



GOVERNMENT COLLEGE FOR MEN (AUTONOMOUS), KADAPA

**Model Syllabus for 4-Year UG Honours in B.Sc. (Computational Mathematics)
as Major in consonance with Curriculum framework w.e.f. AY 2025-26
COURSE STRUCTURE (for Semester I to VI)**

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits	
I	I	1	Basic Mathematics	5	4	
		2	Computational calculus	5	4	
	II	3	Differential Equations	5	4	
		4	Elementary Number theory	5	4	
II	III	5	Group theory	5	4	
		6	Discrete mathematics	5	4	
		7	Elementary Real analysis	5	4	
	IV	8	Ring theory	5	4	
		9	Vector calculus	5	4	
		10	Advanced Real analysis	5	4	
III	V	11	Linear algebra	5	4	
		12 A	Optimization techniques	5	4	
		OR				
		12 B	Analytical Graph theory	5	4	
		13 A	Numerical methods using MATLAB	5	4	
		OR				
13 B	Mathematical computations using Python	5	4			

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits	
	VI	14 A	Mathematical statistics	5	4	
		OR				
		14 B	Mathematical Modeling	5	4	
		OR				
		15 A	Complex analysis for Computational Mathematics	5	4	
		OR				
		15 B	Integral transforms	5	4	

Note: In the III Year (during the V and VI Semesters), students are required to select a pair of electives from one of the **Two** specified domains. **For example: if set 'A' is chosen, courses 12 to 15 to be chosen as 12 A, 13 A, 14 A and 15 A.** To ensure in-depth understanding and skill development in the chosen domain, students must continue with the same domain electives in both the V and VI Semesters.

Model Syllabus for Computational Mathematics (Minor) in consonance with Curriculum framework w.e.f. AY 2025-26

COURSE STRUCTURE

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
II	III	1	Differential Equations	5	4
	IV	2	Group Theory	5	4
III	V	3	Ring Theory	5	4
		4	Elementary Real Analysis	5	4
	VI	5	Linear algebra	5	4
		6	Advanced Real Analysis	5	4

Program Outcomes (POs)

Upon completion of the program, graduates will be able to:

- PO1. Mathematical Knowledge** – Acquire a solid foundation in pure and applied mathematics, including calculus, algebra, analysis, and differential equations.
- PO2. Problem Solving & Logical Thinking** – Develop strong analytical and logical reasoning skills to identify, model, and solve mathematical and computational problems.
- PO3. Computational Proficiency** – Gain practical knowledge of programming (C, Java, Python) and computational tools for solving mathematical problems effectively.
- PO4. Application of Mathematics** – Apply mathematical concepts to real-life situations, scientific investigations, and interdisciplinary areas such as data science and computer applications.
- PO5. Research & Innovation** – Utilize mathematical and computational techniques to explore new ideas, analyze data, and contribute to research and development.
- PO6. Communication Skills** – Present mathematical reasoning, proofs, and computational solutions clearly in both oral and written formats.
- PO7. Ethics & Professional Responsibility** – Demonstrate ethical values, responsibility, and awareness of the role of mathematics and computing in society.
- PO8. Lifelong Learning** – Cultivate self-directed learning and adaptability to keep pace with emerging mathematical methods, technologies, and professional demands.

Program Specific Outcomes (PSOs)

Graduates of **B.Sc. (Computational Mathematics)** will be able to:

- PSO1. Master Core Mathematics** – Understand and apply fundamental concepts of calculus, differential equations, algebra, and analysis in problem-solving.
- PSO2. Abstract Structures & Algorithms** – Develop proficiency in group theory, ring theory, and linear algebra with applications in cryptography, coding theory, and computer algorithms.
- PSO3. Computational Skills** – Apply programming knowledge (C, Java, Python) and database/web technologies for developing algorithms, simulations, and computational models.
- PSO4. Applied Mathematical Modeling** – Use mathematical and computational techniques to model and solve real-world problems in science, engineering, and industry.
- PSO5. Career & Higher Studies Readiness** – Prepare for careers in education, IT, data science, finance, and research, and pursue higher studies in mathematics, computer science, or related disciplines.

