गणित विभाग
गुरु घासीदास विश्वविद्यालय
(केंद्रीय विश्वविद्यालय)
कोनी, बिलासपुर-495009, छत्तीसगढ़, भारत
(नैक से संबद्धता A++ ग्रेड)

Department of Mathematics
Guru Ghasidas Vishwavidyalaya
(A Central University)
Koni, Bilaspur-495009, Chhattisgarh, Bharat
(NAAC Accredited A++ Grade)

No.: 283 /Maths/2025/Bilaspur

Date: 22/07/2025

To,

The Members of BOS
Department of Mathematics
GGV, Bilaspur (CG)

Subject: Regarding BOS Meeting on 25/07/25 (Friday)

Respected BOS Members,

After due consultation with our external member of BOS, a meeting is being convened on 25/07/25 (Friday) in the Department of Mathematics Meeting Hall (Room No. 13) at 12:30 P.M. onwards to discuss and include in the present curriculum of the UG/PG/Ph.D. program. Also any correction / suggestion or inclusion of new specialization may also be discussed. Your presence in this regard is highly appreciable.

Agenda of the Meeting:

1. Implementation of UG NEP 5th Semester syllabus.
2. Correction / Modification of 2nd Semester VOC "Engineering Mathematics" in the place of minor paper "Algebra and Matrix Theory" UG NEP Syllabus, 4th VOC "Industrial Mathematics" in place of minor "Vector Calculus" UG NEP Syllabus, 3rd Semester VOC "Numerical Techniques" in the place of Minor paper "Differential Calculus".
3. Inclusion of three new Ph.D. Course Work Papers "Integral Transforms", "Operator Theory" and "Nonlinear Analysis".
4. Correction / Modification of Paper M.Sc. II Semester "Numerical Analysis".
5. Any other matter with the permission of Chair.

Prof. A. K. Thakur
(Chairman - BOS)

Copy to:

1) PS to VC for information to HVC.
2) PA to Registrar for information to Registrar.
3) Prof. Navnit Jha, Faculty of Mathematical Sciences, South Asian University, Rajpur Road, Maidan Garhi, New Delhi, External Subject, BOS
4) Dr. Ashutosh Kumar Pandey, IT (AI and Machine Learning) Datamatrics Tru AI Pattern Bangalore – 560054, Industry Expert, BOS
5) Dean, School of Studies of Mathematical and Computational Science.
6) AR (Academic), for necessary action.
7) Hon'ble Members of BOS
8) Finance Officer GGV, for necessary action.
9) Notice Board
10) Office Copy

गणित विभाग
गुरु घासीदास विश्वविद्यालय
(केंद्रीय विश्वविद्यालय)
कोनी, बिलासपुर-495009, छत्तीसगढ़, भारत
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(A Central University)
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(NAAC Accredited A++ Grade)

Minutes of the Meeting of Board of Studies

A meeting of Board of Studies has been conducted today on 25/07/2025 at 12:30 PM in the department of Mathematics in hybrid mode. The following members are present in the meeting:

1.	Prof. A.K. Thakur	- Chairman
2.	Prof. Navnit Jha	- External Subject Expert
3.	Dr. Ashutosh Kumar Pandey	– Industry Expert
4.	Prof. A.S. Ranadive	- Member, BoS
5.	Prof. P.P. Murthy	- Member, BoS
6.	Dr. K. Sarkar	- Member, BoS
7.	Mr. C.P. Dhuri	- Member, BoS
8.	Dr. J.P. Jaiswal	- Special Invitee
9.	Dr. M. K. Gupta	- Special Invitee
10.	Dr. B.B. Chaturvedi	- Special Invitee
11.	Dr. K.N.V.V. Vara Prasad	- Special Invitee
12.	Dr. Uma Devi Patel	- Special Invitee
13.	Dr. Santosh Verma	- Special Invitee
14.	Dr. Brijendra Paswan	- Special Invitee
15.	Mr. Hapka Surendra	- Special Invitee

In the meeting, the following points have been concluded:

1. Syllabus of B.Sc. V Sem is approved. (Annexure – I)
2. Correction / Modification of 2nd Semester VOC "Engineering Mathematics" in the place of minor paper "Algebra and Matrix Theory" UG NEP Syllabus, 4th VOC "Industrial Mathematics" in place of minor "Vector Calculus" UG NEP Syllabus, 3rd Semester VOC "Numerical Techniques" in the place of Minor paper "Differential Calculus" is approved. (Annexure – II)
3. Proposal for inclusion of three new Ph.D. Course Work Papers "Integral Transforms", "Operator Theory" and "Nonlinear Analysis" is approved. (Annexure – III)
4. Correction / Modification of Paper M.Sc. II Semester "Numerical Analysis" is approved. (Annexure – IV)
5. The MOOC/SWAYAM Course "Numerical Methods" for B.Sc. V sem is approved. (Annexure – V)

The chairman, BoS extended his thanks to all the members.

