any semester except the 1st Semester. This ID Paper is one of the total ID Papers of this course.

Calculus III

Course No. **LTP**
MTL-221 **3 1 0**
Time: 3 Hours **Max. Marks: 100**
Mid Semester Marks : 20
End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section A

Real Valued functions of several variables with emphasis on functions of two and three variables, Limits and continuity, Partial derivatives, Homogenous Functions, Euler's Theorem

Section B

Total differentiation, Differentiation of composite functions, Implicit functions, Chain Rule, Jacobians, Directional Derivatives, Gradient Vectors, Tangent Planes.

Section C

Saddle Points, Maxima and Minima of functions of two variables, Lagrange's multipler method, Higher dimensional analogues of Lagrange's Mean value Theorem and Taylor's theorem for functions of two variables.

Section D

Double integration over rectangular and non-rectangular regions, change of order of integration, double integration in polar co-ordinates, triple integration over parallelepiped and other solid regions, Applications of double and triple integrals to area, volume, centre of gravity, moment of inertia etc.

Suggested Readings

1. George B. Thomas and Ross L. Finney: Calculus and Analytic Geometry, 9th Edition, Addison Wesley, 1998. (**Scope as in Ch.11-13)**
2. Shanti Narayan & P.K. Mittal: Differential Calculus, S. Chand & Co.
3. Shanti Narayan & P.K. Mittal: Integral Calculus, S. Chand & Co.

B.Sc. (Hons.) Mathematics (Semester-III)
(Credit Based Evaluation & Grading System)

Ordinary Differential Equations & Special Functions

Course No.	**L T P**
MTL-222	**3 1 0**

Time: 3 Hours **Max. Marks: 100**
Mid Semester Marks : 20
End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

SECTION–A

Exact differential equations. First order and higher degree equations solvable for *x,y,p.* Clairaut's form and singular solutions. Geometrical meaning of a differential equation. Orthogonal trajectories. Linear differential equations with constant coefficients.

SECTION– B

Linear differential equations with variable coefficients, Variation of Parameters method, reduction method, series solutions of differential equations. Power series method, Bessel and Legendre equations (only series solution).

SECTION-C

Bessel’s Functions: Recurrence relations, Generating Function, Orthogonal Property, Trigonometric Expansions involving Bessel’s Functions.

SECTION-D

Legendre’s Functions: Recurrence Relations, Generating Function, Rodrigue’s Formula, Orthogonal Property, Trigonometric Series, Laplace definite integrals, Christoffel’s expansion

BOOKS RECOMMENDED:

1. D.A. Murray: Introductory Course in Differential Equations. Orient Longman (India), 1967.
2. G.F. Simmons: Differential Equations, Tata McGraw Hill, 1972.
3. E.A. Codington: An Introduction to Ordinary Differential Equations, Prentice Hall of India, 1961.
4. F.D. Rainville: Special Functions

Probability Theory

Course No. **L T P**
MTL-223 **3 1 0**

Time: 3 Hours **Max. Marks: 100**
Mid Semester Marks : 20
End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section-A
Sample Space, Probability axioms, Combinatorics: Probability on finite sample space, conditional probability and independence, Baye's theorem. Geometric probability.

Section-B
Random variables, probability mass function, probability density function, Distribution Function, Function of a random variable and its distribution, probability integral transformation. Multiple random variables, Joint, marginal and conditional distributions, Functions of random variables and their distributions.

Section-C
Mathematical expectation, conditional expectation, moments, moment generating function, characteristic function, probability generating function, covariance and correlation, properties of correlation coefficient. Chebyshev's inequality, Inequality of expectation: Cauchy Schwartz inequality, Jensen's inequality.

Section-D
Reliability, failure rate of the system reliability, order statistics, joint distribution, marginal distribution of order statistics, distribution of range.

Suggested Readings:

1. Meyer, P.L. (1990): Introductory Probability and Statistical Applications, Oxford & IBH Pub.
2. Rohatgi, V. K. and Saleh: An Introduction to Probability Theory and Mathematical Statistics, A.K.M.E. Wiley Eastern.
3. Casella, R. and Berger, R. L. Statistical Inference, Duxbury Press.

Analytical Trigonometry

Course No. **LTP**
MTL-224 **1 1 0**

Time: 3 Hours **Max. Marks: 100**
Mid Semester Marks : 20
End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section-A

Complex quantities, De-Moivre's Theorem and its simple applications, Bionomial theorem for complex quantities (without proof).