SEMESTER-I

PAPER I: BASIC MATHEMATICS

Theory

Credits: 4

5 hrs/week

Course Objectives

This course aims to:

1. Develop an understanding of sets and set properties and to develop an understanding of functions and to draw the graphs of certain functions.
2. Explain the properties of complex numbers
3. Teach methods to find the rank, determinant and inverse of matrices using elementary transformations.
4. To find the Eigen values and Eigen vectors of the square matrix and hence find its inverse by using Cayley- Hamilton theorem
5. To develop an understanding of three-dimensional geometry

Course Outcomes

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

1. Explain set properties and Demorgan's laws and inclusion-exclusion principles and apply them to solve the problems & Find the inverse of a function and draw the graphs of given function
2. Solve the problems related to addition, multiplication of complex numbers and find the modulus and polar form of complex numbers.
3. Find the Rank of a Matrix & to solve system of Linear Equations.
4. Find the Eigen values and Eigen vectors of the square matrix and hence find its inverse by using Cayley- Hamilton theorem
5. Introduce Fundamental concepts of Plane, Line & Sphere in 3D Geometry

Unit – 1: Sets and functions

Mathematical logic, Tautologies, Sets, subsets, union, Intersection of sets, Cartesian Product of Sets, Functions

(Section 1 to 25 of Chapter of Text book 1)

Unit - 2: Complex Numbers

Complex numbers - Addition, Multiplication and Difference of complex numbers - Division in C - Modulus of a complex number - Conjugate of a complex number - Modulus-Argument form of a complex number - The geometric representation of a complex number - The points on the argand plane representing the sum, difference, product and division of two complex number - Some important properties of modulus and arguments of complex numbers - The order relations greater than or less than do not apply to complex numbers - Some important results about complex numbers - Integral and rational powers of a complex number - Geometric applications of complex numbers

(Chapter- 1 of text book 2)

Unit – 3: Matrices - I

Definition of Matrix - Types of Matrices - Binary Operations using (a_{ij}) notations - Elementary properties of matrices - Inverse of a Matrix - Rank of a Matrix - System of linear equations - Solutions.

(As in Text book 3)

Unit – 4: Matrices - II

Characteristic equations - Characteristic values & Vectors of a square matrix - Cayley-Hamilton theorem- Inverse of a square matrix using Cayley-Hamilton theorem.

(As in Text book 3)

Unit -5: Solid Geometry

Plane general equation - plane equation in normal form - angle between two planes - condition for perpendicularity - distance between parallel planes - perpendicular distance of a point from a plane

- line equation - transforming the given line equation into symmetric form - point of intersection of a line and a plane - plane passing through a line - angle between lines - sphere general equation, centre and radius - plane section of a sphere - great circle and small circle

(problems should be given only from the topics mentioned above – i.e from Text book 4 given below)

Text Book

1. Modern Algebra by A.R.Vashista, Published by Krishna Prakashan Mandir,Meerut.
2. Complex Analysis by A.R. Vasistha and A. K. Vasistha, Published by Krishna Prakashan Media (P)Ltd.
3. A text book of B.Sc mathematics , volume - III published by S. Chand & Co
4. A text book of B.Sc mathematics first year, semester - II, volume - I published by S. Chand & Co

CO–PO–PSO Mapping Matrix (Basic Mathematics)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	2	–	2	–	–	3	–	–	2	–
CO2	3	2	2	2	–	–	–	–	3	–	–	2	–
CO3	3	3	3	2	–	–	–	–	3	2	2	3	–
CO4	3	3	3	2	2	–	–	–	3	3	2	3	–
CO5	3	2	2	3	–	2	–	–	3	–	2	3	2

Pattern of External Examination Max.Marks 60

S.No	Type of Questions	NO. of Questions	Marks allotted	Total Marks
1	Short Questions	5 out of 8 (At least one question must be given from each unit by the paper setter)	4	20
2	Essay Questions	5 out of 8 (At least one question must be given from each unit by the paper setter)	8	40
Total Marks				60