Prof. A.K. Thakur | Prof. Navnit Jha 29-07-2025 | Dr. Ashutosh Kumar Pandey 30-07-2025 | Prof. A.S. Ranadive

Prof. P.P. Murthy | Dr. K. Sarkar | Mr. C.P. Dhuri | Dr. J.P. Jaiswal

Dr. M.K. Gupta | Dr. B.B. Chaturvedi | Dr. K.N.V.V. Vara Prasad

Dr. Uma Devi Patel | Dr. Santosh Verma | Dr. Brijendra Paswan | Mr. Hapka Surendra

Prof. D. Gopal

Phone: 07752-260144; E-mail: hodmathsggv@gmail.com
URL: http://www.new.ggu.ac.in/department-details/20/0/

3 Annexure - I

Guru Ghasidas Vishwavidyalaya, Bilaspur
Department of Mathematics
Four Year's, B. Sc. (Hons.) Mathematics , Academic Year -2025-26

"Note: Only students admitted in the academic years 2024–25 onwards will follow the papers listed for the First to Fourth semesters."

Sem	Courses	Course Code	Paper Name & Number of Courses	Level	Credits	Credits (L+T+P)	Int. Marks	Ext. Marks	Totals
I	Major-1	AMUAMJT1	Algebra and Geometry	2	4	(3-1-0)	30	70	100
	Minor-1	AMUAMNT1	Geometry	2	4	(3-1-0)	30	70	100
	MDC	MDCAM01	Basics of Statistics	1	3	(2-1-0)	30	70	100
	AEC		Offered by Hindi/English Dept.	1	2	(2-0-0)	30	70	100
	SEC	SECAM01	Number System	1	3	(2-1-0)	30	70	100
	VAC-1	VACAM01	Geometry in India	1	2	(2-0-0)	30	70	100
	VAC-2	VACAM02	Vedic Mathematics	1	2	(2-0-0)	30	70	100
			Total		**20**				**700**
II	Major-2	AMUBMJT2	Elementary Analysis	2	4	(3-1-0)	30	70	100
	VOC	VOCAMT01	Engineering Mathematics(Theory)	2	4	(1-0-3)	30	70	100
		VOCAML01	Engineering Mathematics(Practical)				30	70	100
	MDC	MDCAM01	Basics of Statistics	1	3	(2-1-0)	30	70	100
	AEC		Offered by Hindi/English Dept.	1	2	(2-0-0)	30	70	100
	SEC	SECAM01	Number System	1	3	(2-1-0)	30	70	100
	VAC-1	VACAM01	Geometry in India	1	2	(2-0-0)	30	70	100
	VAC-2	VACAM02	Vedic Mathematics	1	2	(2-0-0)	30	70	100
			Total		**20**				**800**
III	Major-3	AMUCMJT1	Ordinary Differential Equations	3	4	(3-1-0)	30	70	100
	Major-4	AMUCMJT2	Abstract Algebra	3	4	(3-1-0)	30	70	100
	VOC	VOCAMT03	Numerical Techniques(Theory)	2	4	(1-0-3)	30	70	100
		VOCAML03	Numerical Techniques(Practical)				30	70	100
	MDC	MDCAM02	Set, matrix and Theory of Equations	1	3	(2-1-0)	30	70	100
	AEC		Offered by Hindi/English Dept.	1	2	(2-0-0)	30	70	100
	SEC	SECAM02	Boolean Algebra	1	3	(2-1-0)	30	70	100
			Total		**20**				**700**

IV	Major-5	AMUDMJT1	Advanced Analysis	3	5	(4-1-0)	30	70	100
	Major-6	AMUDMJT2	Multivariable and Vector Calculus	3	4	(3-1-0)	30	70	100
	Major-7	AMUDMJT3	Linear Programming	3	5	(4-1-0)	30	70	100
	VOC	VOCAMT02	Industrial Mathematics(Theory)	3	4	(1-0-3)	30	70	100
		VOCAML02	Industrial Mathematics(Practical)				30	70	100
	AEC		Offered by Hindi/English Dept.	1	2	(2-0-0)	30	70	100
			Total		**20**				**600**

"Note: Only students admitted in the academic year 2023–24 will follow the papers listed for the V semesters."