Section-B

Expansions of sin $n\theta, cos\ n\theta,$ tan $n\theta$ in terms of trigonometric functions of θ, Expansions of sine, cosine and tangents of an angle in series of ascending powers of an angle.

Section-C

Expansions of sines and cosines of multiple angles and of powers of sines and consines, circular and hyperbolic functions and their inverses.

Section-D

Exponential and lograthmic functions of a complex number, Gregory's series and the value of π, summation of series.

Books Recommended:-

1. S.L. Loney: Plane Trigonometry Part-II (Relevant portions of chapters I to VIII), Combridge Universal Press.

2. Erwin Kreyzig: Advanced Enginnering Mathematics, John Wiley.

Python Programming

Course No.	**LTP**
MTL-225	**3 0 1**

Time: 3 Hours **Max. Marks: 100**
Mid Semester Marks : 20
End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

SECTION A

Introduction to python and Setting up the Python development Environment, Basic syntax, interactive shell, editing, saving, and running a script, Concept of data types, Declaring and using Numeric data types: int, float, complex Lists and Tuples and their basic operations, Python console Input / Output. Arithmetic operators and expressions, Conditions, Comparison operators, Logical Operators, Is and In operators.

SECTION B

String Handling, Unicode strings, Strings Manipulation:- compare strings, concatenation of strings, Slicing strings in python, converting strings to numbers and vice versa. Dictionaries Control statements: if-else, Nested If-Else, Loops (for, while) Loop manipulation using pass, continue, break and else

SECTION C

Built in function and modules in python, user defined functions, passing parameters, arguments and return values; formal vs actual arguments, Lamda function in python, Recursion, organizing python codes using functions, Programming using functions, modules and external packages

SECTION D

Files: manipulating files and directories, os and sys modules; text files: reading/writing text and numbers from/to a file; creating and reading a formatted file (csv or tab separated) understanding read functions, read(), readline() and readlines() Understanding write functions, write() and writelines() Manipulating file pointer using seek. Introduction to graphics.

Suggested Readings:

1. Learning Python by Mark Lutz, 5th edition
2. Python cookbook, by David Beazley , 3rd Edition
3. Python Essential Reference, by David Beazley , 4th edition
4. Python programming: An Introduction to computer science, by John Zelle, 2nd Edition.
5. Python in a Nutshell, by Alex Mortelli, 2nd Edition

ESL-220 : ENVIRONMENTAL STUDIES (COMPULSORY)

Credits: 4-0-0

Teaching Methodologies

The Core Module Syllabus for Environmental Studies includes class room teaching and field work. The syllabus is divided into 8 Units [Unit-1 to Unit-VII] covering 45 lectures + 5 hours for field work [Unit-VIII]. The first 7 Units will cover 45 lectures which are class room based to enhance knowledge skills and attitude to environment. Unit-VIII comprises of 5 hours field work to be submitted by each candidate to the Teacher in-charge for evaluation latest by 15 December, 2019.

Exam Pattern: **End Semester Examination- 75 marks**
Project Report/Field Study- 25 marks [based on submitted report]
Total Marks- 100

The structure of the question paper being:

Part-A, Short answer pattern with inbuilt choice – **25 marks**
Attempt any five questions out of seven distributed equally from Unit-1 to Unit-VII.
Each question carries 5 marks. Answer to each question should not exceed 2 pages.

Part-B, Essay type with inbuilt choice – **50 marks**
Attempt any five questions out of eight distributed equally from Unit-1 to Unit-VII. Each question carries 10 marks. Answer to each question should not exceed 5 pages.

Project Report / Internal Assessment:

Part-C, Field work – **25 marks [Field work equal to 5 lecture hours]**
The candidate will submit a hand written field work report showing photographs, sketches, observations, perspective of any topic related to Environment or Ecosystem. The exhaustive list for project report/area of study are given just for reference:

1. Visit to a local area to document environmental assets: River / Forest/ Grassland / Hill / Mountain / Water body / Pond / Lake / Solid Waste Disposal / Water Treatment Plant / Wastewater Treatment Facility etc.
2. Visit to a local polluted site – Urban / Rural / Industrial / Agricultural
3. Study of common plants, insects, birds
4. Study of tree in your areas with their botanical names and soil types
5. Study of birds and their nesting habits
6. Study of local pond in terms of wastewater inflow and water quality
7. Study of industrial units in your area. Name of industry, type of industry, Size (Large, Medium or small scale)
8. Study of common disease in the village and basic data from community health centre
9. Adopt any five young plants and photograph its growth
10. Analyze the Total dissolved solids of ground water samples in your area.
11. Study of Particulate Matter ($PM_{2.5}$ or PM_{10}) data from Sameer website. Download from Play store.
12. Perspective on any field on Environmental Studies with secondary data taken from Central Pollution Control Board, State Pollution Control Board, State Science & Technology Council etc.