Internal Assessment Procedure

S.NO	TEST	WEIGHTAGE
A	Two Mid Examinations	20+20=40
B	Seminar / Group Discussion	5+5=10
C	Project Based Learning (Course Wise)	10
D	Peer Group Learning (Course Wise)	10
E	Attendance and Participation in Clean and Green Activities)	5
	Total Marks	75*

Note- * This has to be scale down to 40 Marks (As per Our College pattern)

$$\text{Internal Assessment Marks} = \frac{\text{Marks secured}}{75} \times 40$$

Government College for Men (Autonomous):: Kadapa
I B.Sc Honours COMPUTATIONAL MATHEMATICS (w.e.f.2025-26)

Semester – I

Paper I - BASIC MATHEMATICS

Model Paper (w.e.f 2025-26)

Time: 3 Hrs

Max Marks: 60

Section-I

Answer any FIVE of the following questions. Each question carries 04 marks. 5 x 4 = 20

(Paper setter should give at least one question from each unit)

1. Show that the statement is $\sim (p \wedge q) \leftrightarrow (\sim p) \vee (\sim q)$ is a Tautology
2. Prove that $(A-B) \cup (B-A) = (A \cup B) - (A \cap B)$
3. Express $\frac{1+7i}{(2-i)^2}$ in modulus amplitude form.
4. If Z_1, Z_2 are two complex numbers then prove that $|Z_1 + Z_2|^2 = |Z_1|^2 + |Z_2|^2$ if and only if $Z_1 \overline{Z_2}$ is purely imaginary
5. Find the inverse of $A = \begin{pmatrix} 1 & 0 & 1 \\ -2 & 1 & 0 \\ 0 & -1 & 1 \end{pmatrix}$ using elementary operations.
6. If the matrix A is non-singular, show that the eigen values of A^{-1} are the reciprocals of the eigen values of A.
7. Find the angles between the planes $2x - 3y - 6z = 6$ and $6x + 3y - 2z = 18$
8. Find k so that the lines $\frac{x+1}{-3} = \frac{y+2}{2k} = \frac{z-3}{2}$ and $\frac{x-1}{3k} = \frac{y+5}{1} = \frac{z+6}{7}$ are perpendicular

Section-II

Answer any FIVE questions of the following. Each question carries 8 marks

5 x 8 = 40

(Paper setter should give at least one question from each unit)

9. If $f: Q \rightarrow Q$ is a function defined by $f(x) = 2x+3$ then prove that f is one-one, onto and also find a formula that defines f^{-1}
10. If Z_1, Z_2, Z_3 are vertices of an isosceles triangle, right angled at Z_2 then prove that $Z_1^2 + 2Z_2^2 + Z_3^2 = 2Z_2(Z_1 + Z_3)$
11. If the system of equations $\mu x + y + z = 0, x + \mu y + z = 0, x + y + \mu z = 0$ has non zero solutions, then solve it in each case.

12. Find the rank of the matrix $A = \begin{bmatrix} 1 & 3 & 2 \\ 2 & -1 & 3 \\ 3 & -5 & 4 \\ 1 & 17 & 4 \end{bmatrix}$ by reducing into normal form

13. Find the Eigen values and corresponding Eigen vectors of the matrix $A = \begin{pmatrix} 8 & -6 & 2 \\ -6 & 7 & -4 \\ 2 & -4 & 3 \end{pmatrix}$

14. State and prove Caley – Hamilton theorem

15. Find the centre and radius of the circle $x^2 + y^2 + z^2 - 2y - 4z - 11 = 0, x + 2y + 2z - 15 = 0$

16. Find the equation of the sphere circumscribing the tetrahedron formed by the planes $\frac{y}{b} + \frac{z}{c} = 0, \frac{z}{c} + \frac{x}{c} = 0, \frac{x}{a} + \frac{y}{b} = 0, \frac{x}{a} + \frac{y}{b} + \frac{z}{c} = 1$

SEMESTER-I

PAPER II: COMPUTATIONAL CALCULUS

Theory

Credits: 4

5 hrs/week

Course Objectives

This course aims to:

1. To explain the fundamental rules of differentiation to find the derivatives of different types functions.
2. To introduce successive differentiation for some standard functions.
3. To explain about partial differentiation and differentiation of implicit functions.
4. To find the maximum and minimum values of the given function by applying differentiation.
5. To explain about curve tracing and curve tracing rules.

