REVISED CURRICULUM FOR

I and II Semester B. Sc. Mathematics

STARTING YEAR OF IMPLEMENTATION: 2024-25

TUMKUR UNIVERSITY

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2024

CURRICULUM STRUCTURE FOR UNDERGRADUATE DEGREE PROGRAM

Name of the Degree Program : **B. Sc.**
Subject : **Mathematics**
Starting Year of Implementation : **2024-25**

ASSESSMENT

Weightage for the Assessment (in percentage)

Type of Course	Formative Assessment (I. A.)	Summative Assessment (S.A.)
Theory	80%	20%
Practical	80%	20%

CONTENT OF COURSES FOR B. Sc. MATHEMATICS FOR FIRST AND SECOND SEMESTER

Semester	Course No.	Theory/ Practical	Credits	Paper Title	Marks	
					S. A.	I. A.
I	MATDSCT1.1	Theory	4	Mathematics - I	80	20
	MATDSCP1.1	Practical	2	Theory based Lab on Mathematics - I	40	10
II	MATDSCT2.1	Theory	4	Mathematics – II	80	20
	MATDSCP2.1	Practical	2	Theory based Lab on Mathematics - II	40	10

Syllabus for B. Sc. Mathematics

SEMESTER – I

Course Learning Outcomes: This course will enable the students to

- Recall basic matrix operations and properties and remember formulae of higher order derivatives of standard functions.
- Interpret the relationship between polar and Cartesian coordinates.
- Classify and apply the different methods of solving first-order ODEs.
- Understand the geometric properties of curves based on their equations.
- Learn the fundamentals of Maxima.
- Understand the methods of solving problems on matrices, system of linear equations and successive differentiation using Maxima.

MATDSCT1.1: Mathematics - I	
Teaching Hours : 4 Hours/Week	Credits: 4
Total Teaching Hours: 60 Hours	Max. Marks: 100 (S. A. – 80 + I. A. – 20)

Unit-I: Matrices and solution to system of linear equations — 15 Hours

Elementary row and column operations, row reduced echelon form of a matrix, equivalent matrices, rank of a matrix and applications, invariance of rank under elementary operations, determination of rank of a matrix by row reduced echelon form, homogeneous and non-homogeneous systems of linear equations, consistency and inconsistency, criteria for existence and uniqueness of solutions to systems of linear equations.

Eigen values and eigen vectors of a square matrix, standard properties, Cayley-Hamilton theorem and applications, matrix diagonalization using eigen values (only for 2X2 matrices).

Unit-II: Successive Differentiation and Polar Co-ordinates — 15 Hours

n^{th} derivatives of standard functions – $e^{ax+b}, (ax+b)^m, \log(ax+b), \sin(ax+b), \cos(ax+b), e^{ax}\sin(bx+c), e^{ax}\cos(bx+c)$, Leibnitz theorem and its applications.

Introduction to polar co-ordinate system - angle between the radius vector and the tangent, angle between two polar curves, polar sub tangent and polar sub normal, length of the perpendicular from pole to the tangent, pedal equations.

Unit-III: Tracing of curves 15 Hours

Derivative of an arc in Cartesian, polar and parametric forms, radius of curvature in Cartesian, polar, parametric and pedal forms, centre of curvature, evolutes, asymptotes, envelopes.

Tracing of Cartesian and polar curves – Cissoid, Strophoid, Witch of Agnesi, Lemniscate of Bernoulli, Cardioid, three leaved rose.

Unit-IV: Ordinary differential equations of first order 15 Hours

Recapitulation of ordinary differential equations of first order - variables-separable method, homogeneous and linear differential equations and equations reducible to linear form.

Solution to exact differential equations, equations reducible to exact form, first order higher degree differential equations solvable for x, y and p. Clairaut's form and singular solutions, orthogonal trajectories.

Total differential equations – necessary and sufficient condition for the equation $P\,dx + Qdy + Rdz = 0$ to be exact, Simultaneous differential equations of the form $\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$.

