



V.S.K DEGREE COLLEGE

Recognized by UGC as Mentee College under 'PARAMARSH SCHEME'

Affiliated to Adikavi Nannaya University

BHIMAVARAM-534201

Learning Outcomes based Curriculum Framework (LOCF)

B.Sc., Mathematics

Undergraduate Programme

2017.....

DEPARTMENT OF MATHEMATICS
V.S.K COLLEGE
BHIMAVARAM-534201

DEPARTMENT OF MATHEMATICS

B.Sc., Mathematics:

Course Outcomes:

Course Name	DIFFERENTIAL EQUATIONS
Course Code	1
Credits	05
Total Hours	60

This course provides the student with

- ❖ Able to solve first order differential equations utilizing the standard techniques for separable, exact, linear, homogeneous, or Bernoulli cases.
- ❖ Able to find the complete solution of a non-homogeneous differential equation as a linear combination of the complementary function and a particular solution.
- ❖ Introduced to the complete solution of a non-homogeneous differential equation with constant coefficients by the method of undetermined coefficients.
- ❖ Able to find the complete solution of a differential equation with constant coefficients by variation of parameters.
- ❖ A working knowledge of basic application problems described by second order linear differential equations with constant coefficients.
- ❖ Able co-ordinates polar coordinates and equations solvable for p , y , x and clariot's equation solutions.
- ❖ Understand the curves and surfaces in three dimensions.
- ❖ Solve simultaneous equation using various methods.
- ❖ Able to find orthogonal trajectories of a system of curves.
- ❖ Solve Partial differential equation in two and three variables.
- ❖ Understand the formation of partial differential equation and able to solve a linear differential equation of first order.
- ❖ Able to find surfaces orthogonal to a given system of surfaces and integral surfaces to a given curve.
- ❖ Understand first order non-liner partial differential equation.
- ❖ Understands compatible equations and find their solutions.
- ❖ Learn the Chrarpit's method to solve a given non-linear partial differential equation.
- ❖ Solve partial differential equations with variable coefficients.

Title Of Paper	Solid Geometry
Course Code	2
Credits	05
Total Hours	60

This course provides the student with

- ❖ Understand geometrical terminology for angles, triangles, quadrilaterals and circles.
- ❖ Measure angles using a protractor.
- ❖ Use geometrical results to determine unknown angles.
- ❖ Recognize line and rotational symmetries.
- ❖ Find the areas of triangles, quadrilaterals and circles and shapes based on these.
- ❖ Describe various forms of equation of plane, straight line, sphere, cone and cylinder.
- ❖ Find the angle between planes, Bisector planes, perpendicular distance from a point to plane, Image of a line on plane, Intersection of lines.
- ❖ Describe coplanar lines and intersecting lines.
- ❖ Compute the angle between a line and a plane, length of perpendicular from a point to line.
- ❖ Define skew lines and calculate the shortest distance between skew lines.
- ❖ Define plane section of sphere and to find limiting points.
- ❖ Define right circular cone and right circular cylinder and solve problems.
- ❖ To inculcate knowledge on solution problems in analytic geometry.
- ❖ Help computer designers build virtual realities, geometry's application in real world includes medicines, Architecture, Computer – aided manufacturing, biology and design for construction blue prints.