Course Outcomes

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

1. Find the derivatives of different types of functions.
2. Find the successive and partial derivative of the given functions.
3. Understand the Applications of Differentiation
4. Understand some concepts of Integration
5. Understand the Applications of Integration

Unit – 1: Differentiation

Differentiation from the first principle - Fundamental rules for differentiation - Differential coefficient of a function of functions - differential coefficient of inverse functions - Implicit functions - parametric equations - Logarithmic differentiation.

(Chapter - 1 of text book 1)

Unit – 2: Successive differentiation & Partial differentiation

Introduction - Successive differentiation for some standard functions - Rational, Algebraic functions
Leibnitz's theorem

Introduction - Degree of homogeneous functions- Total differential - Total differential coefficient - differentiation of an implicit function - Exact differential.

(Chapter -2 & 5 of text book 1)

Unit – 3: Applications of differentiation

Maxima & Minima, Greatest & Least values : Definitios, A necessary condition for extreme Values, Criteria for extreme values, Applications to problems.

(Chapter VII of Text Book 2)

Unit – 4: Integration

Introduction - Integration by parts - A typical form $\int e^x [f(x) + f'(x)] dx = e^x f(x)$ - The standard forms $\int e^{ax} \sin bx dx$ and $\int e^{ax} \cos bx dx$ - Integration of rational algebraic functions by partial fractions - Properties of definite integrals - Reduction formulae for $\int \sin^n x dx$, $\int \cos^n x dx$, $\int \sin^m x \cos^n x dx$, $\int_0^{\frac{\pi}{2}} \sin^n x dx$, $\int_0^{\frac{\pi}{2}} \cos^n x dx$ and $\int_0^{\frac{\pi}{2}} \sin^m x \cos^n x dx$ - Properties of definite integrals

(Section 16.8 to 16.11 and 17.2 to 17.5 and 17.11 of Text book 4)

Unit – 5: Applications of Integration

Area of a region bounded by a curve, X-axis and two ordinates , Quadrature of Hyperbola, Sectorial Area, Area bounded by a closed curve, Simpson's rule for approximate evaluation of definite integrals and areas.

(Chapter VII of Text Book 3)

Text Book

- 1) Text book of Differential calculus (2 nd Edition) by Ahsan Akhtar and Sabiha Ahsan , published by PHI Learning Pvt..Ltd,New Delhi.
- 2) Differential Calculus by Shanti Narayan & P.K.Mittal, S.Chand & Company,New Delhi
- 3) Integral Calculus by Shanti Narayan, S.Chand & Company,New Delhi
- 4) Elementary Engineering Mathematics by Dr.B.S. Grewal (10 th Edition),Khanna Publishers, Delhi.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	2	–	–	–	–	3	–	–	2	–
CO2	3	3	2	2	–	–	–	–	3	–	–	2	–
CO3	3	3	2	3	–	–	–	–	3	–	–	3	–
CO4	3	2	2	3	–	–	–	–	3	–	–	3	–
CO5	3	2	2	3	–	–	–	–	3	–	–	3	2

Pattern of External Examination Max.Marks 60

S.No	Type of Questions	NO. of Questions	Marks allotted	Total Marks
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Total Marks				60

Internal Assessment Procedure

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Total Marks		75*

Note- * This has to be scale down to 40 Marks (As per Our College pattern)

$$\text{Internal Assessment Marks} = \frac{\text{Marks secured}}{75} \times 40$$

Government College for Men (Autonomous):: Kadapa
I B.Sc Honours COMPUTATIONAL MATHEMATICS (w.e.f.2025-26)
Semester – I

