



"Education through self-help is our motto" - KARMAVEER

Rayat Shikshan Sanstha's  
**DAHIWADI COLLEGE, DAHIWADI**

Tal. Man, Dist. Satara : 415 508

[Arts, Science, Commerce, BCA, B.Voc.Agri.,  
Bank Management, Defence Studies & Vocational Education]

Founder : Padmabhushan Dr. Karmaveer Bhaurao Patil D.Litt.

[NAAC Third Cycle Reaccredited 'A' Grade (with CGPA 3.25)]

Estd : 1965

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## Bachelor of Science (B.Sc.)

(Department of Mathematics)

### Programme Outcomes (PO's)

After completing B.Sc. programme the student will be able to:

- PO1:** Bachelor of Science offers theoretical as well as practical knowledge about different special subject areas.
- PO2:** This course forms the basis of science for coherent understanding of the academic field to pursue multi and interdisciplinary science careers in future. These subject areas include, Chemistry, Physics, Botany, Zoology, Mathematics, Microbiology and Computer Science.
- PO3:** Able to plan and execute experiments or investigations, analyze and interpret data information collected using appropriate methods.
- PO4:** It helps to develop scientific temper, attitude and thus can prove to be more beneficial for the society as the scientific developments and make a nation or society to grow at a rapid pace through research.
- PO5:** Think critically, follow innovations and developments in science and technology.
- PO6:** Understand the issues of environmental contexts and sustainable development.
- PO7:** Acquire the skills and ability to engage in independent and life-long learning in the broadest context socio technological changes.
- PO8:** To demonstrate professional and ethical attitude with enormous responsibility to serve the society.

### Programme Specific Outcomes (PSO's)

- PSO1:** Think in a critical manner.
- PSO2:** Analyze a problem, and identify and define the Computing requirements, which may be appropriate to its solution.
- PSO3:** Enhancing students' overall development and equipping them with mathematical modeling abilities, problem-solving skills, creative talent, and power of Communication necessary for various kinds of employment.

**PSO4:** Formulate and develop mathematical arguments in a logical manner.

**PSO5:** Recall basic facts about mathematics and display knowledge of conventions such as notations, and terminology.

**PSO6:** Develop a positive attitude towards mathematics as an interesting and valuable subject of study.

### Course outcomes (CO's)

#### B.Sc. –I (Sem –I)

##### DSC5A-Differential Calculus

**CO1:** Define complex numbers and find the conjugate of a complex number also find a polar form of a complex number in various quadrants.

**CO2:** Use De-Moivre's theorem for calculating powers of complex numbers in the form of  $\cos\theta$  and  $\sin\theta$ .

**CO3:** Tell the definition of Hyperbolic functions and the relation between Hyperbolic and circular functions.

**CO4:** Explain how to write expansion of  $\sin n\theta$  &  $\cos n\theta$  in terms of powers of  $\sin\theta$  &  $\cos\theta$ .

**CO5:** Evaluate  $n^{th}$  order derivative of standard functions.

**CO6:** Apply Leibnitz's theorem for finding  $n^{th}$  order derivative of a product of two functions.

**CO7:** Find partial derivatives of the first order and higher order.

**CO8:** Use Lagrange's method of undetermined multipliers for evaluating maxima and minima for functions of two variables.

**CO9:** Explain verification of Euler's theorem on homogeneous function.

##### DSC6A-Calculus

**CO10:** Restate Rolle's Theorem, Lagrange's mean value theorem, and Cauchy's.

**CO11:** Justify verification of mean value theorems for various functions.

**CO12:** Find Taylor's and Maclaurin's series expansion of various functions.

**CO13:** Use various indeterminate forms for evaluating the limit of a given function.

**CO14:** Tell  $\epsilon - \delta$  definition of a limit of a function of one variable and Restate theorems on limits.

**CO15:** Find limits of various functions.

**CO16:** Explain continuous functions and their properties.

**CO17:** Examine the continuity or discontinuity of various functions.

**CO18:** Inspect the differentiability of various functions.

#### B.Sc.-I (Sem-II)

##### DSC5B-Differential Equations

**CO19:** Define exact differential equation, Linear differential equations, and Bernoulli's equation.

**CO20:** Restate necessary and sufficient conditions for exactness.

**CO21:** Discuss the method of solutions of an exact differential equation, Linear differential equations, and Bernoulli's equation.