Unit-I

The multidisciplinary nature of environmental studies

Definition, scope and importance, Need for public awareness

(2 lectures)

Unit-II

Natural Resources: Renewable and non-renewable resources:

Natural resources and associated problems.

(a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people.

(b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.

(c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

(d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.

(e) Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources, case studies.

(f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

- Role of an individual in conservation of natural resources.
- Equitable use of resources for sustainable lifestyles.

(8 Lectures)

Unit-III

Ecosystems

- Concept of an ecosystem
- Structure and function of an ecosystem
- Producers, consumers and decomposers
- Energy flow in the ecosystem
- Ecological succession
- Food chains, food webs and ecological pyramids
- Introduction, types, characteristic features, structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, ocean estuaries)

(6 Lectures)

Unit-IV

Biodiversity and its conservation

- Introduction – Definition: genetic, species and ecosystem diversity
- Biogeographical classification of India
- Value of biodiversity: consumptive use, productive use, social, ethical aesthetic and option values
- Biodiversity at global, national and local levels
- India as a mega-diversity nation
- Hot-spots of biodiversity
- Threats to biodiversity: habitat loss, poaching of wildlife, man wildlife conflicts
- Endangered and endemic species of India
- Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity

(8 Lectures)

Unit-V

Environmental Pollution

Definition

- Causes, effects and control measures of Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear pollution
- Solid waste management: Causes, effects and control measures of urban and industrial wastes.
- Role of an individual in prevention of pollution
- Pollution case studies
- Disaster management: floods, earthquake, cyclone and landslides

(8 Lectures)

Unit-VI

Social Issues and the Environment

- From unsustainable to sustainable development
- Urban problems and related to energy
- Water conservation, rain water harvesting, watershed management
- Resettlement and rehabilitation of people; its problems and concerns. Case studies.
- Environmental ethics: Issues and possible solutions
- Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies.
- Wasteland reclamation
- Consumerism and waste products
- Environmental Protection Act, 1986
- Air (Prevention and Control of Pollution) Act, 1981
- Water (Prevention and control of Pollution) Act, 1974
- Wildlife Protection Act
- Forest Conservation Act
- Issues involved in enforcement of environmental legislation
- Public awareness

(7 Lectures)

Unit-VII

Human Population and the Environment

- Population growth, variation among nations
- Population explosion – Family Welfare Programmes
- Environment and human health
- Human Rights
- Value Education
- HIV / AIDS
- Women and Child Welfare
- Role of Information Technology in Environment and Human Health
- Case Studies

(6 Lectures)

Unit-VIII

Field Work

- Visit to a local area to document environmental assets river/forest/grassland/hill/mountain
- Visit to a local polluted site – Urban / Rural / Industrial / Agricultural
- Study of common plants, insects, birds
- Study of simple ecosystems-pond, river, hill slopes, etc

(Field work equal to 5 lecture hours)

References:

1. Bharucha, E. 2005. Textbook of Environmental Studies, Universities Press, Hyderabad.
2. Down to Earth, Centre for Science and Environment, New Delhi.
3. Heywood, V.H. & Waston, R.T. 1995. Global Biodiversity Assessment, Cambridge House, Delhi.
4. Joseph, K. & Nagendran, R. 2004. Essentials of Environmental Studies, Pearson Education (Singapore) Pte. Ltd., Delhi.
5. Kaushik, A. & Kaushik, C.P. 2004. Perspective in Environmental Studies, New Age International (P) Ltd, New Delhi.
6. Rajagopalan, R. 2011. Environmental Studies from Crisis to Cure. Oxford University Press, New Delhi.
7. Sharma, J. P., Sharma. N.K. & Yadav, N.S. 2005. Comprehensive Environmental Studies, Laxmi Publications, New Delhi.
8. Sharma, P. D. 2009. Ecology and Environment, Rastogi Publications, Meerut.
9. State of India's Environment 2018 by Centre for Sciences and Environment, New Delhi
10. Subramanian, V. 2002. A Text Book in Environmental Sciences, Narosa Publishing House, New Delhi.

