The Kelkar Education Trust's

Vinayak Ganesh Vaze College of Arts, Science & Commerce

(AUTONOMOUS)

College with Potential for Excellence

Mithagar Road, Mulund East, Mumbai-400081, India

Phones :022-21631421, 221631423, 221631004 Fax : 022-221634262

email : vazecollege@gmail.com

Syllabus for Program S.Y. B. Sc.

Mathematics

Syllabus as per Choice Based Credit System (NEP-2020)

(June 2024 Onwards)

Submitted by

Department of Mathematics
Vinayak Ganesh Vaze College of Arts, Science and Commerce
Mithagar Road, Mulund (East) Mumbai-400081. Maharashtra, India.
Tel: 022-21631004, Fax: 022-21634262
E-mail: vazecollege@gmail.comWebsite : www.vazecollege.net

Programme Structure and Course Credit Scheme :

Semester	Major		Minor	OE	VSC/SEC	AEC	OJT, FP,CEP, CC,RP	Total
	Mandatory	Elective						
III	8 Credit (6L+2P) (Three Papers)	--	4 Credit (2L+2P) (One Paper)	2 Credit (2L) (One Paper)	2 Credit VSC (2P) (One Paper)	--	**FP-2**	**22**
IV	8 Credit (6L+2P) (Three Papers)	--	2 Credit (2L) (One Paper)	2 Credit (2L) (One Paper)	2 Credit SEC(2P) (One Paper)	--	CEP-2	**22**
TOTAL	**16**		**6**	**4**	**4**		**2**	**44**

SEMESTER-III			
CODE	COURSE TYPE	COURSE TITLE	CREDITS
VGVUSMMA301	MAJOR-I	Multivariable Calculus	2 =2L
VGVUSMMA302	MAJOR-II	Laplace Transform	2 =2L
VGVUSMNMA303	MAJOR-III /MINOR	Ordinary Differential Equation	2 =2L
VGVUSMNMAP304	PRACTICAL BASED ON MAJOR-I,MAJOR-II & MAJOR-III /MINOR	---	2=2P
VGVUSVSMAP305	Vocational Skill Course (VSC)	RDBMS & MYSQL	2=2P
	Open Elective (OE)	Mathematical & Statistical Techniques-I	2=2L

SEMESTER-IV			
CODE	COURSE TYPE	COURSE TITLE	CREDITS
VGVUSMMA401	MAJOR-I	Basic Complex Number and Calculus	2 = 2L
VGVUSMMA402	MAJOR-II	Fourier Transform	2 = 2L
VGVUSMNMA403	MAJOR-III /MINOR	Partial Differential Equation	2 = 2L
VGVUSMMAP404	PRACTICAL BASED ON MAJOR-I, MAJOR-II		2 = 2P
VGVUSSEMAP305	Skill Enhancement Course (SEC)	Programming in C++	2 = 2P
	Open Elective (OE)	Mathematical & Statistical Techniques-II	2 = 2L

SEMESTER-III

S.Y.B.Sc. (Major-I) (MATHEMATICS PAPER-I)		
Title of the Course and Course Code:VGVUSMMA301	**MULTIVARIABLE CALCULUS**	**No. of Credits: 02**

Unit No.	Content	No. of Hours
I	**Functions of several variable**	**10**
	Euclidean space $\mathbb{R}^n$, Euclidean norm function on $\mathbb{R}^n$, open ball and open sets in $\mathbb{R}^n$, sequences in $\mathbb{R}^n$, convergence of sequences and basic properties (These concepts should be specifically discussed for $\mathbb{R}^2$ and $\mathbb{R}^3$). Functions from $\mathbb{R}^n$ to $\mathbb{R}$ (scalar fields) and from $\mathbb{R}^n$ to $\mathbb{R}^m$ (vector fields), limits and continuity of scalar fields and vector fields, basic results on algebra of limits and continuity, nonexistence of limits, relation between continuity of vector field and its component functions. Directional Derivatives and Partial derivatives of scalar fields, gradient of a scalar field, mean value theorem for derivatives of scalar fields.	
II	**Differentiability of scalar fields**	**10**
	Differentiability of a scalar field at a point of $\mathbb{R}^n$(in terms of linear transformation) and on open subsets of $\mathbb{R}^n$, the total derivative and its properties, uniqueness of total derivative of differentiable functions, differentiability of scalar field implies its continuity, necessary condition for differentiability, sufficient condition for differentiability. Chain rule for derivatives of scalar fields, homogeneous functions and Euler's theorem, sufficient condition for equality of mixed partial derivatives (without proof). Second order Taylor's formula for scalar fields.(without proof).	
III	**Differentiability of Vector fields and its Application**	**10**
	Differentiability of vector fields, definition of differentiability of a vector field at a point, Jacobian matrix, differentiability of scalar field implies its continuity, chain rule for derivatives of vector fields (without proof). Mean value inequality. Hessian matrix, Maxima, minima and saddle points, Second derivative test for extrema of functions of two variables. Method of Lagrange Multipliers.	