**CO22:** Solve the differential equation by choosing the proper method of solution.

**CO23:** Tell the definition of Linear differential equations with constant coefficients, complementary functions, and particular integrals.

**CO24:** Find the complementary functions of various differential equations of second order.

**CO25:** Explain various methods to find a particular integral.

**CO26:** Apply the proper method to find the solution of the homogeneous linear differential equation.

### **DSC6B-Higher order ordinary differential equations and partial differential equations**

**CO27:** Define second-order linear differential equations, total differential equations, and partial differential equations.

**CO28:** Solve the second-order linear differential equations by choosing the proper method.

**CO29:** Discuss the method of variation of parameters and solve examples by using it.

**CO30:** Restate necessary conditions for the Integrability of total differential equations and solve total differential equations by choosing the proper method.

**CO31:** Explain the method of formation of partial differential equations by the elimination of arbitrary constants and elimination of arbitrary functions.

**CO32:** Apply the proper method to find the solution of first-order partial differential equations.

**CO33:** Use Charpit's methods to solve first-order partial differential equations.

### **CCPM-I**

**CO34:** Use De-Moivre's theorem for finding roots of complex numbers and Leibnitz's theorem for finding  $n^{th}$ -order derivatives.

**CO35:** Identify the problem and use the proper technique to find the radius of curvature.

**CO36:** Use Lagrange's method of undetermined multipliers for evaluating maxima and minima for functions of two variables.

**CO37:** Evaluate the limit of various functions using indeterminate forms.

**CO38:** Solve differential equations by choosing the proper method.

**CO39:** Use the self-orthogonal method to find an orthogonal trajectory for a curve of family.

### **B.Sc.-II (Sem-III)**

#### **DSC5C- Real Analysis-I**

**CO40:** Tell basic definitions in sets and functions.

**CO41:** Describe properties of functions.

**CO42:** Apply mathematical induction to establish the validity of statements,  $p(n)$  for every natural number  $n$ .

**CO43:** Justify the countability of sets.

**CO44:** Define real numbers, least upper bounds, and greatest lower bounds.

**CO45:** Explain order properties of real numbers, completeness property, and Archimedean property.

**CO47:** Illustrate Arithmetic-Geometric mean inequality, Triangle inequality, and Bernoulli's inequality.

#### **DSC6C-Algebra-I**

**CO48:** Tell definitions of Hermitian and skew-Hermitian matrices and restate properties of matrices.

**CO49:** Define the Rank of the matrix, row echelon form, and normal form of a matrix.

**CO50:** Use row echelon form and normal (canonical) form to find the rank of a matrix and solve the system of linear homogeneous equations and linear non-homogeneous equations by finding rank of a matrix.

**CO51:** Solve the system of simultaneous linear homogeneous and non-homogeneous equations by using the proper method.

**CO52:** Find Eigen values and Eigen vectors by using the Cayley Hamilton theorem.

**CO53:** Develop relations and illustrates Equivalence class theorem, Warshall's Algorithm.

**CO54:** Memorize definitions of group, subgroup, abelian group, and order of the group and discuss theorems on it.

**CO55:** Restate necessary and sufficient conditions for a group to be a subgroup of  $G$ .

**CO56:** Explain the cyclic group and its properties.

**CO57:** Give examples of the group, subgroup, abelian group, and cyclic group.

## **B.Sc.-II (Sem-IV)**

### **DSC5D-Real Analysis-II**

**CO58:** Define sequence, subsequence, the limit of a sequence, and convergent sequence.

**CO59:** Discuss properties of convergent sequences.

**CO60:** Explain the monotone sequence and its properties.

**CO61:** Evaluate the limit superior and limit inferior of different sequences.

**CO62:** Tell definitions of infinite series, convergent and divergent series, and sequence partial sum of series.

**CO63:** Use comparison test for positive term series, D'Alembert's ratio test, Cauchy's root test, and Raabe's test for convergent and absolute convergent of an infinite series of real numbers.

**CO64:** Apply Leibnitz's test for convergence of an infinite series.

**CO65:** Describe Cauchy sequences and justify their properties.

### **DSC6D-Algebra-II**

**CO66:** Discuss Lagrange's theorem and its consequences.

**CO67:** Define the normal subgroup and explain its properties.

**CO68:** Justify the results related to the normal subgroup.

**CO69:** Explain the factor group and its properties.

**CO70:** Identify the Homomorphism, Isomorphism, Automorphism, and endomorphism of the group and discuss results related to homomorphism.