Paper II – **COMPUTATIONAL CALCULUS**
Model Paper (w.e.f 2025-26)

Time: 3 Hrs

Max Marks: 60

Section-I

Answer any FIVE of the following questions. Each question carries 04 mark 5 x 4 = 20

(Paper setter should give at least one question from each unit)

10. Find the differential coefficient of $\sin(\log x)$ from the first principle.
11. Find $\frac{dy}{dx}$, if $y = \tan^{-1}\left(\frac{\sqrt{1+x^2}-1}{x}\right)$
12. If $y = \sin(m \sin^{-1}x)$ then prove that $((1-x^2)y_2 - xy_1 + m^2y = 0$
13. If $u = \log\left(\frac{x^2+y^2}{xy}\right)$ then prove that $\frac{\partial^2 u}{\partial x \partial y} = \frac{\partial^2 u}{\partial y \partial x}$
14. Divide the number 15 into two parts such that the square of one multiplied by the cube of the other is maximum.
15. Evaluate $\int e^{3x} \sin 5x \sin 2x \, dx$
16. Evaluate $\int x^2 \frac{\tan^{-1} x}{1+x^2} \, dx$
17. Find the area of the ellipse $x = a \cos t, y = b \sin t$

Section-II

Answer any FIVE questions of the following. Each question carries 8 marks 5 x 8 = 40

(Paper setter should give at least one question from each unit)

9. Find $\frac{dy}{dx}$, when $(\tan x)^y + (\cot y)^x = 1$.
10. If $y = e^{a \sin^{-1} x}$ then show that
$$(1-x^2)y_{n+2} - (2n+1)y_{n+1} - (x^2 + a^2)y_n = 0.$$
11. If $u = \tan^{-1}\left(\frac{x^3+y^3}{x-y}\right)$ then prove that $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = \sin(2u)$.
12. Prove that the least perimeter of an isosceles triangle in which a circle of radius 'r' can be inscribed is $6r\sqrt{3}$.
13. Show that the semi vertical angle of the cone of maximum volume and given slant height is $\tan^{-1}(\sqrt{2})$.
14. Evaluate $\int_0^{\pi/2} \log(\sin x) \, dx$.
15. Show that the area enclosed between the parabolas $y^2 = 4a(x+a)$,
 $y^2 = -4a(x-a)$ is $\frac{16a^2}{3}$.
16. Calculate $\int_2^4 \frac{dy}{1+x}$ by using Simpson's rule using nine ordinates.

I B.Sc Honours COMPUTATIONAL MATHEMATICS (w.e.f.2025-26)

SEMESTER-II

PAPER III : DIFERENTIAL EQUATIONS

Theory

Credits: 4

5 hrs/week

Course Objectives

1. To introduce the concepts and methods for solving first-order differential equations, including exact, linear, and Bernoulli equations.
2. To understand special types of first-order differential equations such as Clairaut's equations and those solvable for p , x or y .
3. To develop techniques for solving higher-order linear differential equations with constant coefficients.
4. To apply the operator method for finding particular integrals of non-homogeneous differential equations with various types of right-hand side functions.
5. To learn the method of variation of parameters for solving non-homogeneous differential equations

Course Outcomes

After successful completion of the course, the student will be able to

1. Solve exact differential equations, linear equations, Bernoulli's equations, and equations reducible to exact form using integrating factors.
2. Analyze and solve first-order differential equations that are solvable for p , x , and y , including Clairaut's equations.
3. Solve homogeneous and non-homogeneous linear differential equations of higher order with constant coefficients using operator methods.
4. Compute particular integrals for non-homogeneous equations when the right-hand side is a polynomial, exponential, or trigonometric function.
5. Solve non-homogeneous differential equations using the method of variation of parameters and other applicable techniques.
6. Solve the Lagrange's Partial differential equation namely $Pp + Qq = R$.