Vector Calculus

Course No. **LTP**
MTL-251 **3 1 0**
Time: 3 Hours **Max. Marks: 100**
Mid Semester Marks : 20
End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section A

Geometry of R^n: dot product and its geometry, norm, angle between two vectors, Cauchy-Schwarz inequality, the triangle inequality, cross product and its geometric interpretation, Open and closed sets in R^n, Review of calculus of several variables

Section B

Differentiation in several variables:, Derivative as Jacobian matrix, directional derivative and the gradient, tangent plane to a surface, the inverse function theorem and the implicit function theorem (**without proofs**) and their applications, Newton's method

Section C

Vector-valued functions: Scalar and Vector fields, gradient fields and potentials, flow line, gradient, divergence, curl and the del operator, Orthogonal curvilinear coordinates

Line integrals: Scalar and vector line integrals, work, line integrals along curves, Green's theorem and divergence theorem in plane, Conservative vector fields, gradient fields and line integrals, scalar potentials

Section D

Surface Integrals: Parameterized surfaces, piecewise smooth parameterized surface and its area, scalar and vector surface integrals with interpretations, Stokes theorem

Volume Integrals: Volume integrals, Gauss Divergence Theorem, Stoke's theorem from the Divergence theorem, Meaning of divergence and curl

Suggested Readings

1. Susan Jane Colley, Vector Calculus (Fourth Ed.), Pearson Education, Inc, 2012 (**Scope as in Ch. 1-3, 6-7**)
2. George B. Thomas and Ross L. Finney: Calculus and Analytic Geometry, 9th Edition, Addison Wesley, 1998. (**Scope as in Ch 11, 14**)

Linear Algebra

Course No. **LTP**
MTL-252 **3 1 0**

Time: 3 Hours **Max. Marks: 100**
Mid Semester Marks : 20
End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section-A

Definition and examples of vector spaces, properties of vector spaces, subspaces, examples of subspaces, sums and direct sums of subspaces, finite dimensional vector space: span of a list of vectors, linear independence and dependence of vectors.

Section-B

Basis of a vector space, extension of a list to a Linear Independent basis, reduction of a spanning list to a basis, direct complement of subspace, dimension theorems, quotient space, dimension of a quotient space.

Section-C

Linear maps, Null space, Range space, Rank-Nullity Theorem, Matrix of a linear map, invertibility of a linear map, algebra of linear maps.

Section-D

Elementary matrix operations, elementary matrices, rank of a matrix, equality of row & column rank, normal form for a matrix, invertible matrix as a product of elementary matrices, system of linear equations with theoretical & computational aspects.

Suggested Readings

1. Linear Algebra Done Rght by Sheldon Axler, Springer
2. Linear Algebra by Friedberg, S.H. Insel, A.J., Spence, L.E., PHI Learning Pvt. Ltd.
3. Linear Algebra by Vivek Sahai, Vikas Bist., Narosa Publishing House Pvt. Ltd.

Group Theory

Course No. **LTP**
MTL-253 **3 1 0**

Time: 3 Hours **Max. Marks: 100**
Mid Semester Marks : 20
End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section-A

Properties of Integers: Well ordering Principle, division Algorithm, Greatest common divisor, G.C.D. as a linear combination, Euclidean Algorithm, Euclid's Lemma, Least common Multiple, Fundamental Theorem of Arithmetic, Integers modulo n, binary relations, Equivalence relations, Equivalence classes partition.

Section-B

Symmetries of a square, dihedral groups, definition & examples of groups including permutation groups and quartenion groups (through matrices). Elementary properties of groups, uniqueness of the identity, cancellation, Uniqueness of inverses, subgroups, examples of subgroups, tests for a set to be a subgroup, centralize, normalizer, center of a group.

Section-C

Product of two subgroups, cyclic groups, properties of cyclic groups, generators of cyclic groups, fundamental theorem of cyclic group, permutation groups, cyclic notation for permutations, permutation as products of disjoint cycles, order of a permutation, commutness of disjoint cycles, permutation as a product of 2-cycles, even and odd permutations, alternating group.