Learning Objectives:

- To understand the Euclidean Space $\mathbb{R}^n$and how it is different from $\mathbb{R}$.
- To differentiate between the scalar and vector fields.
- To learn the concept of sequence, continuity and differentiability.
- To understand the application of Differentiation of vector fields.

Learning Outcomes:

After learning this course, the learner will be able to

- Learn conceptual variations while advancing from one variable to several variables in calculus.
- Understand the notion of Limits, continuity in $\mathbb{R}^n$.
- Find Differentiability of Scalar Field.
- Apply Chain rule for derivatives, Euler's Theorem.
- Find Differentiability of Vector fields.
- Understand the Hessian matrix, Maxima, minima and saddle points.

REFERENCE BOOKS:

1. Calculus. Vol.2, T. Apostal, John Wiley
2. Calculus.J.Stewart, Brooke/cole Publishing Co.
3. Calculus of several variable by Serge Lang.

S.Y.B.Sc. (Major-II) (MATHEMATICS PAPER-II)		
Title of the Course and Course Code: VGVUSMMA302	**Laplace Transforms**	**No. of Credits: 02**

Unit No.	Content	No. of Hours
I	**Laplace Transform and Their Basic Properties**	**10**
	Basic concept & Definition of Integral Transform, Definition of the Laplace transform, Kernel of Laplace Transform, Definition of Sectional or piecewise continuity& Functions of exponential order, Sufficient conditions for existence of Laplace transform, Laplace transforms of elementary functions. Some important properties of Laplace transforms: Linearity property, first translation or shifting property, second translation or shifting property, change of scale property, Laplace transform of derivatives, Laplace transform of integrals, Multiplication by t, Division by t.	
II	**Inverse Laplace Transform**	**10**
	Definition of inverse Laplace transforms, Uniqueness of inverse Laplace transform. Inverse Laplace transform of some functions. Some important properties of inverse Laplace transforms. Linearity property, first translation or shifting property, second translation or shifting property, change of scale property, Inverse Laplace transform of derivatives, Inverse Laplace transform of integrals, Multiplication by s^n, Division by s. Convolution Theorem, Partial fraction Method.	
III	**Applications to Differential Equations**	**10**
	Applications of Laplace transform to solve ordinary differential equations (ODEs) and partial differential equations (PDEs).	

Learning Objectives:

The basic need of this course is to understand the concepts and applications of Laplace transforms. The concepts and methods are useful for solving Differential Equations.

Learning Outcomes:

Upon successful completion of this course the student will be able to:

- Know about piecewise continuous functions, Dirac delta function, Laplace transform and its properties.
- Know about Unit step, Periodic, Error, Gamma and Null functions.
- Understand Laplace and Inverse Laplace transforms.
- Know the basic properties of Laplace and inverse Laplace transforms.
- Calculate the Laplace transform of basic functions using the definition.
- Find the Laplace transform of derivatives of functions.
- Compute inverse Laplace transforms.
- Solve ordinary differential equations using Laplace transforms.

REFERENCE BOOKS:

1. Murray R. Spiegel, Schaum's Outline Series, Theory and Problems of Laplace Transforms, Mc Graw Hill Ltd, New York, 1965.

2. Lokenath Debnath and Dambaru Bhatta, Integral Transforms and Their Applications, Second Edition, C. R. C. Press, London, 2007.