V	Major-8	AMUEMJT1	Partial Differential equations and Calculus of Variations	3	5	(4-1-0)	30	70	100
	Major-9	AMUEMJT2	Metric Spaces	3	5	(4-1-0)	30	70	100
	Major-10	AMUEMJT3M	MOOC-Numerical Methods(Theory)	3	4	(4-0-0)	30	70	100
		AMUEMJL3	Numerical Methods(Practical)	3	1	(0-0-1)	30	70	100
	VOC	VOCAMT01	Engineering Mathematics(Theory)	2	4	(1-0-3)	30	70	100
		VOCAML01	Engineering Mathematics(Practical)				30	70	100
	Internship								100
			Total		**19**				**700**

Sem	Code	Subject	Periods			Evaluation Scheme				Credit
			L	T	P	Internal Assessment		ESE	Total	
						CT-1	CT-2			
B.Sc.V	AMUEMJT1	Partial Differential Equations and Calculus of Variations (Major-8)	4	1	0	15	15	70	100	5

Major-8: Partial Differential Equations and Calculus of Variations

Course Objectives:

1. To understand about the basic of partial differential equations.
2. To discuss the second order partial differential equations with constants coefficients.
3. To discuss the second order partial differential equations with variable coefficients.
4. To discuss the calculus of variations under fixed boundary conditions.
5. To discuss the calculus of variations under moving boundary conditions.

Unit-I: First-Order Partial Differential Equations-

Order and degree of partial differential equations (PDEs), Concept of linear and nonlinear partial differential equations, First-order partial differential equations, Lagrange's method for solving first-order PDEs, Special types of first-order PDEs solvable by methods other than the general method, Charpit's general method for nonlinear first-order PDEs.

Unit-II: Second-Order Partial Differential Equations with Constant Coefficients-

Classification of second-order linear partial differential equations, Homogeneous and non-homogeneous second-order PDEs with constant coefficients, Methods for solving second-order PDEs with constant coefficients.

Unit-III: Second-Order Partial Differential Equations with Variable Coefficients-

Reduction of PDEs with variable coefficients to equations with constant coefficients,Classification of second-order PDEs,Reduction to canonical or normal form,Monge's method for solving second-order PDEs,Solution of heat and wave equations in one and two dimensions using the method of separation of variables.

Unit-IV: Calculus of Variations-

Variational Problems with Fixed Boundaries- Euler's equation for functionals containing first-order and higher-order total derivatives, Functionals involving first-order partial derivatives. Variational problems in parametric form, Invariance of Euler's equation under coordinate transformations.

Unit-V: Calculus of Variations-

Variational Problems with Moving Boundaries-Variational problems with moving boundaries., Functionals dependent on one and two variables, One-sided variations, Sufficient conditions for an extremum – Jacobi and Legendre conditions, Second variation and its significance.

Reference Books:

1. A. S. Gupta (2004). Calculus of Variations with Applications. PHI Learning.
2. Erwin Kreyszig (2011). Advanced Engineering Mathematics (10th edition). Wiley.
3. TynMyint-U & Lokenath Debnath (2013). Linear Partial Differential Equation for Scientists and Engineers (4th edition). Springer India.
4. H. T. H. Piaggio (2004). An Elementary Treatise on Differential Equations and Their Applications. CBS Publishers.
5. S. B. Rao & H. R. Anuradha (1996). Differential Equations with Applications. University Press.
6. Ian N. Sneddon (2006). Elements of Partial Differential Equations. Dover Publications.

Course Outcomes: By completing this course, students will achieve the following outcomes:

CO1: Students will grasp the fundamental concepts of partial differential equations (PDEs), including their order, degree, and classification. They will learn to solve first-order PDEs using Lagrange's and Charpit's methods.

CO2: Learners will develop the ability to classify second-order PDEs and distinguish between homogeneous and non-homogeneous equations with constant coefficients. They will apply systematic methods to solve these equations effectively.

CO3: Students will understand techniques for reducing PDEs with variable coefficients to simpler forms. They will apply Monge's method and solve heat and wave equations using the method of separation of variables gaining a deeper insight into practical applications.

CO4: Learners will explore Euler's equations for functionals involving first-order and higher-order derivatives. They will analyze variational problems in parametric form and understand the role of coordinate transformations in variational calculus.

CO5: Students will learn to solve variational problems with moving boundaries, apply one-sided variations, and determine sufficient conditions for an extremum using Jacobi and Legendre conditions. They will also study the second variation for stability analysis.