Title Of Paper	ABSTRACT ALGEBRA
Course Code	3
Credits	05
Total Hours	60

This course provides the student with

- ❖ Analyze Group, Cyclic group, Normal subgroup, Quotient groups, Simple group, Commutator subgroup, Isomorphism, Automorphism, Homomorphism and their properties.
- ❖ Understand Lagrange's, Euler's, Fermat's, Cayley's, First, second and third isomorphism theorem and its application.
- ❖ Understand Direct products and prove its properties.
- ❖ Analyze Rings, Integral domains, Fields, Ideals, prime ideals, maximal ideals, Quotient fields, quotient rings, Homomorphism, isomorphism and their properties.
- ❖ Understand Factorization, Associates elements, Irreducible element, Euclidean domain, Principal ideal domain, Unique Factorization domain, Polynomial rings and their properties.
- ❖ Prove First isomorphism theorem, Eisenstein's criterion and Gauss theorem.
- ❖ Analyze Permutation groups and its properties.
- ❖ Find the inverse of a square matrix.
- ❖ Solve the matrix equation $Ax = b$ using row operations and matrix operations.
- ❖ Find the determinant of a product of square matrices, of the transpose of a square matrix, and of the inverse of an invertible matrix.
- ❖ Find the characteristic equation, eigenvalues and corresponding eigenvectors of a given matrix.
- ❖ Determine if a given matrix is diagonalizable.

Title Of Paper	REAL ANALYSIS
Course Code	4
Credits	05
Total Hours	60

This course provides the student with

- ❖ Describe fundamental properties of the real numbers that lead to the formal development of real analysis.
- ❖ Comprehend rigorous arguments developing the theory underpinning real analysis.
- ❖ Demonstrate an understanding of limits and how they are used in sequences, series, differentiation and integration.
- ❖ Construct rigorous mathematical proofs of basic results in real analysis.
- ❖ Appreciate how abstract ideas and rigorous methods in mathematical analysis can be applied to important practical problems.
- ❖ Able to understand the concept of limit for real functions and be able to calculate limits of standard functions and construct simple proofs involving this concept;
- ❖ Introduced to the concept of continuity and be familiar with the statements and proofs of the standard results about continuous real functions;
- ❖ Understand the concept of the differentiability of a real valued function and be familiar with the statements and proofs of the standard results about differentiable real functions.
- ❖ A working knowledge of differentiability for complex functions and be familiar with the Cauchy-Riemann equations;
- ❖ Evaluate integrals along a path in the complex plane and understand the statement of Cauchy's Theorem
- ❖ Define and recognize the basic properties of the field of real numbers.
- ❖ Improve and outline the logical thinking.
- ❖ Illustrate how to communicating with peers. Lecture and community.
- ❖ Determine if a sequence is bounded, monotonic, convergent (or) divergent.
- ❖ Define and recognize the series of real numbers and convergence.
- ❖ Shown the ability of working independently and with group.
- ❖ Illustrate how take up responsibility.
- ❖ Define and recognize Bolzano – Weir strass theorem.
- ❖ Ability to apply the theorem in a correct mathematical way.
- ❖ Define and recognize the real functions and its limits.
- ❖ Define and recognize the continuity of real functions.
- ❖ Define and recognize the different ability of real functions and its related theorems.
- ❖ Define and recognize the Riemann – Integration of real functions and its related theorems.

Title Of Paper	RING THEORY
Course Code	5(A)
Credits	05
Total Hours	45

This course provides the student with

- ❖ Assess properties implied by the definitions of ring, field and integral domain also Boolean ring.
- ❖ Use various canonical types of rings.
- ❖ Analyze and demonstrate examples of ideals and quotient rings.
- ❖ Use the concept of isomorphism and homomorphism for rings.
- ❖ Confidently apply algebraic concept.
- ❖ Students will be able to define ring and subrings.
- ❖ Study of ideals and concept related to ideal.
- ❖ Study of various integral domain in ring.
- ❖ Introduction to field.
- ❖ To study the algebraic structure Ring in detail through various examples.
- ❖ To learn the construction of field of quotients of an integral domain.
- ❖ To study the Rings of polynomials and its factorization over a field.
- ❖ To study the notion of ideals and factor rings with examples.
- ❖ To study Unique Factorization domain, Euclidean Domain and related results.
- ❖ Understand the basic concepts of group actions and their applications.
- ❖ Recognize and use the Sylow theorems to characterize certain finite groups
- ❖ Know the fundamental concepts in ring theory such as the concepts of ideals, quotient rings, integral domains, and fields.
- ❖ Learn in detail about polynomial rings, fundamental properties of finite field extensions, and classification of finite fields.