**CO71:** Define the Kernel of Homomorphism and discuss theorems on it.

**CO72:** Discuss the fundamental theorem of homomorphism and its consequences.

**CO73:** Tell definitions of permutation and give examples of it.

**CO74:** Explain Cayley's theorem.

### **CCPM-II**

**CO75:** Find Eigen values and Eigen vectors of a given matrix.

**CO76:** Verify the Cayley Hamilton theorem and apply it to finding the inverse of a matrix.

**CO77:** Use the underlying unifying structures of mathematics. (i.e., sets, relations and functions, logical structure) and the relationship among them.

**CO78:** Identify convergence of series by using the proper test.

**CO79:** Explain Homomorphism and Kernel

**CO80:** Solve examples on the group and find the order of an element.

### **CCPM-III**

**CO81:** Tell features and SCILAB environment workspaces.

**CO82:** Create a matrix of real values in SCILAB and find the addition, subtraction, and product of the matrix and also find the size and length of a matrix.

**CO83:** Plot a graph of simple functions using SCILAB.

**CO84:** Describe the procedure for creating a polynomial using roots and using coefficients.

**CO85:** Explain the method for creating the SCILAB function and its execution.

**CO86:** Write the program of numerical methods and predict the output.

### **B.Sc.-III (Sem-V)**

#### **DSEE9-Mathematical Analysis**

**CO87:** Find the upper and lower Darboux's sums, Riemann integration, and find the integration of a bounded function on closed and bounded intervals.

**CO88:** Discuss the idea about Riemann's integrability and Riemann integration.

**CO89:** Restate the necessary and sufficient condition for Riemann Integrability and explain it.

**CO90:** Illustrates theorems on algebra and properties of Riemann integrable functions.

**CO91:** Identify the Improper integral of the first kind and improper integral of the second kind.

**CO92:** Select the proper convergence test to check the convergence of given improper integrals.

**CO93:** Examine the convergence of an improper integral by choosing the proper test.

**CO94:** Find Fourier series of periodic functions.

#### **DSE-E10-Abstract Algebra**

**CO95:** Tell definitions of the basic concept of a ring and identify examples of a ring.

**CO96:** Define an integral domain, and field and illustrates the theorems on it.

**CO97:** Restate the necessary and sufficient condition of a ring to be a subring.

**CO98:** Develop a Quotient ring and discuss theorems on it.

**CO99:** Illustrate theorems on the Homomorphism of ring and Isomorphism theorems.

**CO100:** Explain the ideals of a ring, prime ideals, and maximal ideals and related results.

**CO101:** Discuss the embedding of rings.

**CO102:** Describe polynomial rings, Euclidean domain, PID, and UFD.

**CO103:** Construct permutation group  $S_3$  and dihedral group  $D_4$ .

#### **DSEE11-Optimization Techniques**

**CO104:** Construct real word problems as linear programming models and describe the theoretical working of graphical methods.

**CO105:** Define optimal solution and feasible solution.

**CO106:** Analyze whether the given problem has an optimal solution or feasible solution.

**CO107:** Use suitable methods to solve optimization problems.

**CO108:** Discuss solution methods including graphs and linear programming to analyze and solve the two-person, zero-sum game.

**CO109:** Identify and select procedures for solving various sequencing, assignment, transportation problems.

#### **DSEE12-Integral Transforms**

**CO110:** Define Laplace transform and inverse Laplace transforms.

**CO111:** Find the Laplace and inverse Laplace transform of standard functions.

**CO112:** Illustrates standard results for finding Laplace and inverse Laplace transforms.

**CO113:** Discuss various methods to find Laplace and inverse Laplace transforms.

**CO114:** Evaluate the Laplace transforms and inverse Laplace transforms of various functions by using the proper method.

**CO115:** Tell definitions of finite Fourier transform and infinite Fourier transform.

**CO116:** Recall the relation between the Laplace transform and Fourier transform.

**CO117:** Explain various theorems and solve examples on it.

**CO118:** Find finite Fourier transform and infinite Fourier transform of various functions.

### **B.Sc.-III (Sem-VI)**

#### **DSEF9-Metric Space**

**CO119:** Acquire the knowledge of the notion of metric spaces and use the definition of metricspace to show given function is exactly metric for the given set.