Course Outcomes and their Mapping with Programme Outcomes:

CO	PO												PSO		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	1	2								1	1	2	1	1
CO2	2	1	2								1	1	2	1	1
CO3	2	1	2		2						1	1	2	1	1
CO4	3	3	3		3						1	1	3	1	2
CO5	3	3	3		3						1	1	3	1	2

Weightage: 1-Slightly, 2-Moderately, 3-Strongly

Sem	Code	Subject	Periods			Evaluation Scheme				Credit
			L	T	P	Internal Assessment		ESE	Total	
						CT-1	CT-2			
B.Sc. V	AMUEMJT2	Metric Spaces (Major-9)	4	1	0	15	15	70	100	5

Major-9: Metric Spaces

Course Objectives:

1. To understand the concepts of Young, Holder and Minkowski Inequalities.
2. To learn the concept of metric space and basic definitions such as: open, closed, neighborhood, interior, exterior, boundary point set and subspace of metric space.
3. To understand completeness, continuity, uniform continuity and , Banach contraction principle.
4. To study the concept of compactness and characterizations of compact spaces, Lebesgue covering lemma.
5. To understand the concept of connectedness, disconnected, and its properties.

Unit-I: Concepts in Metric Spaces-

Definition and examples of metric spaces, Young, Holder and Minkowski Inequalities,Open spheres and closed spheres, neighbourhoods, open sets, interior, exterior and boundary points, Closed sets, limit pointsand isolated points, Interior and closure of a set, Boundary of a set, Bounded sets, distance between two sets, diameter of a set, subspace of a metric space, Equivalent metrics.

Unit-II: Complete Metric Spaces -

Sequences in metric spaces, Cauchy and Convergent sequences, Completeness of metric spaces and its examples, Completeion of metric spaces, Cantor's intersection theorem, dense sets and separable spaces, nowhere dense sets and Baire'scategory.

Unit-III: Continuity in metric space-

Continuous and uniformly continuous functions, Homeomorphism, Open and closed maps, Banach contraction principle and its applications.

Unit-IV: Compactness-

Compact spaces, Sequential compactness, Bolzano-Weierstrass property, Compactness and finite intersection property, Heine-Borel theorem, Totally bounded sets, Equivalence of compactness and

sequential compactness, Lebesgue covering lemma, Continuous functions on compact spaces.

Unit-V: Connectedness-

Separated sets, Disconnected and connected sets, Components, Connected subsets of $\mathbb{R}$, Continuous functions on connected sets.

Reference Books:

1. D. Gopal, A.S. Ranadive, A. Deshmukh, S. Yadav, An introduction to metric spaces, CRC Press, UK 2021.
2. Pawan K. Jain and Khalil Ahmad, Metric Spaces,Narosa Publishing House, New Delhi, 2nd Ed.2009.
3. SatishShirali and Harikishan L. Vasudeva, Metric Spaces, Springer Verlag, London, 2006.
4. S. Kumaresan, Topology of Metric Spaces, 2nd Ed., Narosa Publishing House, 2011.
5. G.F. Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill, 2004.
6. Malik and Arora, Mathematical Analysis, New age, International Publications.

Course Outcomes: By completing this course, students will achieve the following outcomes:

CO1: Students will grasp the fundamental concepts of partial differential equations (PDEs), including their order, degree, and classification. They will learn to solve first-order PDEs using Lagrange's and Charpit's methods.

CO2: Learners will develop the ability to classify second-order PDEs and distinguish between homogeneous and non-homogeneous equations with constant coefficients. They will apply systematic methods to solve these equations effectively.

CO3: Students will understand techniques for reducing PDEs with variable coefficients to simpler forms. They will apply Monge's method and solve heat and wave equations using the method of separation of variables gaining a deeper insight into practical applications.

CO4: Learners will explore Euler's equations for functionals involving first-order and higher-order derivatives. They will analyze variational problems in parametric form and understand the role of coordinate transformations in variational calculus.

CO5: Students will learn to solve variational problems with moving boundaries, apply one-sided variations, and determine sufficient conditions for an extremum using Jacobi and Legendre conditions. They will also study the second variation for stability analysis.

Course Outcomes and their Mapping with Programme Outcomes:

CO	PO												PSO		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	1									1	1		1	1
CO2	2	1									1	1		1	1
CO3	2	1									1	1		1	1
CO4	3	3			3						1	1		1	1
CO5	3	3			3						1	1		1	2

Weightage: 1-Slightly, 2-Moderately, 3-Strongly

Sem	Code	Subject	Periods			Evaluation Scheme				Credit
			L	T	P	Internal Assessment		ESE	Total	
						CT-1	CT-2			
B.Sc. V	AMUEMJT3M	MOOC-Numerical Methods (Theory) (Major-10)	4	0	0	15	15	70	100	4

Major-10: MOOC-Numerical Methods (Theory)

Course Objectives: By completing this course, students will achieve the following outcomes:

1. To introduce the basic concepts of solving algebraic, transcendental equations and system of linear and non-linear equations.
2. To understand techniques of interpolation.
3. To understand methods of numerical differentiation and integration.
4. To understand numerical solution of ordinary differential equations.

