VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY, BALLARI

Department of Studies in Mathematics

SEP: Credits Structure under Choice Based Credit System [CBCS]

Syllabus of III &IV Semester

Bachelor of Science

With effect from 2024-25 onwards

Approved in the BOS dated on 24-03-2025

VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY

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VSKUB SEP Proposed Curricular and Credits Structure under Choice Based Credit System [CBCS] of Scheme for the Three Years B.Sc. Undergraduate Programme with effect from 2024-25

Curricular and Credits Structure for Mathematics

Semester	Major 1 (A)	Major 2 (B)	Major 3 (C)	Elective /Optional	Language	Compulsory / Skill Courses	Total Credits
1	----	----	Differential calculus and Algebra-I (L:T:P = 4:0:4)	----	----	Constitutional Values (2) (L:T:P = 2:0:0)	26
2	----	----	Integral calculus and Algebra-II(L:T:P = 4:0:4)	----	----	Environmental Studies (2) (L:T:P = 2:0:0)	26
3	----	----	Series and Sequences and Vector Calculus (L:T:P = 4:0:4)	----	----	Integral Transforms (L:T:P = 1:0:2)	26
4	----	----	Differential Equations (L:T:P = 4:0:4)	----	----	Linear Programming Problems (L:T:P = 1:0:2)	26
5	----	----	Real Analysis and Complex Analysis (L:T:P = 4:0:4)	Special Functions (L:T:P = 2:0:0)	----	SEC-3 (2) Elementary Research Methodology (L:T:P = 2:0:0)	22
6	----	----	Numerical Analysis (L:T:P = 4:0:4)	Graph Theory (L:T:P = 2:0:0)	----	Elementary Research Project (A1/B1/C1) (2) (L:T:P =1:0:2)	22
Total	**36**	**36**	**36**	**04**	**24**	**12**	**148**
Total 148 Credits							

Note:

1. The curriculum for all Courses except L1, L2, Constitutional Values, Environmental values and Elementary Research Methodology will be framed by the respective Board of Studies (A/B/C). Here for example A – Physics, B – Chemistry and C – Mathematics.

2. The Curriculum for Languages L1 & L2 will be framed by respective Board of Studies (BoS) (Example Kannada/ English/ Hindi/ Sanskrit/ Telugu etc.).

3. The curriculum for Constitutional values will be framed by Board of Studies (BoS) in Political Science.

4. The curriculum for Environmental Science will be framed by special/common Board of Studies (BoS) set up by the University.

5. The curriculum for Elementary Research Methodologywill be set by special/common Board of Studies (BoS - Faculty of Science & Applied Science) set up by the University.

VSKUB SEP Proposed Curricular and Credits Structure under Choice Based Credit System [CBCS] of Scheme for the Three Years B.Sc. Undergraduate Programme with effect from 2024-25

Curricular and Credits Structure for Mathematics

I-Semester

Course code	Title of the Course	Marks			Teaching hours/week			Credit	Duration of SEE (Hrs)
		IA	SEE	Total	L	T	P		
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----	----	----	----	----	----	----	----	----	----
----	----	----	----	----	----	----	----	----	----
24MJMA1L	Differential calculus and Algebra-I	20	80	100	4	0	0	4	03
24MJMA1P	Differential calculus and Algebra-I Lab	10	40	50	0	0	4	2	03
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24CVCM1L	Constitutional Values	10	40	50	2	0	0	2	1.5*
TOTAL	----	**30**	**120**	**150**	**4**	**0**	**4**	**6**	**-**

*** 40 Multiple Choice Questions for 40 Marks (OMR Based)**

Course Code Description:

24MJAA1L: For Example 24MJPH1L

24 – Year of Curriculum Implementation / Revision

MJ – Major, LG – Language , CV – Constitutional Values

AA/BB/CC – Course Specific (Example for Physics AA – PH, Chemistry AA – CH, Maths – MA etc.)

CM – Common Course

1 – Semester Number

L – Lecture, P - Practical

VSKUB SEP Proposed Curricular and Credits Structure under Choice Based Credit System [CBCS] of Scheme for the Three Years B.Sc. Undergraduate Programme with effect from 2024-25

II-Semester

Course code	Title of the Course	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
		IA	SEE	Total	L	T	P		
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----	----	----	----	----	----	----	----	----	----
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24MJMA2L	Integral calculus and Algebra-II	20	80	100	4	0	0	4	03
24MJMA2P	Integral calculus and Algebra-II Lab	10	40	50	0	0	4	2	03
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----	----	----	----	----	----	----	----	----	----
24ESCM2L	Environmental Studies	10	40	50	2	0	0	2	1.5*
TOTAL	**----**	**30**	**120**	**150**	**4**	**0**	**4**	**6**	**-**

*** 40 Multiple Choice Questions for 40 Marks (OMR Based)**

Course Code Description:

24MJAA2L:

24 – Year of Curriculum Implementation / Revision

MJ – Major, LG – Language ,ES – Environmental Science

AA/BB/CC – Course Specific (Example for Physics AA – PH, Chemistry AA – CH, Maths – MA etc.)

CM – Common Course

2 – Semester Number

L – Lecture, P - Practical

VSKUB SEP Proposed Curricular and Credits Structure under Choice Based Credit System [CBCS] of Scheme for the Three Years B.Sc. Undergraduate Programme with effect from 2024-25

III-Semester

Course code	Title of the Course	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
		IA	SEE	Total	L	T	P		
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24MJMA3L	Series and Sequences and Vector Calculus	20	80	100	4	0	0	4	03
24MJMA3P	Series and Sequences and Vector Calculus	10	40	50	0	0	4	2	03
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24MJMA3S	Integral Transform	10	40	50	1	0	2	2	1.5*
TOTAL	**----**	**40**	**160**	**200**	**5**	**0**	**6**	**8**	**-**

*** 40 Multiple Choice Questions for 40 Marks (OMR Based)**

Course Code Description:

24MJAA3L:

24 – Year of Curriculum Implementation / Revision

MJ – Major, LG – Language

AA/BB/CC – Course Specific (Example for Physics AA – PH, Chemistry AA – CH, Maths – MA etc.)

3 – Semester Number

L – Lecture, P – Practical, S - Skill

VSKUB SEP Proposed Curricular and Credits Structure under Choice Based Credit System [CBCS] of Scheme for the Three Years B.Sc. Undergraduate Programme with effect from 2024-25

IV-Semester

Course code	Title of the Course	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
		IA	SEE	Total	L	T	P		
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24MJMA4L	Differential Equations	20	80	100	4	0	0	4	03
24MJMA4P	Differential Equations Lab	10	40	50	0	0	4	2	03
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----	----	----	----	----	----	----	----	----	----
24MJMA4S	Linear Programming Problems	10	40	50	1	0	2	2	1.5*
TOTAL	**----**	**40**	**160**	**200**	**5**	**0**	**6**	**8**	**-**

*** 40 Multiple Choice Questions for 40 Marks (OMR Based)**

Course Code Description:

24MJAA4L:

24 – Year of Curriculum Implementation / Revision

MJ – Major, LG – Language

AA/BB/CC – Course Specific (Example for Physics AA – PH, Chemistry AA – CH, Maths – MA etc.)