Unit – 1 (Differential equations of first order and first degree)

Exact Differential Equations - Integrating factors - Equations reducible to Exact Equations by Integrating Factors $\frac{1}{Mx+Ny}$ and $\frac{1}{Mx-Ny}$ Linear Differential Equations – Bernoulli's equations

Unit – 2 (Differential equations of first order, not of First Degree)

Equations solvable for p , Equations solvable for y , Equations solvable for x – Clairaut's equation

Unit – 3 (Higher Order Differential Equations-I)

Solutions of homogeneous linear differential equations of second and higher order with constant coefficients $f(D)y = 0$ - Solutions of non-homogeneous linear differential equations $f(D)y = Q(x)$ of second order with constant coefficients by means of polynomial operators (i) $Q(x) = b e^{ax}$ where b is a real constant - (ii) $Q(x) = \text{Sin } ax$ (or) $\text{Cos } ax$ where a is a real constant

Unit – 4 (Higher Order Differential Equations-II)

Solution to a non-homogeneous linear differential equations $f(D)y = Q(x)$ of second order with constant coefficients by means of polynomial operators (i) $Q(x) = b x^k$ (ii) $Q(x) = e^{ax} V$, where V is a function of x .

Problems on Method of Variation of parameters to find solutions of linear differential equations with variable coefficients.

Unit – 5 (Partial Differential Equations)

Origin of partial differential equations - Derivation of a partial differential equation by the elimination of arbitrary constants - Derivation of a partial differential equation by the elimination of arbitrary function ϕ from $\phi(u, v) = 0$ where u and v are functions of x, y and z - Lagrange's method of solving the linear partial differential equation of order one, namely, $Pp + Qq = R$

(Section 1.1 to 1.5 of Part -III: Partial differential equations from **Ordinary and Partial Differential Equations by Dr. M.D. Raisinghania**, published by S. Chand & Company, New Delhi)

Activities

The activities planned throughout the Differential Equations course include a variety of interactive and evaluative methods such as quizzes, assignments, seminars, and student presentations. Students will also engage in a mini project, prepare concept flowcharts, and participate in operator method chart activities. Peer teaching sessions, LMS-based online quizzes, and board work challenges will foster collaborative and digital learning. Additionally, poster presentations on applications and visual aids like chalk talks will be incorporated to support diverse learning styles and deepen conceptual clarity.

Text Book

1. A Text book of B.Sc Mathematics Volume - 1, Semester - 1 by V. Venkateshwara Rao, N. Krishna Murthy, B.V.S.S. Sarma , Published by S. Chand & Company, New Delhi.
2. Ordinary and Partial Differential Equations by Dr. M.D. Raisinghania, published by S. Chand & Company, New Delhi

Reference Books

3. Differential Equations with applications and programs – S. Balachandra Rao & HR Anuradha- Universities Press.
4. Differential Equations -Srinivas Vangala & Madhu Rajesh, published by Spectrum University
5. Differential Equations and Their Applications by Zafar Ahsan, published by Prentice-Hall of India Pvt. Ltd, New Delhi-Second edition.

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COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	2	–	–	–	–	3	2	–	2	–
CO2	3	3	2	2	–	–	–	–	3	2	–	2	–
CO3	3	3	2	3	–	–	–	–	3	3	–	3	–
CO4	3	3	2	3	–	–	–	–	3	3	–	3	–
CO5	3	3	2	3	–	–	–	–	3	3	–	3	–
CO6	3	3	2	3	–	–	–	–	3	3	–	3	–

Pattern of External Examination Max.Marks 60

S.No	Type of Questions	NO. of Questions	Marks allotted	Total Marks
1	Short Questions	5 out of 8 (At least one question must be given from each unit by the paper setter)	4	20
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Total Marks				60

Internal Assessment Procedure

S.NO	TEST	WEIGHTAGE
A	Two Mid Examinations	20+20=40
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C	Project Based Learning (Course Wise)	10
D	Peer Group Learning (Course Wise)	10
E	Attendance and Participation in Clean and Green Activities)	5
	Total Marks	75*

Note- * This has to be scale down to 40 Marks (As per Our College pattern)