Unit-I: Bisection method, Regula-Falsi method, Fixed point iteration method, Newton Raphson method. Solution of nonlinear system of equations using Newton Raphson method, Gauss elimination method, Gauss Jordan method, Method of Triangularization, Crout's triangularization method, Gauss Jacobi iterative method of iteration, Gauss Seidel method of iteration.

Unit-II: Forward finite differences, Backward finite differences, Central differences, Newton's Forward Interpolation, Newton's backward Interpolation, Relation connecting finite differences, Stirling's Interpolation Formula, Gauss' Forward Interpolation Formula, Gauss' backward Interpolation Formula, Newton's divided difference Interpolation, Lagrange's interpolation.

Unit-III: Differentiation using Newton's forward difference formula, Differentiation using Newton's backward difference formula, Differentiation using Stirling's formula, Bessel's formula, Laplace Everett's formula, Integration using Trapezoidal rule, Simpson's one third rule, Simpson's 3/8 th rule, Evaluation of double integrals using trapezoidal rule, Evaluation of double integrals using Simpson's rule.

Unit-IV: Solution of ODE using Picard's iteration method, Taylor series method, Euler's method, Second order Runge-Kutta method, Fourth order Runge-Kutta method, Adam-Bashforth method, Milne's predictor corrector method.

Reference:

1. Brian Bradie, A Friendly Introduction to Numerical Analysis, Pearson Education, India, 2007.
2. M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, 6th Ed., New age International Publisher, India, 2007.
3. C.F. Gerald and P.O. Wheatley, Applied Numerical Analysis, Pearson Education, India, 2008.

4. Uri M. Ascher and Chen Greif, A First Course in Numerical Methods, 7th Ed., PHI Learning Private Limited, 2013.

5. John H. Mathews and Kurtis D. Fink, Numerical Methods using Matlab, 4th Ed., PHI Learning Private Limited, 2012.

6. B.S. Grewal, Higher Engineering Mathematics, Khanna Publisher.

Course Outcomes: After completion of the course students shall be able to :

1. find roots of linear and non-linear system (algebraic and transcendental) equations.
2. understand the concepts of interpolation and construction of polynomials.
3. solve differential and integral equations numerically.
4. Identify various numerical methods to solve linear and non-linear ordinary differential equations.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	3	2	3						2	1	3	1	2
CO2	2	2	2	1	2						2	3	2	3	1
CO3	2	3	2	1	2						1	3	3	3	3
CO4	1	3	1	3	1						1	2	1	1	3
CO5	2	3	1	3	2						3	3	2	2	2

Weightage: 1-Slightly, 2-Moderately, 3-Strongly

Sem	Code	Subject	Periods			Evaluation Scheme				Credit
			L	T	P	Internal Assessment		ESE	Total	
						CT-1	CT-2			
B.Sc V	AMUEMJL3	Numerical Methods (Practical) (Major-10)	0	0	1	15	15	70	100	1

Major-10: Numerical Methods (Practical)

List of Practicals:

1. Solution of algebraic or transcendental equations using bisection method.
2. Solution of algebraic or transcendental equations using false position method.
3. Solution of simultaneous non-linear equations using Newton Raphson method.
4. Solution of simultaneous linear equations using Gaussian Elimination method.
5. Solution of simultaneous linear equations using Gauss Jardan and Gauss Seidal iteration methods.
6. Interpolation by using Newton's Forward Interpolation method.
7. Interpolation by using Lagrange interpolation method.
8. Numerical Differentiation using Stirling's Interpolation Formula.
9. Numerical Integration Simpson's one third rule and Simpson's 3/8 th rule.
10. Numerical Solution of initial value problem using Euler's method,
11. Numerical Solution of initial value problem using Runga Kutta method
12. Numerical Solution of initial value problem using Picard's iteration method.