**CO120:** Define the Cauchy sequence and discuss the convergence of the Cauchy sequence.

**CO121:** Explain Limits in Metric space.

**CO122:** Describe the continuity of a function in metric space and the Algebra of continuous functions.

**CO123:** Tell definitions of the open ball, open sets, and closed sets and identify open sets and closed sets.

**CO124:** Discuss proof of the theorems on open sets, and closed sets.

**CO125:** Illustrate theorems on connectedness and compactness by using the basic concept of closed and bounded sets.

**CO126:** Apply the basic concepts of metric space to a continuous function on compact metric space.

#### **DSEF10-Linear Algebra**

**CO127:** Define concepts as Vector Spaces, subspace, span, kernel, linearly dependent, etc.

**CO128:** Tell definitions of Quotient space, Homomorphism, Kernel and Range of homomorphism, and Linear span and illustrates theorems on it.

**CO129:** Evaluate the basis and dimension of a vector space and subspace.

**CO130:** Explain linear transformation and find the Rank and Nullity of linear transformation.

**CO131:** Solve examples to find the inverse of a linear transformation and check whether the linear transformation is bijective or not.

**CO132:** Discuss theorems on spanning of vector space, the inner product of vectors, linear transformation for the set of vectors

**CO133:** Illustrate Cauchy-Schwarz inequality, Generalized Pythagoras theorem, and Bessel's inequality.

**CO134:** Apply the Gram-Schmidt orthogonalization process to find an orthogonal basis.

**CO135:** Find characteristic polynomial, Eigen values, and Eigen vectors of a given matrix.

#### **DSEF11-Complex Analysis**

**CO136:** Define the basic concept of the function of complex variables.

**CO137:** Explain Analytic function and Cauchy Riemann equations.

**CO138:** Discuss necessary and sufficient conditions for a function to be analytic.

**CO139:** Use Cauchy integral formula to evaluate complex integration.

**CO140:** Illustrate Liouville's theorem and the fundamental theorem of Algebra.

**CO141:** Describe the convergence of sequence and series of complex variables.

**CO142:** Apply the concept of residue to evaluate certain real integrals.

**CO143:** Find Taylor and Laurent series expansion for various functions.

#### **DSEF12-Discrete Mathematics**

**CO144:** Use classical notation of logic: implications, equivalence, negation, proof by contradiction, proof by induction, and quantifiers.

**CO145:** Examine valid and invalid arguments.

**CO146:** Explain the addition and subtraction of binary, decimal, quintal, octal, and hexadecimal number system and their conversions.

**CO147:** Define Graphs, and types of Graphs and identify them.

**CO148:** Compute the degree of the vertex of a given graph.

**CO149:** Explain Trails, Paths, and Circuits.

**CO150:** Find the matrix representation of the graph.

**CO151:** Analyze the isomorphism of the graph.

#### **CCPM-IV**

**CO152:** Solve LPP by graphical, simplex, and Big M methods.

**CO153:** Solve transportation problems by NWCR, VAM, and MODI methods.

**CO154:** Determine the solution to assignment problems by using the Hungarian method.

**CO155:** Use game theory and Simulation for Solving Business Problems.

**CO156:** Choose an appropriate method for solving examples of Sequencing Problems by using Johnson's algorithm.

#### **CCPM-V**

**CO157:** Find the Laplace transform of various functions by choosing the proper method.

**CO158:** Determine the Inverse Laplace transform of various functions by choosing the proper method.

**CO159:** Use the proper method to find the infinite Fourier sine, infinite Fourier cosine transform, and its inverse.

**CO160:** Explain the methods to find Fourier sine, Fourier cosine transform, and its inverse.

#### **CCPM-VI**

**CO161:** Discuss Python, Anaconda, Spyder IDE, Python Identifiers and keywords, data types, First Python program.

**CO162:** Use conditional statements, Looping statements, and control statements in Python programming.

**CO163:** Tell modules and packages in Python.

**CO164:** Write the programs of Numerical methods using Python and predict the output.

**CO165:** Explain Collatz conjecture, Monte Hall Problem, and data visualization in Python.