4 – Semester Number

L – Lecture, P – Practical, S - Skill

VSKUB SEP Proposed Curricular and Credits Structure under Choice Based Credit System [CBCS] of Scheme for the Three Years B.Sc. Undergraduate Programme with effect from 2024-25

V-Semester

Course code	Title of the Course	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
		IA	SEE	Total	L	T	P		
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24MJMA5L	Real analysis and Complex analysis	20	80	100	4	0	0	4	03
24MJMA5P	Real analysis and Complex analysis Lab	10	40	50	0	0	4	2	03
24MJMA5E	Special Functions	10	40	50	2	0	0	2	1.5
24RMBS5S	Elementary Research Methodology#	10	40	50	2	0	0	2	01*
TOTAL		**40**	**160**	**200**	**6**	**0**	**4**	**8**	**-**

*** 40 Multiple Choice Questions for 40 Marks (OMR Based)**

 # The curriculum for Elementary Research Methodology will be set by special/common Board of Studies (BoS - Faculty of Science & Applied Science) set up by the University. The course code for Elementary Research Methodology shall be 24RMBS5S.

Course Code Description:

24MJAA5L:

24 – Year of Curriculum Implementation / Revision

MJ – Major, LG – Language, RM – Research Methodology

AA/BB/CC – Course Specific (Example for Physics AA – PH, Chemistry AA – CH, Maths – MA etc.)

BS – Bachelor of Science

4 – Semester Number, L – Lecture, P – Practical, S – Skill, E – Elective Course

VSKUB SEP Proposed Curricular and Credits Structure under Choice Based Credit System [CBCS] of Scheme for the Three Years B.Sc. Undergraduate Programme with effect from 2024-25

VI-Semester

Course code	Title of the Course	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
		IA	SEE	Total	L	T	P		
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24MJMA6L	Numerical Analysis	20	80	100	4	0	0	4	03
24MJMA6P	Numerical Analysis Lab	10	40	50	0	0	4	2	03
24MJMA6E	Graph Theory	10	40	50	2	0	0	2	1.5
24MJAA6R	Elementary Research Project	10	40	50**	0	0	4	2	01**
TOTAL		**40**	**160**	**200**	**6**	**0**	**4**	**8**	**-**

Course Code Description:

24MJAA6L:

24 – Year of Curriculum Implementation / Revision

MJ – Major, LG – Language, CM – Common Course,

AA/BB/CC – Course Specific (Example for Physics AA – PH, Chemistry AA – CH, Maths – MA etc.)

BS – Bachelor of Science

6 – Semester Number

L – Lecture, P – Practical, E – Elective Course, R – Research Project

B.Sc III Semester

Department Name: Mathematics

Semester - III

Course Title: Series and Sequences and Vector Calculus	Course Code: 24MJMA3L
Total Contact Hours: 4 hours/week	No. of Credits: 4
L:T:P- 4:0:0	
Internal Assessment Marks: 20	Duration of SEE: 3 Hours
Semester End Exam Marks: 80	

Course Outcomes (COs):

At the end of the course, students will be able to:

1. Analyze and determine whether a sequence converges or diverges.
2. Apply Cauchy's criterion to determine the convergence of a sequence.
3. Use the algebra of convergent sequences to perform operations like addition, subtraction, multiplication, and division on sequences.
4. Get introduced to the fundamentals of vector differential and integral calculus.
5. Get familiar with the various differential operators and their properties.
6. Learn the applications of vector calculus.

Unit	Description	Hours
1	**Sequences:** Definition of sequence. Bounded and unbounded sequences. Convergence, divergence and oscillatory sequences, monotonic sequences, algebra of convergent sequences, Cauchy's criterion for convergence.	11
2	**Series of real numbers:** Partial sums of a series, convergence, divergence and oscillation of series. Properties of convergent series. Properties of series of positive terms. Geometric series. Tests for convergence of series: P-series test, comparison test, D Alembert's ratio test(without proof), Raabe's test(without proof), D'Alembert's test for absolute convergence (without proof), alternating series, Leibnitz test. Absolute and conditional convergence.	12
3	**Vector Algebra** Multiple product – scalar triple product, vector triple product, geometrical interpretation, related problems; vector function of a scalar variable – interpretation as a space curve, derivative, tangent, normal and binormal vectors to a space curve; Curvature and Torsion of a space curve- definitions, derivation and problems.	11
4	**Scalar field** Gradient of a scalar field, geometrical meaning, directional derivative, unit normal using surfaces - tangent plane and normal to the surface;	11

	Vector field - Divergence and curl of a vector field, geometrical meaning, solenoidal and irrotational fields; Laplacian of a scalar field; Vector identities.	
5	**Vector Integration** Definition and basic properties, vector line integral, surface integral and volume integral; Green's theorem in the plane–proof and related problems, Direct consequences of the theorem; Gauss Divergence theorem- statement related problems, Direct consequences of the theorem; Stokes theorem- statement related problems, Direct consequences of the theorem.	11

References:

1. G.K.Ranganath: B.Sc Mathematics (S Chand & Company Limited)
2. O.E.Stanaitis: An Introduction to Sequences, Series and Improper integrals Holdan-dey Inc.
3. S.C Malik, Real Analysis, New Age International (India) Pvt. Ltd.
4. S.C.Malik and Savita Arora, Mathematical Analysis, 2nd ed. New Delhi, India: New Age international (P) Ltd.
5. M. D. Raisinghania, Vector Calculus, S Chand Co. Pvt. Ltd., 2013.
6. M. Spiegel, Vector Analysis, 2 nd Edition, Schaum's Outline Series, Mc-Graw Hill, Education, 2017.
7. C. E. Weatherburn, Elementary Vector Analysis, Alpha edition, 2019.
8. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers.
9. P. N. Wartikar and J. N. Wartikar, A Textbook of Applied Mathematics, Vol. II, Pune Vidyarthi Griha Prakashan, Pune, 2009.

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Department Name: Mathematics

Semester - III

Course Title: Series and Sequences and Vector Calculus Lab	Course Code: 24MJMA3P
Total Contact Hours: 4 hour/week	No. of Credits: 2
L:T:P- 0:0:4	
Internal Assessment Marks: 10	Duration of SEE: 3 Hours
Semester End Exam Marks: 40	

Course Outcomes (COs):

At the end of the course, students will be able to:

1. Learn Free and Open-Source Software (FOSS) tools for computer programming.
2. Solve problems related to Series and Sequences and Vector Calculus using FOSS software.
3. Test the convergence of sequences
4. Verify the Root test, and D Alembert's Test
5. Find curvature and torsion of a space curve.