Reference:

1. Brian Bradie, A Friendly Introduction to Numerical Analysis, Pearson Education, India, 2007.
2. M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, 6th Ed., New age International Publisher, India, 2007.
3. C.F. Gerald and P.O. Wheatley, Applied Numerical Analysis, Pearson Education, India, 2008.
4. Uri M. Ascher and Chen Greif, A First Course in Numerical Methods, 7th Ed., PHI Learning Private Limited, 2013.
5. John H. Mathews and Kurtis D. Fink, Numerical Methods using Matlab, 4th Ed., PHI Learning Private Limited, 2012.

6. B.S. Grewal, Higher Engineering Mathematics, Khanna Publisher.

Course Outcomes: After completion of the course students shall be able to :

1. find roots of linear and non-linear system (algebraic and transcendental) equations.
2. understand the concepts of interpolation and construction of polynomials.
3. solve differential and integral equations numerically.
4. Identify various numerical methods to solve linear and non-linear ordinary differential equations.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	3	2	3						2	1	3	1	2
CO2	2	2	2	1	2						2	3	2	3	1
CO3	2	3	2	1	2						1	3	3	3	3
CO4	1	3	1	3	1						1	2	1	1	3
CO5	2	3	1	3	2						3	3	2	2	2

Weightage: 1-Slightly, 2-Moderately, 3-Strongly

Sem	Code	Subject	Periods			Evaluation Scheme				Credit
			L	T	P	Internal Assessment		ESE	Total	
						CT-1	CT-2			
B.Sc. II/V	VOCAMT01	Engineering Mathematics (Theory)	1	0	0	15	15	70	100	1

VOC: Engineering Mathematics (Theory)

Course Objectives: By completing this course, students will achieve the following outcomes:

1. To build the strong foundation of calculus.
2. Make able to apply the concept of linear algebra on engineering problems.
3. Make able to solve problem of vector calculus.
4. Make able to solve the differential equations.

Unit-I: Functions, Limits, Continuity, Differentiation and its Applications, Integration and its Applications, Partial Differentiation, Multivariable Calculus.

Unit-II: Matrices and Determinants, Systems of Linear Equations, Eigen values and Eigen vectors, Vector Spaces.

Unit-III: Gradient, Divergence, and Curl, Line and Surface Integrals, Green's Theorem, Stokes' Theorem, Divergence Theorem.

Unit-IV: Ordinary Differential Equations (ODEs), First-order and Higher-order Linear ODEs, Laplace Transforms, Solutions of Partial Differential Equations (PDEs).

Reference:

1. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
2. G.F. Simmons, Differential Equations, Tata Mcgraw Hill Publishing Company Ltd.
3. M. D. Rai Singhania, Ordinary and Partial Differential Equations, S. Chand and Company Ltd., New Delhi.
4. A.C. Srivastava, Engineering Mathematics, PHI Publication.
5. K. Hoffman and R. Kunze, Linear Algebra (2nd ed.), Prentice-Hall of India.
6. S. Kumaresan (1999), Linear Algebra- A Geometric Approach, Prentice Hall of India.

Course Outcomes: By completing this course, students will achieve the following outcomes:

1. To apply the idea of calculus on engineering problems.
2. To solve the system of equation.
3. To solve the problems on vector calculus and to apply them on engineering problems.

4. To model the real world problems.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	1	2								1	1	2	1	1
CO2	2	1	2								1	1	2	1	1
CO3	2	1	2								1	1	2	1	1
CO4	3	3	3		3						1	1	3	1	2

Weightage: 1-Slightly, 2-Moderately, 3-Strongly

Sem	Code	Subject	Periods			Evaluation Scheme				Credit
			L	T	P	Internal Assessment		ESE	Total	
						CT-1	CT-2			
B.Sc II	VOCAML01	Engineering Mathematics (Practical)	0	0	3	15	15	70	100	3

VOC: Engineering Mathematics (Practical)

List of Practicals:

1. Use of any mathematical software for solving differential equations, integration, and matrix manipulations. To identify the engineering problem (e.g., structural engineering, mechanical engineering, civil engineering etc) and to apply the idea of calculus on such engineering problems.
2. Graphing and visualization of functions, gradients, and surface integrals. To identify and analyze the real world problem and to apply the concept of linear algebra.
3. Hands-on exercises on the application of vector calculus. To apply vector calculus in engineering.
4. Solving ODEs and PDEs using numerical methods (e.g., Euler's method, Runge-Kutta method).

Reference:

1. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
2. G.F. Simmons, Differential Equations, Tata Mcgraw Hill Publishing Company Ltd.
3. M. D. Rai Singhania, Ordinary and Partial Differential Equations, S. Chand and Company Ltd., New Delhi.
4. A.C. Srivastava, Engineering Mathematics, PHI Publication.
5. K. Hoffman and R. Kunze, Linear Algebra (2nd ed.), Prentice-Hall of India.
6. S. Kumaresan (1999), Linear Algebra- A Geometric Approach, Prentice Hall of India.