Title Of Paper	LINEAR ALGEBRA
Course Code	5(B)
Credits	05
Total Hours	45

This course provides the student with

- ❖ Identify and construct linear transformations of a matrix.
- ❖ Characterize linear transformations as onto, one-to-one.
- ❖ Solve linear systems represented as linear transforms.
- ❖ Express linear transforms in other forms, such as as matrix equations, and vector equations.
- ❖ Characterize a set of vectors and linear systems using the concept of linear independence.
- ❖ Uses of Matrix system in Linear Algebra and applications of Matrix in Linear Algebra.
- ❖ Given set of vectors Correct their LI or LD
- ❖ $\dim(r/w) = \dim r - \dim w$
- ❖ Construction of linear transformation what is given function is LT or not.
- ❖ Vectors in Euclidian space and lot of applications.
- ❖ Analyze Vector spaces and subspaces over a field and their properties
- ❖ Understand Span of a set and its properties.
- ❖ Analyze Linear dependence and independence of sets and their properties together with examples.
- ❖ Find Dimension and basis of a vector space and prove their properties
- ❖ Analyze Linear Transformations and their properties.
- ❖ Determine Matrix associated with a linear map and Linear map associated with a Matrix.
- ❖ Introduction to vector space and subspace.
- ❖ Use computational techniques and algebraic skills essential for the study of systems of Linear equations, matrix algebra, vector spaces, eigenvalues and eigenvectors, Orthogonality and Diagonalization. (Computational and Algebraic Skills).

Title Of Paper	NUMERICAL ANALYSIS
Course Code	6
Credits	05
Total Hours	45

This course provides the student with

- ❖ Understand the theoretical and practical aspects of the use of numerical analysis.
- ❖ Proficient in implementing numerical methods for a variety of multidisciplinary applications.
- ❖ Establish the limitations, advantages, and disadvantages of numerical analysis.
- ❖ Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.
- ❖ Understand of common numerical analysis and how they are used to obtain approximate solutions to otherwise intractable mathematical problems.
- ❖ Learn various numerical methods to solve algebraic and transcendental equations.
- ❖ Understands forward, backward and central differences and relationships between them.
- ❖ Learns interpolation with equally spaced points and applies various interpolation formulas to interpolate a given data.
- ❖ Learns interpolation with unequally spaced points and applies various interpolation formulas to interpolate a given data.
- ❖ Learns divided difference and its properties and uses Newton's formula to for interpolation.
- ❖ Learns numerical differentiation and able to use various numerical methods to find differentiation.
- ❖ Understands various methods of numerical integration.
- ❖ Able to solve ordinary differential equation using various numerical methods.
- ❖ To apply appropriate numerical methods to solve the problem with most accuracy.
- ❖ Using appropriate numerical methods determine approximate solution of ODE and system of linear equation.
- ❖ Compare different methods in numerical analysis w.r.to accuracy and efficiency of solution.

Title Of Paper	ADVANCED NUMERICAL ANALYSIS
Course Code	6
Credits	05
Total Hours	45

This course provides the student with

- ❖ Acquire basic knowledge in solving interpolation with equal interval problems by various numerical methods. Estimate the missing terms through interpolation methods.
- ❖ Develop skills in analyzing the methods of interpolating a given data, properties of interpolation with unequal intervals and derive conclusions, approximate a function using an appropriate numerical method.
- ❖ Implement numerical methods for a variety of multidisciplinary applications and a variety of numerical algorithms using appropriate technology.
- ❖ Use relevant numerical techniques for interpolation with equal and unequal intervals by using various central difference formulae and code a numerical method in a modern computer language.
- ❖ Apply appropriate numerical methods to solve the problem with most accuracy.
- ❖ Be able to derive Least – Squares curve fitting procedures, fitting a straight line, fitting a parabola, nonlinear curve fitting, Curve fitting by a sum of exponentials.
- ❖ Be able to find the derivatives using Newton’s forward difference formula, Newton’s backward difference formula, Derivatives using central difference formulae, Stirling’s interpolation formula, Newton’s divided difference formula, Maximum and minimum values of a tabulated function.
- ❖ Be able to derive Trapezoidal rule, Simpson’s 1/3 – rule, Simpson’s 3/8 – rule, and Weddle’s rules from General Quadrature formula and find the Euler – Maclaurin Formula of summation and The Euler transformation.
- ❖ Be able to find the solution of linear systems by using Direct methods, Matrix inversion method, Gaussian elimination methods, Gauss-Jordan Method, Method of factorization, Solution of Tridiagonal Systems,
- ❖ Be able to find the solution of ordinary differential equation of first order by Euler, Taylor and Runge-Kutta methods
- ❖ Compare different methods in numerical analysis with accuracy and efficiency of solution.