3. Phil Dyke, An Introduction to Laplace Transforms and Fourier Series, Second Edition, Springer-Verlag London, 2014.

4. Joel L. Schiff, The Laplace Transform: Theory and Applications (Undergraduate Texts in Mathematics), Springer.

5. E. Kreyszig, "Advanced Engineering Mathematics", 10th Edition, John & Wiley Sons, U.K., 2016

S.Y.B.Sc. (Major-III /Minor) (MATHEMATICS PAPER-III)		
Title of the Course and Course Code VGVUSMNMA303	**Ordinary Differential Equation**	**No. of Credits: 02**

Unit No.	Content	No. of Hours
I	**First Order First Degree Differential Equations**	**10**
	Definitions of: Differential Equation, Order and Degree of a differential Equation, Ordinary Differential Equation (ODE), Linear ODE, non-linear ODE. Existence and uniqueness Theorem for the solution of a second order initial value problem (statement only). Definition of Lipchitz function. Examples based on verifying the conditions of existence and uniqueness theorem. Review of solution of homogeneous and non-homogeneous linear differential equations of first order and first degree. Exact Equations: General Solution of Exact equations of first order and first degree, Necessary and sufficient condition for $Mdx + Ndy = 0$ to be exact. Non-exact equations: Rules for finding integrating factors (without proof) for non-exact equations. Linear and reducible linear equations of first order. Finding solutions of first order differential equations, applications to orthogonal trajectories, population growth, and finding the current at a given time.	
II	**Second Order Linear Differential Equations**	**10**
	Homogeneous and non-homogeneous second order linear differentiable equations: The space of solutions of the homogeneous equation as a vector space. Wronskian and linear independence of the solutions. The general solution of homogeneous differential equations. The general solution of a non homogeneous second order equation. Complementary functions and particular integrals. The homogeneous equation with constant coefficients, auxiliary equation. The general solution corresponding to real and distinct roots, real and equal roots and complex roots of the auxiliary equation. Non-homogeneous equations: The method of undetermined coefficients. The method of variation of parameter	
III	**Linear Differential Equations with constant coefficients**	**10**
	Complementary function and particular integral. General solution of $f(D)y = X$. Solution of $f(D)y = 0$, for non-repeated, repeated, real and complex roots of $f(D)y = X$ where X is of the form $e^{ax}, sinax, cosax, x^m, e^{ax}V, xV$	

Learning Objectives:

The main objectives of this course are to introduce the students to the exciting world of differential equations, system of differential equations and their applications.

Learning Outcomes:

After learning this course, the learner will be able to:

- Understand the genesis of ordinary differential equations.
- Learn various techniques of getting exact solutions of solvable first order differential equations and linear differential equations of higher order.
- Grasp the concept of a general solution of a linear differential equation of an arbitrary order and also learn a few methods to obtain the general solution of such equations.

RECOMMENDED BOOKS:

1. William F Trench, Elementary Differential Equations with Boundary Value Problems, E book (Free download)
2. Frank Ayres JR, Theory and Problems on Differential Equations, Schaum's outline Series, SI (metric) edition.

REFERENCE BOOKS:

1. M. D. Raisinghania, Ordinary and Partial Differential Equations, S. Chand Pub. Ltd 2009.
2. Elementary Differential Equations seventh edition by Earl D. Rainville and Philip E Bedient.
3. George F. Simmons and Stevan G. Krantz, Differential Equations, Tata McGraw-Hill.
4. W. R. Derrick and S. I. Grossman, A First Course in Differential Equations with Applications.
CBS Publishers and Distributors, Delhi 110032, Third Edition.

S.Y.B.Sc. (VSC-Vocational Skill Course)		
Title of the Course and Course Code VGVUSVSMAP305	**RDBMS & MYSQL**	**No. of Credits: 02**