Course Outcomes: By completing this course, students will achieve the following outcomes:

1. To apply the idea of calculus on engineering problems.
2. To solve the system of equation.
3. To solve the problems on vector calculus and to apply them on engineering problems.
4. To model the real world problems.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	1	2								1	1	2	1	1
CO2	2	1	2								1	1	2	1	1
CO3	2	1	2								1	1	2	1	1
CO4	3	3	3		3						1	1	3	1	2

Weightage: 1-Slightly, 2-Moderately, 3-Strongly

Sem	Code	Subject	Periods			Evaluation Scheme				Credit
			L	T	P	Internal Assessment		ESE	Total	
						CT-1	CT-2			
B.Sc. IV	VOCAMT02	Industrial Mathematics (Theory)	1	0	0	15	15	70	100	1

VOC: Industrial Mathematics (Theory)

Course Objectives: By completing this course, students will achieve the following outcomes:

1. To build the strong ability to solve the industry problems related to Sequencing.
2. Able to give the solution of Assignment Problems related to the industry/society.
3. Make able to identify and solve the Transportation Problems related to the industry/society

Unit-I: Basics of Industrial mathematics:

Introduction, Definition, main features of industrial mathematics, important sub-areas in industrial mathematics and importance of Industrial Mathematics.

Unit-II: Sequencing:(Practical Approach)

Introduction, General assumptions, Sequencing decision problem for n-jobs on two Machines, Sequencing decision problem for n-jobs on three Machines, Sequencing decision problem for n-jobs on m Machines.

Unit-III: Assignment Problems:(Practical Approach)

Introduction, important theorems related to the assignment problems, Unbalanced Assignment problems, Maximization of Assignment problems, Restrictions on Assignment.

Unit-IV: Transportation Problems:(Practical Approach)

Introduction, different transportation problems, Difference between transportation and assignment problems. Theorems related to the transportation problems, Solution of a transportation problem. Initial feasible solution, Optimality test.

Reference:

1. Avner Friedman and Walter Littman (1987), Industrial Mathematics, A Course in Solving Real-World Problems, SIAM Publication.
2. Hamdy A. Taha (2010), Operations Research-An Introduction, Prentice Hall, 9th Edition.
3. Wayne L. Winston and M. Venkataramanan (2002), Introduction to Mathematical Programming, Applications and Algorithms, 4th edition, Duxbury Press.
4. Ravindran, D. T. Phillips and James J. Solberg (2005), Operations Research- Principles and Practice, John Wiley & Sons.
5. G. Hadley (1964), Nonlinear and Dynamic Programming, Addison-Wesley.

Course Outcomes: By completing this course, students will achieve the following outcomes:

1. Able to identify the problems of industry related to Sequencing and also able to give proper solution.
2. Able to identify the problems of industry related to Assignment Problems and also able to give proper solution.
3. Able to identify the problems of industry related to Transportation Problems and also able to give proper solution.

EXPECTED JOB ROLE AND CAREER OPPORTUNITY The industry and society have different types of problems related to the sequencing, Assignment ant transportation. This vocational course will provide ample of job and career opportunity to the students to secure job in government, private and to start entrepreneurship.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	1	2								1	1	2	1	1
CO2	2	1	2								1	1	2	1	1
CO3	2	1	2			2					1	1	2	1	1

Weightage: 1-Slightly, 2-Moderately, 3-Strongly

Sem	Code	Subject	Periods			Evaluation Scheme				Credit
			L	T	P	Internal Assessment		ESE	Total	
						CT-1	CT-2			
B.Sc. IV	VOCAML02	Industrial Mathematics (Practical)	0	0	3	15	15	70	100	3

VOC: Industrial Mathematics (Practical)

List of Practicals:

1. Identify the problems of industry or society related to the sequencing theory and suggests the proper solution.
2. Identify the problems of industry or society related to the Assignment Problems and suggests the proper solution.
3. Identify the problems of industry or society related to the Transportation Problems and suggests the proper solution.

Reference:

1. Avner Friedman and Walter Littman (1987), Industrial Mathematics, A Course in Solving Real-World Problems, SIAM Publication.
2. Hamdy A. Taha (2010), Operations Research-An Introduction, Prentice Hall, 9th Edition.
3. Wayne L. Winston and M. Venkataramanan (2002), Introduction to Mathematical Programming, Applications and Algorithms, 4th edition, Duxbury Press.
4. Ravindran, D. T. Phillips and James J. Solberg (2005), Operations Research- Principles and Practice, John Wiley & Sons.
5. G. Hadley (1964), Nonlinear and Dynamic Programming, Addison-Wesley.