List of Experiments / Programs (For a Lab Course)

Sl.No	Experiment / Program
1	Test the convergence of sequences
2	Verification of exponential and logarithm series.
3	Verification of geometric series, p-series and Cauchy's Integral test.
4	Verification of Root test, and D Alembert's Test
5	Examples on alternating series using Leibnitz's theorem.
6	Program on multiple product of vectors – Scalar and Cross product.
7	Program on vector differentiation and finding unit tangent
8	Program to find curvature and torsion of a space curve.
9	Program to find the gradient and Laplacian of a scalar function, divergence and curl of a vector function.
10	Program to demonstrate the physical interpretation of gradient, divergence and curl.
11	Program to evaluate a vector line integral.
12	Program to evaluate surface/ volume integral.
13	Program to verify Green's theorem.

References:

1. O. E. Stanaitis: An Introduction to Sequences, Series and Improper integrals Holdan-dey Inc.

2. S.C Malik, Real Analysis, New Age International (India) Pvt. Ltd.
3. S.C.Malik and Savita Arora, Mathematical Analysis, 2nd ed. New Delhi, India: New Age international (P) Ltd.
4. G.K.Ranganath: B.Sc Mathematics (S Chand & Company Limited)
5. M. D. Raisinghania, Vector Calculus, S Chand Co. Pvt. Ltd., 2013.
6. M. Spiegel, Vector Analysis, 2 nd Edition, Schaum's Outline Series, Mc-Graw Hill, Education, 2017.
7. C. E. Weatherburn, Elementary Vector Analysis, Alpha edition, 2019.
8. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers.
9. P. N. Wartikar and J. N. Wartikar, A Textbook of Applied Mathematics, Vol. II, Pune Vidyarthi Griha Prakashan, Pune, 2009.

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Department Name: Mathematics

Semester - III

Course Title: Integral Transform	Course Code: 24MJMA3S
Total Contact Hours: 3Hrs/Week	No. of Credits:2
L:T:P-1:0:2	
Internal Assessment Marks:10	Duration of SEE: 1.5 Hours
Semester End Exam Marks: 40	

Course Outcomes (COs):

At the end of the course, students will be able to:

1. Find Laplace transform of some basic functions.
2. Apply Convolution theorem for solving problems.
3. Learn Free and Open Source software (FOSS) tools or computer programming.
4. Find Laplace transform of various functions
5. Find the Fourier Transform of periodic functions
6. Solve differential equations by using Integral transforms.

Unit	Description	Hours
1	**Laplace transforms:** Definition and basic properties. Laplace transforms of some common functions, Laplace transforms of the derivatives and the integral of the function, Convolution theorem (without proof). **Inverse Laplace transforms**: Application to ordinary linear differential equation of first and second order with constant co-efficient, solving the system of first order simultaneous differential equations.	7
2	**Fourier Series:** Periodic function, Fourier series of function with period 2π and period 2L. Half range cosine and sine series, Complex form of Fourier series. **Fourier transforms:** Definition and basic properties. Fourier integrals, Fourier sine and cosine integral, Fourier sine and cosine transforms. Properties of Fourier Transforms.	7
3	**Programs using Scilab/Maxima/Python:** Elements of Integral transforms using FOSS 1. Program to find the Laplace transforms of some standard and periodic functions. 2. Program find the inverse Laplace transform of simple functions 3. Program to verify of Convolution Theorem for Laplace transform. 4. Program to solve a first order ordinary linear differential equation using Laplace transform.	

	5. Python program that solves a second-order ordinary linear differential equation using the Laplace transform 6. Program to solve a system of first-order simultaneous differential equations 7. Program to solve Integral equation using Laplace transform. 8. Program to find Cosine Fourier transforms. 9. Program to find sine Fourier transforms. 10. Program to verify of Convolution Theorem for Fourier transform.	

References:

1. Laplace transforms by S K Anand (Sarup and Sons New Delhi)
2. Fourier Transforms by Ian. Sneddon (Dover Publications)
3. Murry. R. Spiegel: Laplace transforms (schaum's Outline Series)
4. Dr.B.S.Grewal: Higher Engineering Mathematics, Khanna Publishers.

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B.Sc IV Semester

Department Name: Mathematics

Semester – IV

Course Title: Differential Equations	Course Code: 24MJMA4L
Total Contact Hours: 4 Hours/Week	No. of Credits: 04
L:T:P- 4:0:0	
Internal Assessment Marks: 20	Duration of SEE: 3 Hours
Semester End Exam Marks: 80	

Course Outcomes (CO's):

At the end of the course, students will be able to

1. Distinguish between linear, nonlinear, partial and ordinary differential equations.
2. Recognize and solve an exact differential equation.
3. Recognize and solve a linear differential equation by use of an integrating factor.
4. Make a change of variables to reduce a differential equation to a known form.
5. Find particular solutions to initial value problems.
6. Solve basic application problems described by first order differential equations and total Differential Equations.

Unit	Description	Hours
1	Recapitulation of differential equations, Linear and Bernoulli's equations, exact equations, equations reducible to exact form., simple equations of first order and higher degree equations: solvable for p,x,y. Clairauts equations and their singular solutions.	12
2	Second and higher order ordinary linear differential equations with constant coefficients, complementary functions, particular integrals (Standard types), Cauchy- Euler differential equation of order two, simultaneous differential equations with constant coefficients.	11
3	Solutions of ordinary second order linear differential equation by the following methods: when a part of complementary function is given, Changing the independent variable. Changing the dependent variable, When first integral is given (Exact equation).	11
4	Total Differential Equations: Necessary condition for the equation Pdx+Qdy+Rdz=0 to integral problems there on, Solution of the equation of the form $\frac{dx}{P}=\frac{dy}{Q}=\frac{dz}{R}$.	11

5	**Partial Differential Equations (PDEs):** Formation of Partial Differential Equations, Lagrange's linear equations Pp+Qq=R, Standard types of first order linear Partial Differential Equations and equations reducible to standard form, Charpit's method.	**11**

References:

1. M.D Raisinghania: Advanced Differential equations (S.Chand & co).
2. B.S Grewal: Higher Engineering Mathematics (Khanna Publishers).
3. Rudraiah et al: College Mathematics, Vol. I & II, (Sapna Book House, Bang
4. Simnons G.F: Differential equations (TMH)

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Department Name: Mathematics

Semester -IV

Course Title: Differential Equations Lab	**Course Code: 24MJMA4P**
Total Contact Hours: 4 Hours/Week	**No. of Credits: 02**
L:T:P- 0:0:4	
Internal Assessment Marks: 10	**Duration of SEE: 3 Hours**
Semester End Exam Marks: 40	

Course Outcomes (CO's):

At the end of the course, students will be able to

1. Gain hands-on experience of Free and Open Source software (FOSS) tools or computer programming.
2. Solve exact differential equations
3. Plot orthogonal trajectories
4. Find complementary function and particular integral of linear and homogeneous differential equations.
5. Solve problems on Partial Differential Equations

List of Experiments/ Programs (For a Lab Course)

Sl. No.	Experiment/ Program
1	Verification of exactness of a differential equation.
2	Plot orthogonal trajectories for Cartesian curves
3	Plot orthogonal trajectories for polar curves
4	Solutions of differential equations that are solvable for p.
5	Solutions of differential equations that are solvable for x,y.
6	To find the singular solution by using Clairaut's form.
7	Finding the Complementary Function and Particular Integral of linear and homogeneous differential equations with constant coefficients and plot the solutions.
8	Finding the Particular Integral of differential equations up to second order and plot the solutions.
9	Solutions to the Total and Simultaneous differential equations and plot the solutions.
10	Solutions of Linear Partial differential equations of type1 and type2.
11	Solutions of Linear Partial differential equations of type3 and type4.
12	Solutions of Linear Partial differential equations of Lagrange's method
13	Solutions of partial differential equation using Charpit's method.