Unit No.	Content	No. of Hours
I	**Relational Data Base Management System**	**10**
	Introduction to Data base Concepts: Database, Overview of data base management system. Data base Languages- Data Definition Languages (DDL) and Data Manipulation Languages (DML). Entity Relation Model: Entity, attributes, keys, relations, Designing ER diagram, integrity Constraints over relations, conversion of ER to relations with and without constrains.	
II	**MySQL Basics**	**10**
	Statements (Schema Statements, Data statements, Transaction statements), names (table & column names), data types (Char, Varchar, Text, Medium text, Long text, Smallint, Bigint, Boolean, Decimal, Float, Double, Date, Date Time, Timestamp, Year, Time), Creating Database, inserting data, Updating data, Deleting data, expressions, built-in-functions – lower, upper, reverse length, ltrim, rtrim, trim, left, right, mid, concat, now, time, date, curdate, day, month, year, dayname, monthname, abs, pow, mod, round, sqrt missing data(NULL and NOT NULL DEFAULT values) CREATE,USE, ALTER (Add, Remove, Change columns), RENAME, SHOW, DESCRIBE (CREATE TABLE, COLUMNS, STATUS and DATABASES only) and DROP (TABLE, COLUMN, DATABASES statements), PRIMARY KEY FOREIGN KEY (One and more columns) Simple Validity checking using CONSTRAINTS.	
III	**MySQL Queries**	**10**
	MySQL Simple queries: The SELECT statement (From, Where, Group By, Having, Order By, Distinct, Filtering Data by using conditions. Simple and complex conditions using logical, arithmetic and relational operators (=,!, =, <, >, <>, AND, OR, NOT, LIKE) Aggregate Functions: count, sum, avg,	

	max, min. Multi-table queries: Simple joins (INNER JOIN), SQL considerations for multi table queries (table aliases, qualified column names, all column selections self joins). Nested Queries : Using sub queries, sub query search conditions, sub queries & joins, nested sub queries, correlated sub queries, sub queries in the HAVING clause. Simple Transaction illustrating START, COMMIT, and ROLLBACK.	

List of Practicals:

1.Introduction to MySQL, Database creation, Table creation.

2.Data insertion, update/modification/Delete and retrieval through MySQL.

3.Basic SQL structure. Query implementation 2 Enforcing integrity constraints (Domain, Key constraints (Primary/Foreign keys), not null, unique, default, Check) .

4.Creating and updating View. Query implementation using View.

5.Use of string functions (Lower, Upper, Proper, mid, len, substring, etc.)

6.Use of aggregate functions (AVG, COUNT, MIN, MAX, SUM)

7. Use of Date and Time function

8. Use of Join operator (Natural join, Outer join (left, right and full)

9.Query optimization through Nested Query (Use of logical connectives, set comparison operators, Union, Intersect, Except, Exists clauses)

10.Use of Group By and Having clause.

Learning Objectives:

- Provide for mass storage of relevant data.
- Allow multiple users to be active at one time.
- Provide data integrity.
- Protect the data from physical harm and unauthorized access.
- Provide security with a user access privilege.

Learning Outcomes:

Upon successful completion of this course, students should be able to:

- Describe the fundamental elements of relational database management systems
- Explain the basic concepts of relational data model, entity-relationship model, relational database design, relational algebra and SQL.
- Design ER-models to represent simple database application scenarios
- Convert the ER-model to relational tables, populate relational database and formulate SQL queries on data.

Reference Books:

1.Elsmasri and Navathe, “Fundamentals of Database Systems” Pearson Education.

2. MySQL: The Complete Reference by VASWANI, McGraw Hill.

3.Martin Gruber, “Understanding MYSQL”, B.P.B. Publications.

4. Data base management system, Ramakrishnan, Gehrke, McGraw-Hill

(OE-OPEN ELECTIVE) (For Arts Students)		
Title of the Course and Course Code	**MATHEMATICAL AND STATISTICAL TECHNIQUE -I**	**No. of Credits: 02**

Unit No.	Content	No. of Hours
I	**Functions, Derivatives and Their Applications**	**10**
	Concept of real functions: Constant function, linear function x^n, e^x,,,Demand, Supply, Total Revenue, Average Revenue, Total cost, Average cost and Profit function. Equilibrium Point, Break-even point. **Derivative of functions:** Derivative as rate of measure, Derivative of $x^n, e^x, a^x, logx$, Rules of derivatives: Scalar multiplication, sum, difference, product, quotient (Statements only), Simple problems. Second order derivatives. Applications: Marginal Cost, Marginal Revenue, Elasticity of Demand. Maxima and Minima for functions in Economics and Commerce.	
II	**Summarization Measures**	**10**
	Measures of Central Tendencies: Definition of Average, Types of Averages: Arithmetic Mean, Median, and Mode for grouped as well as ungrouped data. Quartiles, Deciles and Percentiles. Combined and Weighted mean. **Measures of Dispersion:** Concept and idea of dispersion. Various measures: Range, Quartile Deviation, Mean Deviation, Standard Deviation, Variance, Combined Variance.	
III	**Time series and Index Numbers**	**10**
	Time Series: Concepts and components of a time series. Representation of trend by Freehand Curve Method, Estimation of Trend using Moving Average Method and Least Squares Method.	