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Government College for Men (Autonomous):: Kadapa
I B.Sc. Honours COMPUTATIONAL MATHEMATICS (w.e.f.2025-26)

Semester – II

Paper III - **DIFERENTIAL EQUATIONS**

Model Paper (w.e.f 2025-26)

Time: 3 Hrs

Max Marks: 60

Section-I

Answer any FIVE of the following questions. Each question carries 04 marks. 5 x 4 = 20

(Paper setter should give at least one question from each unit)

1. Solve $(1 + e^{\frac{x}{y}})dx + e^{\frac{x}{y}}\left(1 - \frac{x}{y}\right)dy = 0$
2. Solve $xdy - ydx = xy^2dx$
3. Solve $(py + x)(px - y) = 2p$
4. Solve $p^2 + 2p\cot x = y^2$
5. Solve $(D^4 - 4D^3 + 6D^2 - 4D + 1)y = 0$.
6. Solve $(D^3 + 1)y = 0$
7. Solve $(D^2 - 3D + 2)y = \cosh x$
8. Form a partial differential equation by eliminating constants A and p from $z = A e^{pt} \sin px$.

Section-II

Answer any FIVE questions of the following. Each question carries 8 marks

5 x 8 = 40

(Paper setter should give at least one question from each unit)

9. Solve $xy dx - (x^2 + 2y^2)dy = 0$
10. Solve $y = (1 + p)x + p^2$
11. Solve $y + px = p^2x^4$
12. Solve $(D^2 + 4)y = e^x + \sin 2x + \cos 2x$
13. Solve $(D^2 - 6D + 13)y = 8e^{3x}\sin 2x$
14. Solve $(D^2 + a^2)y = \tan(ax)$ by the method of variation of parameters
15. Solve $(x^2 - y^2 - z^2)p + 2xyp = 2xz$.
16. Solve $x(y^2 + z)p - y(x^2 + z)q = z(x^2 - y^2)$

SEMESTER-II

PAPER - 4: ELEMENTARY NUMBER THEORY

Theory

Credits: 4

5 hrs/week

Course Objectives

1. To develop an understanding of concepts - Euclidean algorithm, the Diophantine equation $ax + by = c$, the fundamental theorem of Arithmetic
2. To explain Mobius inversion formula and Euler's pi function
3. To explain about the Properties of congruencies.
4. To develop an understanding of primitive roots for primes, Composite numbers having primitive roots.
5. To explain Euler's criteria, The Legendre symbol and its criteria

Course Outcomes

After successful completion of the course, the student will be able to

1. To apply Euclidean algorithm to solve the given Diophantine equation $ax + by = c$
2. Prove Euler pi function and apply it to find the number of divisors
3. Understand and apply the properties of congruencies.
4. Apply the concepts of primitive roots for primes and Composite numbers having primitive roots to solve the given problem.
5. Prove and apply Euler's criteria

Unit – 1

The Division algorithm, the greatest common divisor, the Euclidean algorithm, the Diophantine equation $ax + by = c$, the fundamental theorem of Arithmetic.

Unit – 2

The sum and number of divisors, The mobius inversion formula, Euler's pi function

Unit – 3

Basic Properties of congruencies', Linear Congruence and the Chinese remainder theorem, Fermat's little theorem, Wilson's theorem, Euler's theorem

Unit – 4

The order of an integer modulo n, primitive roots for primes, Composite numbers having primitive roots

Unit – 5

Euler's criteria, The Legendre symbol and its criteria

Text Book

David M. Burton, Elementary Number Theory, 6th Edition, McGraw Hill Higher Education, 2007

Reference Books

1. W. W. Adams and L.J. Goldstein, Introduction to the Theory of Numbers, 3rd ed., Wiley Eastern, 1972.
2. A. Baker, A Concise Introduction to the Theory of Numbers, Cambridge University Press, Cambridge, 1984.
3. I. Niven and H.S. Zuckerman, An Introduction to the Theory of Numbers, 5th Ed., Wiley, New York, 2008.
4. Thomas Koshy, Elementary Number Theory with Applications, 2nd Edition, Academic Press