Reference Books:

1. University Algebra – N S Gopala Krishnan, New Age International (P) Limited.
2. Theory of Matrices - B S Vatsa, New Age International Publishers.
3. Matrices - A R Vasista, Krishna Prakashana Mandir.
4. S. Narayan and P.K. Mittal, Text book of Matrices, 10th ed. New Delhi: S. Chand and Co. Ltd, 2004.
4. Differential Calculus - Shanti Narayan, S. Chand & Company, New Delhi.
5. Applications of Calculus, Debasish Sengupta, Books and Allied (P) Ltd., 2019.
6. Calculus – Lipman Bers, Holt, Rinehart & Winston.
7. Calculus - S Narayanan & T. K. Manicavachogam Pillay, S. Viswanathan Pvt. Ltd.,vol. I & II.
8. Schaum's Outline of Calculus - Frank Ayres and Elliott Mendelson, 5th ed. USA:Mc. Graw Hill.
9. Ordinary and Partial Differential Equations, M D Raisinghania, S. Chand, Delhi, 2020.
10. Schaum's Outline of Differential Equations – R Bronson and G Costa, 4th Edition, 2014.

MATDSCP1.1: Theory based Lab on Mathematics – I using Maxima	
Teaching Hours : 4 Hours/Week	Credits: 2
Total Teaching Hours: 60 Hours	Max. Marks: 50 (S.A.-40 + I.A.-10)

Practical/Lab Work to be performed in Computer Lab:

1. Introduction to Maxima and its standard commands .
2. Basic operations on matrices – Addition, Subtraction and Multiplication.
3. Computation of the rank of matrix and row reduced echelon form.
4. Solving systems of homogeneous and non-homogeneous linear equations.
5. Solving problems related to Cayley-Hamilton theorem.
6. Finding the n^{th} derivatives of standard functions.
7. Finding the angle between the radius vector and tangent.
8. Finding the angle between two polar curves.
9. Solution to first order Ordinary Differential Equations and plotting the solution.
10. Solving total and simultaneous differential equations.
11. Finding the curvature and radius of curvature of the Cartesian and parametric curves.
12. Tracing of standard Cartesian and polar curves.

SEMESTER – II

Course Learning Outcomes: This course will enable the students to

- Recall the properties of groups and subgroups.
- Explain the geometrical aspects of partial derivatives and learn the partial differentiation of implicit and explicit functions of several variables.
- Compare the different methods to solve higher order ordinary differential equations and relate their solutions to real world problems.
- Understand and evaluate line integrals and multiple integrals and their geometric properties.
- Learn various commands in Maxima to obtain partial differentiation and evaluate line and multiple integrals.
- Solve different problems using conditional and logical commands in Maxima.

MATDSCT2.1: Mathematics - II	
Teaching Hours : 4 Hours/Week	Credits: 4
Total Teaching Hours: 60 Hours	Max. Marks: 100 (S. A. – 80 + I. A. – 20)

Unit-I: Relations, functions and mathematical logic 15 Hours

Cartesian product of sets, relations – types of relations, equivalence relations, equivalence classes, partition of a set. Functions – injective, surjective and bijective functions.

Mathematical logic – proposition, basic connectives and truth tables, tautology, contradiction, logical equivalence – laws of logic, converse, inverse and contraposition of a proposition, logical implication – rules of inference.

Unit-II: Groups 15 Hours

Binary operation, semigroups, definition of a group with examples and properties, congruence problems, subgroups, center of groups, order of an element of a group and its related theorems. cyclic groups, coset decomposition, factor groups, Lagrange's theorem and its consequences.

Unit-III: Partial Derivatives 15 Hours

Functions of two or more variables - explicit and implicit functions, partial derivatives, basic properties, geometrical meaning of partial derivatives, partial differentiation of homogeneous functions, Euler's theorem, total derivative and chain rule for partial

differentiation of implicit and composite functions, Jacobians - standard properties, maxima and minima of functions of two variables, method of Lagrange's multipliers.