	Index Number: Concept and usage of Index numbers, Types of Index numbers, Aggregate and Relative Index Numbers, Lasperye's, Paasche's, Dorbish Bowley's, Marshall-Edgeworth and Fisher's ideal index numbers,Chain Base Index Nos. Shifting of Base year. Cost of Living Index Numbers, Concept of Real Income, Concept of Wholesale Price Index Number.	

Learning objective

- To define the derivative function of a given function and apply it to define several economics function.
- To judge the reliability of measures of central tendency and measures of dispersions.
- The main objective of this course is to introduce statistics to undergraduate students of commerce, so that they can use them in the field of commerce and Industry to solve the real life problems.
- To calculate the indices to measure price and quantity changes over period of time.
- To understand different tests an ideal Index Number satisfies.

Learning outcomes

- Understand and work with derivatives as rates of change in mathematical models.
- Understand what are Mean, Median and Mode and how to calculate it.
- Understand how all of alternative measures differ and why.
- Differentiate among simple index numbers, unweighted aggregate price index numbers, weighted aggregate price index numbers, Laspeyres price index numbers, and Paasche price index numbers by defining and calculating each.

Recommended Books:

1)Mathematical & Statistical Techniques by Manan Prakashan.

2)Mathematical & Statistical Techniques,Sheth Publication,

3) Statistical Methods - S.G. Gupta S. Chand & Company ltd.

4)Statistics - Theory, Method & Applications D.S.Sancheti & V. K. Kapoor.

SEMESTER-IV

S.Y.B.Sc. (Major-I) (MATHEMATICS PAPER-I)		
Title of the Course and Course Code VGVUSMMA401	**Basic Complex Number and Calculus**	**No. of Credits: 02**

Unit No.	Content	No. of Hours
I	**Elementary Complex Analysis**	**10**
	Complex number system, Representation of complex number (Cartesian and polar form), Modulus and Argument of complex number, their properties, De-moivre's theorem, Complex functions:e^z, $\sin z$, $\cos z$, Circular and inverse circular functions of z, Hyperbolic functions, Logarithm of complex number, Stereographic Projection, Chordal distance and point set topology in complex plane.	
II	**Multiple Integrals**	**10**
	Definition of double and triple integral of a bounded function on rectangle, Fubini's theorem over rectangles, Evaluation of double integrals, Area under the curve by double integration, Double integration (polar co-ordinates).	
III	**Line Integrals**	**10**
	Definition of line integrals, Fundamental Theorem of Line integrals, evaluation for smooth curves, vector fields, Gradient fields, work done by a force over a curve in space, Evaluation of work integrals, Path independence of line integral incase of conservative fields, Calculation of potential function, Green's Theorem and evaluation of line integrals using Green's Theorem.	

Learning Objectives:

1. To introduce Complex number system and complex function to students.
2. To develop the skill of evaluating double and triple integrals.
3. To understand the properties of integrals of vector fields.
4. To use line integral to check vector fields are path independent.

Learning Outcomes:

After learning this course, the learner will be able to

1. Understand how complex number provides a satisfying extension of the real numbers.
2. Learn How to evaluate double and triple integrals.
3. Appreciate how double integral is used to evaluate area under the curve.
4. Understand the application of line integrals in Green's Theorem.