References:

1. M.D Raisinghania: Advanced Differential equations (S.Chand & co).
2. B.S Grewal: Higher Engineering Mathematics (Khanna Publishers).
3. Rudraiah et al: College Mathematics, Vol. I & II, (Sapna Book House, Bang
4. Simnons G.F: Differential equations (TMH)

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Department Name: Mathematics

Semester - IV

Course Title:Linear Programming problems	Course Code:24MJMA4S
Total Contact Hours: 3Hrs/Week	No. of Credits:2
L:T:P-1:0:2	
Internal Assessment Marks:10	Duration of SEE: 1.5 Hours
Semester End Exam Marks: 40	

Course Outcomes (COs):

At the end of the course, students will be able to:

1. Define Linear Programming and explain basic terminology.
2. Formulate mathematical model of a real-life problem
3. Solve LPP by Graphical method
4. Solve LPP by Simplex method
5. Solve LPP using FOSS like Maxima/Python/Excel Solver.

Unit	Description	Hours
1	**Linear Programming: Basic Concepts** Introduction, Basic terminology: decision variables, non-negativity conditions, Slack variable, Surplus variable, objective function, constraints, feasible region, Basic solution, Basic feasible solution, optimal solution; Requirements for a linear programming problem (LPP), Assumptions in LPP, Areas of Applications of LPP, Mathematical formulation of LPP: Examples of Production allocation problem, Diet problem, Blending problem, Media selection problem, Inspection problem, Investment problem, Product mix problems etc.; Advantages and limitations of LPP.	7
2	**Solving Linear Programming Problems:** **Graphical method of solving LPP**: Statement of theorems (Corner Point Method) without proof, Problems-Production allocation problem, Diet problem, Blending problem, Media selection problem, Inspection problem, Investment problem, Product mix problems etc. Discussion of Special cases: infeasibility, unbounded solutions, multiple optimal solutions. **Simplex Method of solving LPP**: General form of LPP, Canonical and standard form of LPP, theory of the Simplex method, Algorithm of Simplex method, Big-M-Method, Two-Phase Method, Problems.	7
3	**Programs using Scilab/Maxima/Python/ Excel Solver:** 1. Program to solve a Diet Problem using graphical method 2. Program to solve anInvestment Problem using graphical method 3. Program to solve a Product Mix Problem using graphical method	

	4. Program to solve a Production allocation Problem using graphical method 5. Program to solve a Diet Problem using Simplex method 6. Program to solve an Investment Problem using Simplex method 7. Program to solve a Product Mix Problem using Simplex method 8. Program to solve a Production allocation Problem using Simplex method 9. Program to solve a Production allocation Problem using Big-M mehod. 10. Program to solve a Production allocation Problem using Two-Phase method.	

References

1. Prem Kumar Gupta & D S Hira: Operations Research (S Chand & Co.)
2. Dr. U S Rana: Mathematics for Degree Students (B.Sc. Third Year)(S Chand & Co.)
3. Richard Bronson &GovindasamiNaadimuthu:Schaum's Outline of Operations Research (McGraw Hill Publications)
4. Hamdy A. Taha: Operations Research: An Introduction (Pearson Publications)
5. Dimitris Bertsimas & John N. Tsitsiklis: Introduction to Linear Optimization (Dynamic Ideas & Athena Scientific Publications)

QUESTION PAPER PATTERN FOR THEORY SEMESTER END EXAMINATION

PART-A

Duration: 3 Hours **80 Marks**

Answer all Questions

1. Answer any TEN questions **10X2=20**

a.

b.

c.

d.

e.

f.

g.

h.

i.

j.

k

l.

Note: Two questions from each unit

PART-B

Answer any EIGHT questions **8X5=40.**

2.

3.

4.

5.

6.

7.

8.

9.

10.

11.

Note: TWO question from each unit

PART-C

Answer any TWO questions **2X10=20.**

12. Question from unit-I and unit-II

13.Question from unit-III and unit-IV

14.Question from unit-I and unit-V

NOTE: Each question in section-c has subdivision i),ii),iii) questions and marks 4+4+2=10 distribution

QUESTION PAPER PATTERN FOR ELECTIVE PAPER SEMESTER END EXAMINATION

Duration: 1.5 Hours **40 Marks**

Answer all the questions.

PART-A

1. **Answer any Five questions.** **(5*2=10M)**
   a
   b
   c
   d
   e
   f
   g

Note: Two questions from each unit and One question from: I to III units.

PART-B

Answer any Four questions. **(4*5=20M)**

2

3

4

5

6

7

Note: Two questions from each unit.

PART-C

Answer any One questions. **(1*10=10M)**

8

9

10

Note: One question from each unit. Questions distribution in each question is a), b), Sub-questions i.e., (5+5=10M)

EVALUATION METHOD FOR PRACTICALS SEMESTER END EXAMINATION

DURATION: 3Hours **Maximum Marks: 40**

1. To write two Scilab/Maxima program -	2*5=10
2. To execute TWO program -	10*2=20
3. Viva -	05
4. Record Book(Certified Record Book)	05
Total Marks	**40**

INTERNAL ASSESSSMENT METHOD FOR PRACTICALS
Maximum Marks: 10

Internal Test	05 Marks
Journal/ Observations	05 Marks
Total Marks	**10**

VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY, BALLARI

Department of Studies in Mathematics

SEP: Credits Structure under Choice Based Credit System [CBCS]

Syllabus of V &VI Semester

Bachelor of Science

With effect from 2024-25 onwards
Approved in the BOS dated on 24-03-2025

VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY

Jnanasagara campus, Ballari.-583105

Web: www.vskub.ac.in, Email: Phone : 08392-242703 and Fax: 08392-242806

VSKUB SEP Proposed Curricular and Credits Structure under Choice Based Credit System [CBCS] of Scheme for the Three Years B.Sc. Undergraduate Programmewith effect from 2024-25