Title Of Paper	SPECIAL FUNCTIONS
Course Code	8
Credits	05
Total Hours	45

This course provides the student with

- ❖ Understand integral calculus and special functions of various engineering problem and to known the application of some basic mathematical methods via all these special functions.
- ❖ Explain the applications and the usefulness of these special functions.
- ❖ Classify and explain the functions of different types of differential equations.
- ❖ Understand purpose and functions of the gamma and beta functions, Fourier series and Transformation.
- ❖ Use the gamma function, beta function and special functions to: evaluate different types of integral calculus problems and Fourier series to solve differential equations.
- ❖ Define and recognize the important contribution to Number Theory, Special functions, calculus of variations and elliptic integrals.
- ❖ Bessel's equation is used in many physical problems involving vibrations (or) heat conduction in cylinder regions.
- ❖ Special functions have many applications in Engineering.
- ❖ Laguerre's Equation is particularly in boundary values problems for spheres.
- ❖ Define and recognize Hermite and Laguerre's polynomials and applications.
- ❖ Define and recognize the Beta and Gamma functions and its applications.
- ❖ Improve and outline the logical thinking.
- ❖ Illustrate how take up responsibility.
- ❖ Shown the ability of working Independently and with Group.

Teaching-Learning Process

As a program of study, B.Sc. Mathematics is designed to encourage the acquisition of knowledge of mathematics, understanding and professional skills required for the industrial/professional jobs. The program provides a strong background in mathematics while introducing you to the field of education. Upon completion of this degree, you will earn your Adolescence to Young Adult (AYA) teacher license in integrated mathematics. Development of practical/experimental skills should constitute an important aspect of the teaching-learning process. The program includes a wide array of courses meant to expand your mathematical content knowledge from calculus to upper-level mathematics. In addition, you will take education courses with accompanying field experiences designed to provide you with a foundation in the educational process, culminating in a semester-long student teaching experience. Methods which actively involve students are more effective than lectures for encouraging them to take intense approaches which are likely to result in developing understanding and encouraging critical thinking. Students learn more effectively when lectures include activities which engage their thoughts and motivation.

The faculty should promote learning on a proportionate scale of 20:30:50 principle, where lectures (listening/hearing) constitute 20 percent of the delivery; visuals (seeing/power point presentation/video/demonstrations) 30 percent of the learning methods; and experience (doing/participating/discussion) 50 percent. This ratio is subject to change as per institutional needs. In order to achieve its objective of focused process based learning and holistic development, the Institution/University may use a variety of knowledge delivery methods. The following general approaches are suggested for more outcome oriented and participative learning.

Lectures: Lectures should be designed to provide the learners with interesting and fresh perspectives on the subject matter. Lectures should be interactive in a way that students work with their teachers to get new insights in the subject area, on which they can build their own bridges to higher learning. In order to make every lecture outcome oriented, faculty may specify the lecture outcomes in the beginning and at the end, the main points covered during the lecture should be summarized.

Case Studies: Real case studies, wherever possible, should be encouraged in order to challenge students to find creative solutions to complex problems faced by electronics industry, community, society and various aspects of knowledge domain concerned. Student may be asked to communicate findings of the study in the form of a report and seminar.