Reference Books:

1. Calculus. Vol.2, T. Apostal, John Wiley
2. Advanced Calculus, D.V.Widder, Second Edition, Dover Pub; New York.
4. Calculus.J.Stewart, Brooke/cole Publishing Co.
5. Introduction to Real Analysis. Berberian, Springer
6. Richard G.Goldberg, Methods of Real Analysis, Oxford & IBH Co. Pvt. Ltd; New Delhi
7. Foundation of Complex Analysis, S.Ponnusamy
8. Functions of One Complex Variable-I, John B.Conway

SEMESTER-IV

S.Y.B.Sc. (Major-II) (MATHEMATICS PAPER-II)		
Title of the Course and Course Code VGVUSMMA402	**Fourier Transform**	**No. of Credits: 02**

Unit No.	Content	No. of Hours
I	**Fourier Series**	
	Fourier Series: Periodic functions. Fourier co-efficient. Fourier series of functions with period 2π and $2l$. Fourier series of even and odd functions. Half range cosine and sine series.	**10**
II	**Fourier Transform**	
	Fourier Transforms: Fourier integrals, Fourier sine and cosine integrals, Complex form of Fourier integral representation, Fourier transform, Fourier transform of derivatives and integrals, Fourier sine and cosine transforms and their properties, Convolution theorem.	**10**
III	**Application of Fourier transforms**	
	Application of Fourier transforms to solve ordinary differential equations (ODEs) and partial differential equations (PDEs).Boundary Value Problems.	**10**

Learning Objectives:

To enable the students to study Fourier Transforms and some concepts of infinite Fourier Sine and Cosine transforms, finite Fourier Sine and Cosine transforms and applications to solve some infinite and boundary value problems using finite and infinite transforms.

Learning Outcomes:

After learning this course, the learner will be able to

- Calculate the Infinite Fourier transform, Fourier Sine and Cosine transform of elementary functions from the definition.
- Demonstrate their understanding of the shifting theorems, Fourier integral theorems,
- Inverse Fourier sine and cosine transforms by applying them to appropriate examples.
- Calculate the Finite Fourier cosine and sine transform and apply it in solving boundary value problems.

RECOMMENDED BOOKS:

1."Fourier Transforms and Representation Theory" by David M. Roark

2."Fourier Transforms: Mathematics and Applications" by Mohammed S. Saad

3."Fourier Transform Methods for Digital Signal Processing" by Françoise A. Yao

4."Fourier Transform with Fluctuation Threshold" by Tomasz O. Jelitsin

5."Fourier Transform of Signals and Time-Series" by Wu Wanxiong

S.Y.B.Sc. (Major-III/Minor) (MATHEMATICS PAPER-III)		
Title of the Course and Course Code VGVUSMNMA403	**Elementary Partial Differential Equation**	**No. of Credits: 02**

Unit No.	Content	No. of Hours
I	**Introduction To Partial Differential Equations**	**10**
	Partial Differential Equation, Order & Degree of PDE, Surface and Normals, parametric equation of surface, Curves and tangents, Origin of first order partial differential equation. Classification of first order partial differential equation. Linear Equation, Semi-Linear Equation, Quasi Linear Equation, Non-Linear Equation, Formation of first order partial differential equation, By Elimination of arbitrary constants, By Elimination of arbitrary functions.	
II	**Linear Partial Differential Equations of order one**	**10**
	Lagrange's method, working rule for solving $Pp + Qq = R$ By Lagrange's method, Four types of problems based on $Pp + Qq = R$ The Cauchy problem for first order Quasi Linear PDE Existence and Uniqueness of integral surface passing through a given curve.	
III	**Nonlinear Partial Differential Equations of order one**	**10**
	Surface orthogonal to Given System of surface. The linear PDE with n independent variables. Types of solutions (Complete Integral, General Integral, Singular Integral) Method of getting Singular Integral. Charpit's method.	

Learning Objectives:

The main objectives of this course are to introduce the students to the exciting world of differential equations, system of differential equations and their applications.

Learning Outcomes:

After learning this course, the learner will be able to:

- To understand the genesis of ordinary differential equations.

- To learn various techniques of getting exact solutions of solvable first order differential equations and linear differential equations of higher order.
- To grasp the concept of a general solution of a linear differential equation of an arbitrary order and also learn a few methods to obtain the general solution of such equations.

RECOMMENDED BOOKS:

1.Ian Sneddon, Element of Partial Differential Equations, McGraw-Hill Book Company, McGraw-Hill Book Company.

2.J.N. Sharma, Kehar Singh, Partial Differential equations for Engineers and Scientists, second Edition, Narasa Publications.

REFERENCE BOOKS:

1. T. Amarnath, An Elementary Course in Partial Differential Equations, Narosa Publishing, House 2nd Edition, 2003 (Reprint, 2006).