Curricular and Credits Structure for Mathematics

Semester	Major 1 (A)	Major 2 (B)	Major 3 (C)	Elective /Optional	Language	Compulsory / Skill Courses	Total Credits
1	----	----	Differential calculus and Algebra-I (L:T:P = 4:0:4)	----	----	Constitutional Values (2) (L:T:P = 2:0:0)	26
2	----	----	Integral calculus and Algebra-II(L:T:P = 4:0:4)	----	----	Environmental Studies (2) (L:T:P = 2:0:0)	26
3	----	----	Series and Sequences and Vector Calculus (L:T:P = 4:0:4)	----	----	Integral Transforms (L:T:P = 1:0:2)	26
4	----	----	Differential Equations (L:T:P = 4:0:4)	----	----	Linear Programming Problems (L:T:P = 1:0:2)	26
5	----	----	Real Analysis and Complex Analysis (L:T:P = 4:0:4)	Special Functions (L:T:P = 2:0:0)	----	SEC-3 (2) Elementary Research Methodology (L:T:P = 2:0:0)	22
6	----	----	Numerical Analysis (L:T:P = 4:0:4)	Graph Theory (L:T:P = 2:0:0)	----	Elementary Research Project (A1/B1/C1) (2) (L:T:P =1:0:2)	22
Total	**36**	**36**	**36**	**04**	**24**	**12**	**148**
Total 148 Credits							

Note:

1. The curriculum for all Courses except L1, L2, Constitutional Values, Environmental values and Elementary Research Methodology will be framed by the respective Board of Studies (A/B/C). Here for example A – Physics, B – Chemistry and C – Mathematics.

2. The Curriculum for Languages L1 & L2 will be framed by respective Board of Studies (BoS) (Example Kannada/ English/ Hindi/ Sanskrit/ Telugu etc.).

3. The curriculum for Constitutional values will be framed by Board of Studies (BoS) in Political Science.

4. The curriculum for Environmental Science will be framed by special/common Board of Studies (BoS) set up by the University.

5. The curriculum for Elementary Research Methodologywill be set by special/common Board of Studies (BoS - Faculty of Science & Applied Science) set up by the University.

VSKUB SEP Proposed Curricular and Credits Structure under Choice Based Credit System [CBCS] of Scheme for the Three Years B.Sc. Undergraduate Programme with effect from 2024-25

Curricular and Credits Structure for Mathematics

I - Semester

Course code	Title of the Course	Marks			Teaching hours/week			Credit	Duration of SEE (Hrs)
		IA	SEE	Total	L	T	P		
----	----	----	----	----	----	----	----	----	----
----	----	----	----	----	----	----	----	----	----
----	----	----	----	----	----	----	----	----	----
----	----	----	----	----	----	----	----	----	----
24MJMA1L	Differential calculus and Algebra-I	20	80	100	4	0	0	4	03
24MJMA1P	Differential calculus and Algebra-I Lab	10	40	50	0	0	4	2	03
----	----	----	----	----	----	----	----	----	----
----	----	----	----	----	----	----	----	----	----
24CVCM1L	Constitutional Values	10	40	50	2	0	0	2	1.5*
TOTAL	----	**30**	**120**	**150**	**4**	**0**	**4**	**6**	**-**

*** 40 Multiple Choice Questions for 40 Marks (OMR Based)**

Course Code Description:

24MJAA1L: For Example 24MJPH1L

24 – Year of Curriculum Implementation / Revision

MJ – Major, LG – Language , CV – Constitutional Values

AA/BB/CC – Course Specific (Example for Physics AA – PH, Chemistry AA – CH, Maths – MA etc.)

CM – Common Course

1 – Semester Number

L – Lecture, P - Practical

VSKUB SEP Proposed Curricular and Credits Structure under Choice Based Credit System [CBCS] of Scheme for the Three Years B.Sc. Undergraduate Programme with effect from 2024-25

II-Semester

Course code	Title of the Course	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
		IA	SEE	Total	L	T	P		
----	----	----	----	----	----	----	----	----	----
----	----	----	----	----	----	----	----	----	----
----	----	----	----	----	----	----	----	----	----
----	----	----	----	----	----	----	----	----	----
24MJMA2L	Integral calculus and Algebra-II	20	80	100	4	0	0	4	03
24MJMA2P	Integral calculus and Algebra-II Lab	10	40	50	0	0	4	2	03
----	----	----	----	----	----	----	----	----	----
----	----	----	----	----	----	----	----	----	----
24ESCM2L	Environmental Studies	10	40	50	2	0	0	2	1.5*
TOTAL	**----**	**30**	**120**	**150**	**4**	**0**	**4**	**6**	**-**

*** 40 Multiple Choice Questions for 40 Marks (OMR Based)**

Course Code Description:

24MJAA2L:

24 – Year of Curriculum Implementation / Revision

MJ – Major, LG – Language ,ES – Environmental Science

AA/BB/CC – Course Specific (Example for Physics AA – PH, Chemistry AA – CH, Maths – MA etc.)

CM – Common Course

2 – Semester Number

L – Lecture, P - Practical

VSKUB SEP Proposed Curricular and Credits Structure under Choice Based Credit System [CBCS] of Scheme for the Three Years B.Sc. Undergraduate Programme with effect from 2024-25

III-Semester

Course code	Title of the Course	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
		IA	SEE	Total	L	T	P		
----	----	----	----	----	----	----	----	----	----
----	----	----	----	----	----	----	----	----	----
----	----	----	----	----	----	----	----	----	----
----	----	----	----	----	----	----	----	----	----
24MJMA3L	Series and Sequences and Vector Calculus	20	80	100	4	0	0	4	03
24MJMA3P	Series and Sequences and Vector Calculus	10	40	50	0	0	4	2	03
----	----	----	----	----	----	----	----	----	----
----	----	----	----	----	----	----	----	----	----
24MJMA3S	Integral Transform	10	40	50	1	0	2	2	1.5*
TOTAL	**----**	**40**	**160**	**200**	**5**	**0**	**6**	**8**	**-**

*** 40 Multiple Choice Questions for 40 Marks (OMR Based)**

Course Code Description:

24MJAA3L:

24 – Year of Curriculum Implementation / Revision

MJ – Major, LG – Language

AA/BB/CC – Course Specific (Example for Physics AA – PH, Chemistry AA – CH, Maths – MA etc.)