Unit-IV: Higher Order Ordinary differential equations 15 Hours

Second and higher order linear differential equations with constant coefficients, complementary functions, Particular Integrals when the RHS is of the form e^{ax}, $sin(ax+b)$, $cos(ax+b)$, x^n, $e^{ax}V$ and xV where V is a function of x. Solutions to second order ordinary differential equations with variable coefficients - Cauchy – Euler differential equations, Legendre differential equations, Method of variation of parameters, when a part of complementary function is given, change of independent variables.

Reference Books:

1. Discrete and Combinatorial Mathematics – Ralph P. Grimaldi, Pearson Education.
2. Topics in Algebra, I.N Herstein, Wiley Eastern Ltd., New Delhi.
3. Higher algebra - Bernard & Child, Arihant, ISBN: 9350943199/9789350943199.
4. Modern Algebra - Sharma and Vasista, Krishna Prakashan Mandir, Meerut, U.P.
5. Differential Calculus - Shanti Narayan, S. Chand & Company, New Delhi.
6. Applications of Calculus - Debasish Sengupta, Books and Allied (P) Ltd., 2019.
7. Calculus – Lipman Bers, Holt, Rinehart & Winston.
8. Schaum's Outline of Calculus - Frank Ayres and Elliott Mendelson, 5th ed. USA:Mc. Graw Hill.
9. Ordinary and Partial Differential Equations - M D Raisinghania, S. Chand, Delhi, 2020.
10. Schaum's Outline of Differential Equations – R Bronson and G Costa, 4th Edition, 2014.

MATDSCP2.1: Theory based Lab on Mathematics – II using Maxima	
Teaching Hours : 4 Hours/Week	Credits: 2
Total Teaching Hours: 60 Hours	Max. Marks: 50 (S.A.-40 + I.A.-10)

Course Learning Outcomes: This course will enable the students to

- Learn the different commands in Maxima to perform partial differentiation and evaluate multiple integrals.
- Understand the Maxima.

Practical/Lab Work to be performed in Computer Lab:

1. Verification of a relation to be an equivalence relation.
2. Finding equivalence classes w. r. t. a relation on a set.
3. Verification of a function to be a bijection.
4. Verification of binary operations.
5. Constructing Cayley's table and testing the abelian property of an algebraic structure.
6. Verifying whether an algebraic structure is a group.
7. Finding first and second order partial derivatives of functions of two/three variables.
8. Verification of Euler's theorem and its extension for homogeneous functions.
9. Finding Jacobian of functions of two and three variables and verifying its properties.
10. Finding the Complementary Function of second and third order linear differential equations with constant coefficients.
11. Finding the general solution of second and third order linear differential equations with constant coefficients.
12. Solving Cauchy-Euler differential equations of second order.

Question Paper Pattern for DSCT (I and II semester)
4 Credits (S.A. - 80 + I.A. - 20)

Duration: 03 hours Max. Marks: 80

PART- A	
Answer any 10 questions	10 X 2 = 20
Question Numbers – 1 to 12	
PART- B	
Answer any 6 questions	6 X 5 = 30
Question Numbers –13 to 20	
PART – C	
Answer any 6 questions	6 X 5 = 30
Question Numbers –21 to 28	

Note: The question paper shall strictly adhere to the following blueprint.

Blueprint

Unit	Unit 1	Unit 2	Unit 3	Unit 4
PART- A	03 Questions	03 Questions	03 Questions	03 Questions
PART- B	04 Questions	04 Questions	-	-
PART- C	-	-	04 Questions	04 Questions

Practical Examination Pattern for DSCP (I and II semester)
2 Credits (S.A. - 40 + I.A. - 10)

Duration: 03 hours Max. Marks: 40

Marks Allotment	
Program writing*	10
Problem solving*	10
Program execution*	10
Viva-voce**	05
Record	05
Total	40 marks

Note:

*(i)A total of 3 programs should be given to each student. He/she has to write any two out of the three programs, solve the corresponding problems, write the programs and then execute them using Maxima.

**(ii) Viva-voce examination should be conducted based on the syllabus for the corresponding semester.