2. K. Sankara Rao, Introduction to Partial Differential Equations, Third Edition, PHI.

3. M.D.Raisinghania, Ordinary and Partial Differential Equations, 20^{th} Edition, S Chand

S.Y.B.Sc. (SEC-Skill Enhancement Course)		
Title of the Course and Course Code VGVUSSEMAP405	**(C++ Programming)**	**No. of Credits: 02**

Unit No.	Content	No. of Hours
I	**Introduction to C++**	**10**
	Object Oriented Methodology: Introduction, Advantages and Disadvantages of Procedure Oriented Languages, Application of OOPS, Principles of OOPS: Objects, Classes, Data Abstraction and Data Encapsulation, Inheritance, Polymorphism, Dynamic Binding, Message Passing. Classes and Objects: Simple classes (Class specification, class members accessing), Defining member functions, passing object as an argument, Returning object from functions, friend classes, friend function. Constructors and Destructors: Introduction, Default Constructor, Parameterized Constructor and examples, Destructors.	
II	**Inheritance**	**10**
	Program development using Inheritance: Introduction, Advantages provided by inheritance, choosing the access specifier, Derived class declaration, derived class constructors, class hierarchies, multiple inheritance, multilevel inheritance, hybrid inheritance. Polymorphism: Concept of function overloading, overloaded operators, overloading unary and binary operators.	
III	**Advanced Concepts and Application Development**	**10**
	Virtual Functions: Introduction and need, Pure Virtual Functions, this Pointer, abstract classes, virtual destructors. Exception Handling: Introduction, Exception Handling Mechanism, Concept of throw & catch with example. Working with Files: Introduction, File Operations, Various File Modes, File Pointer and their Manipulation	

List of Practiclas :

1. program for Adding two numbers
2. To Check if a number is even or odd
3. program to swap two numbers, printing Fibonacci series, factorial of given number
4. program to find the largest number among three numbers
5. Program to Find the sum of all the natural numbers from 1 to n
6. To check whether a number is prime or not.
7. Defining function to find the length of a string
8. Program to create an array of pointers. Invoke functions using array objects

Learning Objective:

- To introduce students to the syntax and structure of the C++ programming language.
- To develop problem-solving skills through hands-on programming exercises.
- To familiarize students with the principles of object-oriented programming (OOP) in C++.
- To cultivate good programming practices and coding standards.
- To prepare students for more advanced programming courses.

Learning Outcomes:

After completion of this course, student will be able to:

- Identify importance of object-oriented programming and difference between structured.
- oriented and object-oriented programming features.
- make use of objects and classes for developing programs.
- use various object-oriented concepts to solve different problems.

Recommended Books:

1.Object Oriented Programming with C++ by E Balaguruswamy Tata McGraw Hill India

2.Programming: Principles and Practice Using C++" by Bjarne Stroustrup.

3. C++ Primer" by Stanley B. Lippman, Josée Lajoie, and Barbara E. Moo

4. D. Parasons, Object Oriented Programming with C++, BPB Publication.

(OE- OPEN ELECTIVE) (For Arts Students)		
Title of the Course and Course Code	**MATHEMATICAL AND STATTISTICAL TECHNIQUE -II**	**No. of Credits: 02**

Unit No.	Content	No. of Hours
I	**Bivariate Linear Correlation and Regression**	**10**
	Correlation Analysis: Meaning, Types of Correlation, Determination of Correlation: Scatter diagram, Karl Pearson's method of Correlation Coefficient and Spearman's Rank Correlation Coefficient. **Regression Analysis:** Meaning, Concept of Regression equations, Slope of the Regression Line and its interpretation. Regression Coefficients, Relationship between Coefficient of Correlation and Regression Coefficients, Finding the equations of Regression lines by method of Least Squares	
II	**Elementary Probability Theory**	**10**
	Probability Theory: Concept of random experiment/trial and possible outcomes; Sample Space and Discrete Sample Space; Events their types, Algebra of Events, Mutually Exclusive and Exhaustive Events, Complimentary events. Classical definition of Probability, Addition theorem (without proof),conditional probability. Independence of Events: $P(A \cap B) = P(A)P(B)$.Simpleexamples. **Random Variable:** Probability distribution of a discrete random variable; Expectation and Variance of random variable, simple examples on probability distributions.	
III	**Decision Theory**	**10**
	Decision making situation, Decision maker, Courses of Action, States of Nature, Pay-off matrix; Decision making under uncertainty, Maximin, Maximax, Minimax regret and Laplace criteria; simple examples to find optimum decision .Formulation of Payoff Matrix. Decision making under Risk, Expected Monetary Value (EMV); Decision Tree; Simple Examples	

	based on EMV. Expected Opportunity Loss(EOL),simple examples based on EOL.	