SWAYAM Portal: The platform provides the best teaching learning e-resources to all. Students can enrich the learning experience by using audio-video and multi-media and state of the art pedagogy / technology on SWAYAM portal. The courses hosted on SWAYAM are in 4 quadrants – (1) video lecture, (2) specially prepared reading material that can be downloaded/printed (3) self-assessment tests through tests and quizzes and (4) an online discussion forum for clearing the doubts.

Problem solving: Instead of following an established procedure given in manual, student will be given a scientific problem and will be able to design his/her own way of solving the problem. Student involvement in the technical skills increases if the theories are designed and executed by the students themselves.

Mini Projects: Mini-projects provide opportunities for the students to develop project management skills while working in a team. They may be assigned circuit/system design related problems for solving. This helps to achieve short cut techniques by their own knowledge and skills.

Assessment Methods

Mathematical Science is a professional academic program, so there is need to focus more on activity-based evaluation rather than purely written examination. A variety of assessment methods that are appropriate within the disciplinary area of mathematics must be used. The assessment of learners 'achievement in B.Sc. Mathematics will be aligned with the following

- Course outcomes
- Program Outcomes

Allowing for the diversity in learning and pedagogical methods adopted by different universities and institutions, Universities are expected to ensure that the assessment techniques are able to provide clear information about the attainment level of course outcomes and program outcomes for each and every student.

Assessment Priorities: Institutions will be required to prioritize formative assessments (in-semester activities including tests done at the department or instructor level) rather than giving heavy and final weightage to summative assessments (end-semester). Progress of learners towards achieving learning outcomes may be assessed making creative use of the following, either independently or in combination:

- Time-constrained examinations (say 1-hour or 2-hour tests)
- Closed-book and open-book tests (if applicable)
- Problem based assignments
- Quizzes
- Real life projects
- Individual/Team project reports;
- Oral presentations, including seminar presentation;
- Viva voce
- Interviews
- Peer and self-assessment etc.
- Any other pedagogic approaches as may be relevant keeping in view the learner's level, credit load and class size.

Weightage Distribution: In view of need for more activity centric evaluation, more marks should be assigned for in-semester i.e., internal evaluation. The distribution of marks for in-semester and end-semester examination should preferably be in the ratio of 25:75.

End Semester Examination: The final theory exam should contain preferably 40% marks assigned for problem solving questions. The problem-solving questions should comprise numerical problems, circuit analysis and design type questions. The various teaching, learning and evaluation strategies for various skills/outcomes are summarized in the next table.

Innovation and Flexibility: Within each category, institutions are expected to encourage instructors to bring in innovative and flexible methods to guarantee the fullest realization of Learning Outcomes outlined in the document. All such instructional and assessment requirements must be clearly communicated to all stakeholders at the time of course registration. Any subsequent change or minor modification necessary for fuller realization of learning outcomes must be arranged with due notice and institutional arrangement at the relevant level.

Freedom and Accountability: Freedom and accountability of the stakeholder are key attributes that determine the success of the Learning Outcomes framework. The excellence of institutions will be increasingly determined by Learning Outcomes rather than programme or course objectives. Hence it is necessary to innovate continually in learning and assessment in order to ensure meaningful and socially relevant learning (with transparent Learning Outcomes indices) rather than rote learning.

Activities planned for achievement of outcomes:

Activities to be selected from following list (Partial list, more activities can be added by faculty)	Tick mark
1. Assignments	✓
2. Quizzes	✓
3. Internal Assessment Tests	✓
4. Course Seminar	✓
5. Course Project (Mini project)	
6. Group discussion	✓
7. Viva-Voce	✓

B.Sc., MATHEMATICS

PROGRAMME OUTCOMES

This undergraduate course in Mathematics would provide the opportunity to the students:

- Scientific temper will be developed.
- Able to present mathematics clearly and precisely, make vague ideas precise by formulating them in the language of mathematics, describe mathematical ideas from multiple perspectives and explain fundamental concepts of mathematics to non-mathematicians.
- Acquire basic Practical skills & Technical knowledge along with domain knowledge of different subjects in the science stream.
- Become employable; they will be eligible for career opportunities in Industry, or will be able to opt for entrepreneurship.
- Ability to acquire in-depth knowledge of algebra, calculus, geometry, differential equations and several other branches of mathematics. This also leads to study of related areas like computer science and physical science. Thus, this Program helps learners in building a solid foundation for higher studies in mathematics.
- Possess basic subject knowledge required for higher studies, professional and applied courses like Management Studies, Law etc.
- Aware of and able to develop solution-oriented approach towards various Social and Environmental issues.
- The skills and knowledge gained has intrinsic beauty, which also leads to proficiency in analytical reasoning. This can be utilized in modelling and solving real life problems.
- Utilize mathematics to solve theoretical and applied problems by critical understanding, analysis and synthesis.
- Ability to share ideas and insights while seeking and benefitting from knowledge and insight of others. This helps them to learn behave responsibly in a rapidly changing interdependent society.
- Ability to communicate mathematics effectively by written, computational and graphic means.
- Enhancing students' overall development and to equip them with mathematical modeling abilities, problem solving skills, creative talent and power of communication necessary for various kinds of employment.
- Ability to apply multivariable calculus tools in physics, economics, optimization, and understanding the architecture of curves and surfaces in plane and space etc.
- Ability to analyze a problem, identify and define the computing requirements, which may be appropriate to its solution.
- This Program will also help students to enhance their employability for jobs in banking, insurance and investment sectors, data analyst and in various other public and private enterprises.

B.Sc., MATHEMATICS

PROGRAMME SPECIFIC OUTCOMES

This undergraduate course in Physics would provide the opportunity to the students

- Able to recall basic facts about mathematics and should be able to display knowledge of conventions such as notations, terminology.
- To develop a positive attitude towards mathematics as an interesting and valuable subject of study.
- Solid Foundation in Knowledge as Bachelor Degree in Mathematics is the culmination of in-depth knowledge of many core branches of mathematics, viz. Algebra, Calculus, Geometry, Differential Equations, Mechanics, Real and Complex Analysis including some related areas like Computer Science and Statistics. Thus, this program helps students in building a solid foundation for further higher studies and research in Mathematics.
- Adequate exposure to global and local concerns that explore them many aspects of mathematical sciences.
- Equipped with mathematical modeling ability, problem solving skills, creative talent and power of communication necessary for various kinds of employment.
- Interdisciplinary and Research Skills able to present mathematics clearly and precisely, make vague ideas precise by formulating them in the language of mathematics, describe mathematical ideas from multiple perspectives and explain fundamental concepts of mathematics to non-mathematicians.
- Formulate and develop mathematical arguments in a logical manner.
- Able to apply their skills and knowledge that is translate information presented verbally into mathematical form, select and use appropriate mathematical formulae or techniques in order to process the information and draw the relevant conclusion.
- Think in a critical manner.
- Problem Solving learn to logically question assertions, to recognize patterns and to distinguish between essential and irrelevant aspects of problems. This helps them to learn behave responsibly in a rapidly changing interdependent society.
- Know when there is a need for information, to be able to identify, locate, evaluate, and effectively use that information for the issue or problem at hand.
- Understand, formulate and use quantitative models arising in social science, Business and other contexts.
- Acquire good knowledge and understanding in advanced areas of mathematics and statistics, chosen by the student from the given courses.
- Competency in Skills and knowledge gained has intrinsic beauty, which leads to proficiency in analytical reasoning, critical understanding, analysis and synthesis in order to solve theoretical and practical problems. This can orient students towards applications of mathematics in other disciplines and moreover, can also be utilized in modelling and solving real life problems.
- Proficiency in Employments help students to enhance their employability for Government jobs, jobs in banking, insurance and investment sectors, data analysis jobs, and jobs in various other public and private enterprises.