3 – Semester Number

L – Lecture, P – Practical, S - Skill

VSKUB SEP Proposed Curricular and Credits Structure under Choice Based Credit System [CBCS] of Scheme for the Three Years B.Sc. Undergraduate Programme with effect from 2024-25

IV-Semester

Course code	Title of the Course	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
		IA	SEE	Total	L	T	P		
----	----	----	----	----	----	----	----	----	----
----	----	----	----	----	----	----	----	----	----
----	----	----	----	----	----	----	----	----	----
----	----	----	----	----	----	----	----	----	----
24MJMA4L	Differential Equations	20	80	100	4	0	0	4	03
24MJMA4P	Differential Equations Lab	10	40	50	0	0	4	2	03
----	----	----	----	----	----	----	----	----	----
----	----	----	----	----	----	----	----	----	----
24MJMA4S	Linear Programming Problems	10	40	50	1	0	2	2	1.5*
TOTAL	**----**	**40**	**160**	**200**	**5**	**0**	**6**	**8**	**-**

*** 40 Multiple Choice Questions for 40 Marks (OMR Based)**

Course Code Description:

24MJAA4L:

24 – Year of Curriculum Implementation / Revision

MJ – Major, LG – Language

AA/BB/CC – Course Specific (Example for Physics AA – PH, Chemistry AA – CH, Maths – MA etc.)

4 – Semester Number

L – Lecture, P – Practical, S - Skill

VSKUB SEP Proposed Curricular and Credits Structure under Choice Based Credit System [CBCS] of Scheme for the Three Years B.Sc. Undergraduate Programmewith effect from 2024-25

V-Semester

Course code	Title of the Course	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
		IA	SEE	Total	L	T	P		
----	----	----	----	----	----	----	----	----	----
----	----	----	----	----	----	----	----	----	----
----	----	----	----	----	----	----	----	----	----
----	----	----	----	----	----	----	----	----	----
24MJMA5L	Real analysis and Complex analysis	20	80	100	4	0	0	4	03
24MJMA5P	Real analysis and Complex analysis Lab	10	40	50	0	0	4	2	03
24MJMA5E	Special Functions	10	40	50	2	0	0	2	1.5
24RMBS5S	Elementary Research Methodology#	10	40	50	2	0	0	2	01*
TOTAL		**40**	**160**	**200**	**6**	**0**	**4**	**8**	**-**

*** 40 Multiple Choice Questions for 40 Marks (OMR Based)**

 # The curriculum for Elementary Research Methodology will be set by special/common Board of Studies (BoS - Faculty of Science & Applied Science) set up by the University. The course code for Elementary Research Methodology shall be 24RMBS5S.

Course Code Description:

24MJAA5L:

24 – Year of Curriculum Implementation / Revision

MJ – Major, LG – Language, RM – Research Methodology

AA/BB/CC – Course Specific (Example for Physics AA – PH, Chemistry AA – CH, Maths – MA etc.)

BS – Bachelor of Science

4 – Semester Number, L – Lecture, P – Practical, S – Skill, E – Elective Course

VSKUB SEP Proposed Curricular and Credits Structure under Choice Based Credit System [CBCS] of Scheme for the Three Years B.Sc. Undergraduate Programmewith effect from 2024-25

VI -Semester

Course code	Title of the Course	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
		IA	SEE	Total	L	T	P		
----	----	----	----	----	----	----	----	----	----
----	----	----	----	----	----	----	----	----	----
----	----	----	----	----	----	----	----	----	----
----	----	----	----	----	----	----	----	----	----
24MJMA6L	Numerical Analysis	20	80	100	4	0	0	4	03
24MJMA6P	Numerical Analysis Lab	10	40	50	0	0	4	2	03
24MJMA6E	Graph Theory	10	40	50	2	0	0	2	1.5
24MJAA6R	Elementary Research Project	10	40	50**	0	0	4	2	01**
TOTAL		**40**	**160**	**200**	**6**	**0**	**4**	**8**	**-**

Course Code Description:

24MJAA6L:

24 – Year of Curriculum Implementation / Revision

MJ – Major, LG – Language, CM – Common Course,

AA/BB/CC – Course Specific (Example for Physics AA – PH, Chemistry AA – CH, Maths – MA etc.)

BS – Bachelor of Science

6 – Semester Number

L – Lecture, P – Practical, E – Elective Course, R – Research Project

Concept Note, Abbreviation Explanation and Coding:

Concept Note:

1. CBCS is a mode of learning in higher education which facilitates a student to have some freedom in selecting his/her own choices, across various disciplines for completing a UG/PG program.
2. A credit is a unit of study of a fixed duration. For the purpose of computation of workload as per UGC norms the following is mechanism be adopted in the university:
   One credit (01) = One Theory Lecture (L) period of one (1) hour;
   One credit (01) = One Tutorial (T) period of one (1) hour;
   One credit (01) = One practical (P) period of two (2) hours.
   One Credit (01) = One Field Study (F) period of one (1) hour
3. Students shall select any two languages during 1-IV semesters.
4. Student shall select only one Skill course from any one of the major courses opted in 3rd and 4th semesters.
5. Student shall select Elective course from any one of the major courses opted one in each in 5th and 6th semesters.
6. Elementary Research Methodology Course is common for all B.Sc. students.
7. Student shall perform Elementary Research Project inany one of the major courses opted in 6th semester.

Abbreviation Explanations:

1. SEC: Skill Enhancement Course;
2. L1: Language One
3. L2: Language One
4. L= Lecture; T= Tutorial; P=Practical; S= Skill; E = Elective; R = Research Project
5. MJ – Major
6. LG – Language
7. RM – Research Methodology
8. CM – Common Course

NOTE:

1. FOR A THEORY COURSE WITH 4 CREDITS, SYLLABUS HAS TO SET FOR TOTAL OF 52-56 HOURS.
2. FOR A THEORY COURSE WITH 3 CREDITS, SYLLABUS HAS TO SET FOR TOTAL OF 40-42 HOURS.
3. FOR A THEORY COURSE WITH 2 CREDITS, SYLLABUS HAS TO SET FOR TOTAL OF 26-28 HOURS.
4. FOR A LAB COURSE/RESEARCH PROJECT WITH 2 CREDITS, SYLLABUS HAS TO SET FOR TOTAL OF 52-56 HOURS.
5. FOR A SKILL COURSE WITH 1 HOUR THEORY AND 2 HOUR LAB OF 2 CREDITS, SYLLABUS HAS TO BE SET FOR 40-42 HOURS.

B.Sc V Semester

Department Name: Mathematics

Semester - V

Course Title: Real Analysis and Complex Analysis	Course Code: 24MJMA5L
Total Contact Hours: 4 hours/week	No. of Credits: 4
L:T:P- 4:0:0	
Internal Assessment Marks: 20	Duration of SEE: 3 Hours
Semester End Exam Marks: 80	

Course Outcomes (COs):

At the end of the course, students will be able to:

1. Carry out certain computations such as computing upper and lower Riemann sums as well integrals
2. Describe various criteria for Integrability of functions.
3. Exhibit certain properties of mathematical objects such as integrable functions, analytic functions, harmonic functions and so on.
4. Prove some statements related to Riemann integration as well as in complex analysis.
5. Applies the gained knowledge to solve various other problems.