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	2	2	–	–	–	–	3	2	–	2	–
CO 2	3	3	2	2	–	–	–	–	3	3	–	2	–
CO 3	3	3	2	3	–	–	–	–	3	3	–	3	–
CO 4	3	3	2	3	–	–	–	–	3	3	–	3	–
CO 5	3	3	2	3	–	–	–	–	3	3	–	3	–

Pattern of External Examination Max.Marks 60

S.No	Type of Questions	NO. of Questions	Marks allotted	Total Marks
1	Short Questions	5 out of 8 (At least one question must be given from each unit by the paper setter)	4	20
2	Eassay Questions	5 out of 8 (At least one question must be given from each unit by the paper setter)	8	40
Total Marks				60

Internal Assessment Procedure

S.NO	TEST	WEIGHTAGE
A	Two Mid Examinations	20+20=40
B	Seminar / Group Discussion	5+5=10
C	Project Based Learning (Course Wise)	10
D	Peer Group Learning (Course Wise)	10
E	Attendance and Participation in Clean and Green Activities)	5
	Total Marks	75*

Note- * This has to be scale down to 40 Marks (As per Our College pattern)

$$\text{Internal Assessment Marks} = \frac{\text{Marks secured}}{75} \times 40$$

Government College for Men (Autonomous) :: Kadapa

I B.Sc. Honours COMPUTATIONAL MATHEMATICS (w.e.f.2025-26)

Semester – II

Paper IV - ELEMENTARY NUMBER THEORY

Model Paper (w.e.f 2025-26)

Time : 3 Hrs

Max Marks : 60

Section-I

Answer any FIVE of the following questions. Each question carries 04 marks. $5 \times 4 = 20$

(Paper setter should give at least one question from each unit)

1. For $n \geq 1$, prove that $\frac{n(n+1)(2n+1)}{6}$ is an integer.
2. If a/bc and $\text{g.c.d}(a, b)=1$ then prove that a/c .
3. If f is a multiplicative function and F is defined by $F(n) = \sum_{d|n} f(d)$, then F is also multiplicative.
4. For $n > 2$, prove that $\phi(n)$ is an even integer.
5. Using congruencies, solve the Diophantine equation $4x + 51y = 9$
6. For $k \geq 3$, prove that the integer 2^k has no primitive roots.
7. Given 3 is a positive root of 31, find all positive integers less than 31 having order 6 modulo 31.
8. If p is an odd prime then $\sum_{a=1}^{p-1} (a/p) = 0$

Section-II

Answer any FIVE questions of the following. Each question carries 8 marks $5 \times 8 = 40$

(Paper setter should give at least one question from each unit)

9. State and prove Fundamental theorem of Arithmetic.
10. Determine all solutions in the positive integers of the Diophantine equation $172x + 20y = 1000$
11. State and prove Mobius inversion formula.
12. If p is a prime, then $(p - 1)! \equiv -1 \pmod{p}$.
13. If $n \geq 1$, $\text{gcd}(a, n) = 1$, then prove that $a^{\phi(n)} \equiv 1 \pmod{n}$
14. If p is a prime and $f(x) = a_n x^n + a_{n-1} x^{n-1} + \dots + a_1 x + a_0$, $a_n \not\equiv 0 \pmod{p}$ is a polynomial of degree $n \geq 1$ with integer coefficients, then the congruence $f(x) \equiv 0 \pmod{p}$. has atmost n incongruent solutions modulo p .
15. If p is an odd prime, then prove that

$$2/p = \begin{cases} 1 & \text{if } p \equiv 1 \pmod{8} \text{ or } p \equiv 7 \pmod{8} \\ -1, & \text{if } p \equiv 3 \pmod{8} \text{ or } p \equiv 5 \pmod{8} \end{cases}$$

16. If p is an odd prime and a is an odd integer, with $\text{gcd}(a,p)=1$ then prove that

$$a/p = (-1)^{\sum_{k=1}^{p-1} [ka/p]}$$