Learning objective

- To analyze the result by data handling.
- To judge the reliability of measures of central tendency and measures of dispersions.
- Explain the concept of probability; calculate the probability of simple events.
- To design the Decision Theory Model. To know the representation of Decision Theory.
- To understand and criteria for Decision Making.

Learning outcomes

- Calculate and interpret the correlation between two variables.
- Determine whether the correlation is significant. Calculate the simple linear regression equation for a set of data and know the basic assumptions behind regression analysis.
- Understand the concept of probability and its features.
- Understand the decision-making processes.

Recommended Books:

1)Mathematical & Statistical Techniques by Manan Prakashan.

2)Mathematical & Statistical Techniques, Sheth Publication, Dr.NeenaJoshi,Dr.N.N.Pandey.

3) Basic practice of statistics: Study guide,Flinger,Nortz

4) Statistics, Freedman, Pisani, Purves

THEORY EXAMINATION PATTERN FOR (MAJOR/MINOR)		
Que.1 A)	Attempt Any One:	(7 Marks)
	i) Theory Question based on Unit-I	
	ii) Theory Question based on Unit-I	
B)	Attempt Any Two:	(8 Marks)
	i) Problems based on Unit-I	
	ii) Problems based on Unit-I	
	iii) Problems based on Unit-I	
Que.2 A)	Attempt Any One:	(7 Marks)
	i) Theory Question based on Unit-II	
	ii) Theory Question based on Unit-II	
B)	Attempt Any Two:	(8 Marks)
	i) Problems based on Unit-II	
	ii) Problems based on Unit-II	
	iii) Problems based on Unit-II	
Que.3 A)	Attempt Any One:	(7 Marks)
	i) Theory Question based on Unit-III	
	ii) Theory Question based on Unit-III	
B)	Attempt Any Two:	(8 Marks)
	i) Problems based on Unit-III	
	ii) Problems based on Unit-III	
	iii) Problems based on Unit-III	
Q.4)	Solve the following.	(15 marks)
	i) Problems based on Unit-I	
	ii) Problems based on Unit-II	
	iii) Problems based on Unit-III	

THEORY EXAMINATION PATTERN FOR (OE-OPEN ELECTIVE COURSE)		
Que.1	Attempt Any Three:	(15 Marks)
i)	Questions based on unit -I	
ii)	Questions based on unit -I	
iii)	Questions based on unit -I	
iv)	Questions based on unit -I	
Que.2	Attempt Any Three:	(15 Marks)
i)	Questions based on unit –II	
ii)	Questions based on unit –II	
iii)	Questions based on unit –II	
iv)	Questions based on unit –II	
Que.3	Attempt Any Three:	(15 Marks)
i)	Questions based on unit –III	
ii)	Questions based on unit –III	
iii)	Questions based on unit -III	
iv)	Questions based on unit –III	
Que.4	Solve the following :	(15 Marks)
i)	Questions based on unit –I	
ii)	Questions based on unit –II	
iii)	Questions based on unit -III	

PRACTICAL EXAMINATION PATTERN FOR (MAJOR AND MINOR)

Que.1	Attempt any 8 objectives out of 12 from the following:	(8 x 3=24 Marks)
Que.2	Attempt any two from the following:	(8 x 2 =16 Marks)
	a) Based on unit-I	
	b) Based on unit-II	
	c) Based on unit-III	

(VEC & SEC) PRACTICAL EXAMINATION PATTERN

Semester End Examinations Practicals:

At the end of the Semester, III & IV Practical examinations of three hours duration and 100 marks shall be conducted for (VSC & SEC) paper.

Marks for Journals and Viva:

For each VSC and SEC course.

1. Journal: 10 marks.

2. Viva: 10 marks.

3. 80 Marks Computer based exam.