Unit	Description	Hours
1	Reimann Integration: Recapitulation of real number system, postulates and their consequences, inequalities and absolute values, lower and upper bounds. The upper and lower sums, necessary and sufficient conditions for integrability.	11
2	Algebra of integrable functions. Integrability of continous and monotonic functions. Fundamental theorem of calculus, change of variables.Integration by parts. The first and second mean value theorems of integral calculus.	11
3	Recapitulation of complex numbers and complex plane, conjugate and modulus of a complex number. The polar form, geometrical representation, Euler's formula Function of complex variable: Limits, continuity and differentiability.	11
4	Analytic functions, Cauchy-Reimann equations in Cartesian and polar forms. Sufficient conditions for analyticity (in Cartesian form).Real and imaginary parts of analytic functions which are harmonic. Construction of analyticfunction given real and imaginary parts. Some standard transformation: Conformal transformation, special conformal transformation.	12
5	The complex line integral: examples and properties (definitions of the concepts like Neighborhood of a point, closed contour etc. at appropriate places should be mentioned.) Cauchy integral theorem (statement) and its consequences. The Cauchy's integral formulae for the function and its derivatives, applications to the evaluation of simple line integrals.	11

References:

1. S.C Malik, Real Analysis, New Age International (India) Pvt. Ltd.

2. S.C.Malik and Savita Arora, Mathematical Analysis, 2nd ed. New Delhi, India: New Age international (P) Ltd.
3. Richard R Goldberg, Methods of Real Analysis, Oxford and IBH Publishing.
4. Ajit Kumr and S. Kumaresan - A Basic Course in Real Analysis, Taylor and Francis Group.
5. L. V. Ahlfors, Complex Analysis, 3 rd Edition, McGraw Hill Education.
6. Bruce P. Palka, Introduction to the Theory of Function of a Complex Variable, Springer.
7. Serge Lang, Complex Analysis, Springer.
8. Shanthinarayan, Theory of Functions of a Complex Variable, S. Chand Publishers.

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Department Name: Mathematics

Semester - V

Course Title: Real Analysis and Complex Analysis Lab	Course Code: 24MJMA5P
Total Contact Hours: 4 hours/week	No. of Credits: 2
L:T:P- 0:0:4	
Internal Assessment Marks: 10	Duration of SEE: 3 Hours
Semester End Exam Marks: 40	

Course Outcomes (COs):

At the end of the course, students will be able to:

1. Learn Free and Open Source Software (FOSS) tools for computer programming.
2. Find upper and lower Riemann sums with respect to given partition.
3. Find Cross ratio of points and related aspects.
4. Draw graphical representation of w=1/z and w=z+1/z
5. Evaluate Riemann integral as a limit of sum.

List of Experiments / Programs (For a Lab Course)using Scilab/Maxima/Python:

Sl.No	Experiment / Program
1	Program to check whether a given set of real numbers attains supremum or infimum.
2	Program to find upper and lower Riemann sums with respect to given partition.
3	Program to test Riemann Integrability.
4	Program to evaluate Riemann integral as a limit of sum.
5	Program on verification of Cauchy – Riemann equations (Cartesian form) or test for analyticity.
6	Program on verification of Cauchy – Riemann equations (Polar form) or test for analyticity.
7	Program to check whether a function is harmonic or not.
8	Program to construct analytic functions (through Milne–Thompson method).
9	Program to find Cross ratio of points and related aspects.
10	Program to find fixed points of bilinear transformations.
11	Program to draw graphical representation of w=1/z and w=z+1/z
12	Program to draw graphical representation of w=sinz and w=coshz
13	Program to draw graphical representation of w=e^z and w=logz

References:

1. S.C Malik, Real Analysis, New Age International (India) Pvt. Ltd.

2. S.C.Malik and Savita Arora, Mathematical Analysis, 2nd ed. New Delhi, India: New Age international (P) Ltd.
3. Richard R Goldberg, Methods of Real Analysis, Oxford and IBH Publishing.\
4. S. Ponnuswamy, Foundations of Complex Analysis, 2 nd Edition, Alpha Science International Limited.
5. R.V. Churchil& J.W. Brown, Complex Variables and Applications, 5th ed, McGraw Hill Companies.

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Department Name: Mathematics

Semester - V

Course Title: Special Functions	Course Code: 24MJMA5E
Total Contact Hours: 4 hours/week	No. of Credits: 2
L:T:P- 2:0:0	
Internal Assessment Marks: 10	Duration of SEE: 2 Hours
Semester End Exam Marks: 40	

Course Outcomes (COs):

At the end of the course, students will be able to:

1. Understand the derivation and solutions of Legendre's differential equation in spherical coordinate systems.
2. Learn the generation of Legendre polynomials and their orthogonality property.
3. Understand the derivation and solutions of Bessel's differential equation in cylindrical coordinates.
4. Understand the orthogonality property of Bessel functions for solving problems in cylindrical coordinates.

Unit	Description	Hours
1	**Legendre's Special Functions:** Legendre's differential equation, Legendre polynomials Pn(x) as a solution, Rodrigue's formula, generating polynomials theorem, orthogonal property and basic relation. Recurrence relations.	14
2	**Bessel's Special Functions:** Bessel's differential equation, Bessel function Jn(x) as a solution – generation formulae, integral formula for Jn(x), orthogonal property, recurrence relations.	14

References:

1. Ayres F : Differential Equations (Schaum's Outline Series)
2. B.S Grewal: Higher Engineering Mathematics (Khanna Publishers).
3. M.D Raisinghania: Advanced Differential equations (S.Chand& co)

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B.Sc VI Semester

Department Name: Mathematics

Semester - VI

Course Title: Numerical Analysis	Course Code: 24MJMA6L
Total Contact Hours: 4 hours/week	No. of Credits: 4
L:T:P- 4:0:0	
Internal Assessment Marks: 20	Duration of SEE: 3 Hours
Semester End Exam Marks: 80	

Course Outcomes (COs):

At the end of the course, students will be able to:

1. Understand difference operators, shift operators, and other related operators in numerical analysis.
2. Grasp the reasoning behind techniques for finding roots, integrals, and derivatives.
3. Implement existing algorithms for tasks like root-finding, integration, and differentiation.
4. Use calculus and other mathematical principles to justify numerical analysis techniques.
5. Apply appropriate numerical methods to solve problems effectively.

Unit	Description	Hours
1	**Errors:** Significant digits, absolute, relative, percentage errors, rounding off and truncation errors (meanings and related problems), general error formula (derivation of formula and problems based on it), error in series approximation: Taylor series approximations (problems only).	11
2	**Algebraic and Transcendental Equations:** Solutions to algebraic and transcendental equations - Bisection method, Regula-Falsi method, iterative method- secant method and Newton-Raphson method.	11
3	**System of Linear Algebraic Equations:** Direct Methods – Gauss elimination method, Gauss-Jordan elimination method; Iterative methods – Jacobi method, Gauss-Jacobi method, Gauss Seidal method.	11
4	**Polynomial Interpolations:** Finite differences. Forward, backward and shift operators: definitions, properties and problems; Polynomial interpolation - Newton-Gregory forward and backward interpolation formulas, Gauss's Forward and backward interpolation formulas, Lagrange interpolation polynomial, Newton's divided differences.	12
5	**Numerical Differentiation an Integration:** Formula for derivatives (till second order) based on Newton-Gregory forward and backward interpolations. Numerical Integration - General Quadrature formula, Trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8 rule and Weddle's rule.	11

References:

1. E. Isaacson and H. B. Keller, Analysis of Numerical methods, Dover Publications.
2. S. S. Sastry, Introductory methods of Numerical Analysis, 5th Edition, PHI Learning Private Limited.