Section-D

Properties of cosets, Lagrange's theorem and consequences including fermat's little theorem, normal subgroups, factor groups, Cauchy's Theorem for finite abelian groups, External direct product of a finite number of groups, Groups homomorphism, First, second and third isomorphism theorems

Suggested Readings

1. Gallian, Joseph: Contemporary Abstract Algebra, Narosa Publishing House
2. Burton, David: Elementary Number Theory, McGraw Hill
3.Bhattacharya, P.B., Jain. S.K., Nagpaul, S.R.: Basic Abstract Algebra, Cambridge University Press.
4. Surjeet Singh, Qazi Zameerudin: Modren Algebra, Vikas Publishing House Pvt. Ltd.

Statistical Methods

Course No. **L T P**
MTL254 **3 1 0**
Time: 3 Hours **Max. Marks: 100**
Mid Semester Marks : 20
End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section–A

Collection of data, presentation of data, diagrammatic representation of data. discrete and continuous frequency distribution of a variable, graphical representation of frequency distribution of a variable. Central tendency and its measures, Dispersion and its measures, Quartiles, deciles & percentiles, moments, Skewness and its measures, Kurtosis and its measures.

Section–B

Bivariate data, scatter diagram, covariance, Karl–Pearson's correlation coefficient and its properties, calculation of correlation coefficient from grouped data, bounds of the correlation coefficient, Spearman's rank correlation coefficient, The principle of least squares, fitting of straight line, polynomials, exponential, logarithmic, curve. Regression lines, relation between correlation coefficient and regression coefficients.

Section-C

Census and sample surveys, Principal steps in sample survey, Probability sampling, Simple random sampling and its basic results, Estimation of population mean and population proportion under simple random sampling.

Section-D

Stratified random sampling, principles & advantages of stratification, Estimation of population mean under stratified random sampling, allocation of sample size in different strata, relative precision of stratified random sampling with simple random sampling, formation of strata, Determination of number of strata.

Books Recommended:

1. Gupta, S.C. and Kapoor, V.K.: Fundamentals of Mathematical Statistics, Sultan Chand and Company, 2007
2. Croxton F.E., Cowden, D.J. and Kelin, S. (1973): Applied General Statistics, Prentice Hall of India.
3. Goon, A.M. Gupta, M.K. and Dasgupta B.: Fundamentals of Statistics, Vol. I, World Press, 2005.
4. Daroga Singh & FS choudhary: Theory and analysis of sample survey designs, 2002, New Age International Publishers, New Delhi.
5. S.C. Gupta & V.K.Kapoor: Fundamentals of applied statistics, Sultan chand & sons, New Delhi.

Books Suggested for Supplementary Reading:

1. Goon, A.M. Gupta, M.K. and Dasgupta B.: Basic Statistics, World Press, 2005.
2. Gupta, S.C.: Statistical Methods, Himalayan Publishing House, 2003.
3. Nagar, A.L. and Das, R.K., Basic Statistics, Oxford University Press, 2005.

R Programming

Course No. **L T P**
MTL255 **3 0 1**

Time: 3 Hours **Max. Marks: 100**
Mid Semester Marks : 20
End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section..

Section A

Introducing to R, Help functions in R, Vectors, Common Vector Operations, Using all and any function, subletting of vector. Creating matrices, Matrix operations, Applying Functions to Matrix Rows and Columns, Adding and deleting rows and columns , lists, Creating lists, general list operations, Accessing list components and values, applying functions to lists, recursive lists

Section B

Creating Data Frames – Matrix-like operations in frames , Merging Data Frames, Applying functions to Data frames, Factors and Tables , factors and levels , Common functions used with factors , string operations

Section C

Input/ Ouput: scan() , readline() Function, Printing to the Screen Reading and writing CSV and text file. Control statements: Loops, Looping Over Nonvector, Sets, if-else , writing user defined function, scope of the variable, R script file

Section D

Graphics in R: Graph Syntax ((title, xlabel, ylabel, pch, lty, col.), Simple graphics (Bar, Multiple Bar, Histogram, Pie, Box-Plot, Scatter plot, qqplot), Low-level and High-Level plot functions, par() command to generate multiple plots.
Practical: Based on simple mathematical problems and based on syllabus of Statistical Methods for descriptive Statistics.

Suggested Books:

1. Dennis, B. (2013): The R Student Companion, Taylor & Francis Group.
2. Matloff, N. (2011): The Art of R Programming: A Tour of Statistical Software Design,
3.William. Lander, J. P. (2014): R for Everyone: Advanced Analytics and Graphics, Addison-Wesley Data & Analytics Series.