3. E Kreyszig, Advanced Engineering Mathematics, Wiley India Pvt. Limited
4. B. S. Grewal, Numerical Methods for Scientists and Engineers, Khanna Publishers.
5. M. K. Jain, S. R. K. Iyengar and R. K. Jain, Numerical Methods for Scientific and Engineering computation, 4th Edition, New Age International
6. H. C. Saxena, Finite Difference and Numerical Analysis, S. Chand Publishers
7. B. D. Gupta, Numerical Analysis, Konark Publishers Pvt. Ltd.

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Department Name: Mathematics

Semester - VI

Course Title: Numerical Analysis Lab	Course Code: 24MJMA6P
Total Contact Hours: 4 hours/week	No. of Credits: 2
L:T:P- 0:0:4	
Internal Assessment Marks: 10	Duration of SEE: 3 Hours
Semester End Exam Marks: 40	

Course Outcomes (COs):

At the end of the course, students will be able to:

1. Learn Free and Open Source Software (FOSS) tools for computer programming.
2. Find the root of an equation using Bisection method.
3. solve system of algebraic equations using Gauss-elimination method
4. evaluate integral using Trapezoidal and Weddle rules
5. find differentiation at specified point using Newton-Gregory interpolation method.

List of Experiments / Programs (For a Lab Course)using Scilab/Maxima/Python

Sl.No	Experiment / Program
1	Program to find root of an equation using Bisection method.
2	Program to find root of an equation using Regula-Falsi method.
3	Program to find root of an equation using Newton-Raphson method
4	Program to find root of an equation using Secant method.
5	Program to solve system of algebraic equations using Gauss-elimination method.
6	Program to solve system of algebraic equations using Gauss-Jordan method.
7	Program to solve system of algebraic equation using Gauss-Jacobi method.
8	Program to solve system of algebraic equation using Gauss-Seidel method.
9	Program to evaluate integral using Simpson's 1/3 and 3/8 rules.
10	Program to evaluate integral using Trapezoidal and Weddle rules
11	Program to find the sums of powers of successive natural numbers using Newton – Gregory technique.
12	Program to find differentiation at specified point using Newton-Gregory interpolation method.
13	Program to find the missing value of table using Lagrange method.
References:	

1. E. Isaacson and H. B. Keller, Analysis of Numerical methods, Dover Publications.
2. S. S. Sastry, Introductory methods of Numerical Analysis, 5th Edition, PHI Learning Private Limited.
3. E Kreyszig, Advanced Engineering Mathematics, Wiley India Pvt. Limited.
4. B. S. Grewal, Numerical Methods for Scientists and Engineers, Khanna Publishers.

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Department Name: Mathematics

Semester - VI

Course Title: Graph Theory	Course Code: 24MJMA6E
Total Contact Hours: 4 hours/week	No. of Credits: 2
L:T:P- 2:0:0	
Internal Assessment Marks: 10	Duration of SEE: 2 Hours
Semester End Exam Marks: 40	

Course Outcomes (COs):

At the end of the course, students will be able to:

1. Identify and describe finite, null, and complete graphs, including line and total graphs.
2. Recognize that the number of vertices with odd degrees in a graph is always even.
3. Differentiate between subgraphs, spanning subgraphs, and induced subgraphs.
4. Define and apply the concepts of trees, spanning trees, and binary trees in graph theory.
5. Apply graph theory concepts to solve real-world problems in various fields like computer science, network analysis, and optimization.

Unit	Description	Hours
1	Graphs, finite and null graphs. Degree of vertex, minimum and maximum degree, $\Sigma \deg v_i = 2q$. The number of vertices of odd degree is even. complete graph, line graph, total graph. Sub graphs, spanning and induced sub graphs,	14
2	Walk, trial, path, cycle, bipartite graph. Indroduction to Eulerian and Hamiltonian graphs, Cut vertex, bridge, block, tree, spanning tree, binary trees. **Matrix representation:** adjacency matrix, Incidence matrix, Circuit matrix, Characteristic polynomials, Eigen values, Spectra of a graph.	14

References:

1. Robin J Wilson: Introduction to Graph theory Longman (London), UK.
2. NarsingDeo : Graph theory and applications (PHI), India.
3. Frank .Harrary : Graph Theory, Narosa Publications, India.
4. V.K.Balakrishnan: Graph Theory, (Schum's Outline Series).

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QUESTION PAPER PATTERN FOR THEORY SEMESTER END EXAMINATION

PART-A

Duration: 3 Hours **80 Marks**

Answer all Questions

1. Answer any TEN questions **10X2=20**

a.

b.

c.

d.

e.

f.

g.

h.

i.

j.

k

l.

Note: Two questions from each unit

PART-B

Answer any EIGHT questions **8X5=40.**

2.

3.

4.

5.

6.

7.

8.

9.

10.

11.

Note: TWO question from each unit

PART-C

Answer any TWO questions **2X10=20.**

12. Question from unit-I and unit-II

13. Question from unit-III and unit-IV

14. Question from unit-I and unit-V

NOTE: Each question in section-c has subdivision i),ii),iii) questions and marks 4+4+2=10 distribution

QUESTION PAPER PATTERN FOR ELECTIVE PAPER SEMESTER END EXAMINATION

Duration: 1.5 Hours **40 Marks**

Answer all the questions.

PART-A

1. **Answer any Five questions.** **(5*2=10M)**
   a
   b
   c
   d
   e
   f
   g

Note: Two questions from each unit and One question from: I to III units.

PART-B

Answer any Four questions. **(4*5=20M)**

2

3

4

5

6

7

Note: Two questions from each unit.

PART-C

Answer any One questions. **(1*10=10M)**

8

9

10

Note: One question from each unit. Questions distribution in each question is a), b), Sub-questions i.e., (5+5=10M)

EVALUATION METHOD FOR PRACTICALS SEMESTER END EXAMINATION

DURATION: 3Hours **Maximum Marks: 40**

1. To write two Scilab/Maxima program -	2*5=10
2. To execute TWO program -	10*2=20
3. Viva -	05
4. Record Book(Certified Record Book)	05
Total Marks	**40**

INTERNAL ASSESSSMENT METHOD FOR PRACTICALS

Maximum Marks: 10

Internal Test	05 Marks
Journal/ Observations	05 Marks
Total Marks	**10**