Course Outcomes: By completing this course, students will achieve the following outcomes:

1. Able to identify the problems of industry related to Sequencing and also able to give proper solution.
2. Able to identify the problems of industry related to Assignment Problems and also able to give proper solution.
3. Able to identify the problems of industry related to Transportation Problems and also able to give proper solution.

EXPECTED JOB ROLE AND CAREER OPPORTUNITY The industry and society have different types of problems related to the sequencing, Assignment ant transportation. This

vocational course will provide ample of job and career opportunity to the students to secure job in government, private and to start entrepreneurship.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	1	2								1	1	2	1	1
CO2	2	1	2								1	1	2	1	1
CO3	2	1	2			2					1	1	2	1	1

Weightage: 1-Slightly, 2-Moderately, 3-Strongly

Sem	Code	Subject	Periods			Evaluation Scheme				Credit
			L	T	P	Internal Assessment		ESE	Total	
						CT-1	CT-2			
B.Sc. III	VOCAMT03	Numerical Techniques (Theory)	1	0	0	15	15	70	100	1

VOC: Numerical Techniques (Theory)

Course Objectives: The goal of this paper is to acquaint students for the study of certain algorithms that use numerical approximation for the problems of mathematical analysis. Also, the use of Computer Algebra Systems (CAS) by which the intractable problems can be solved both numerically and analytically.

Unit-I: Solution of Algebraic and transcendental equations

Introduction to significant digits and errors, Solution of system of linear Equations by Gauss elimination method. Finding root of an equation by Bisection method and Newton-Raphson method.

Unit-II: Interpolation, Integration and solution of differential equations

Finite differences, Lagrange's and Newton's interpolation formulas. Numerical Integration: Trapezoidal rule, Simpson's one-third rule. Numerical solution of ordinary differential equations: Picard's method, Euler's method, Numerical solution of one-dimensional Heat and Wave equations.

Reference:

1. John H. Mathews and Kurtis D. Fink, Numerical Methods using Matlab, 4th Ed., PHI Learning Private Limited, 2012.
2. M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, 6th Ed., New age International Publisher, India, 2007.
3. Fausett, Laurence V. Applied Numerical Analysis Using Matlab, Pearson India, 2009.

Course Learning Outcomes:

After completion of this course, students will be able to:

1. Find the consequences of finite precision and the inherent limits of numerical methods.
2. Appropriate numerical methods to solve algebraic and transcendental equations.
3. How to solve first order initial value problems of ODE's numerically using Euler methods.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	2	3	2		3				1	1	3	1	2	1
CO2	1	2	2	1						1	3	2	3	1	2
CO3	1	3	2	1						1	3	3	3	3	3
CO4	1	3	1	3						1	2	1	3	2	
CO5	2	3	1	3						3	3	2	2	2	3

Weightage: 1-Slightly, 2-Moderately, 3-Strongly

Sem	Code	Subject	Periods			Evaluation Scheme				Credit
			L	T	P	Internal Assessment		ESE	Total	
						CT-1	CT-2			
B.Sc. III	VOCAML03	Numerical Techniques (Practical)	0	0	3	15	15	70	100	3

VOC: Numerical Techniques (Practical)

List of Practicals:

1. Gauss elimination method
2. Bisection method
3. Newton-Raphson method
4. Lagrange interpolation
5. Newton's interpolation
6. Trapezoidal rule for numerical integration
7. Simpson's one-third rule for numerical integration
8. Picard's method to solve ODE
9. Euler's method to solve ODE
10. Solution of one-dimensional Heat equation
11. Solution of one-dimensional Wave equation

Reference:

1. John H. Mathews and Kurtis D. Fink, Numerical Methods using Matlab, 4th Ed., PHI Learning Private Limited, 2012.
2. M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, 6th Ed., New age International Publisher, India, 2007.
3. Fausett, Laurence V. Applied Numerical Analysis Using Matlab, Pearson India, 2009.

Course Learning Outcomes:

After completion of this course, students will be able to:

1. Find the consequences of finite precision and the inherent limits of numerical methods.
2. Appropriate numerical methods to solve algebraic and transcendental equations.
3. How to solve first order initial value problems of ODE's numerically using Euler methods.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	2	3	2		3				1	1	3	1	2	1
CO2	1	2	2	1						1	3	2	3	1	2
CO3	1	3	2	1						1	3	3	3	3	3
CO4	1	3	1	3						1	2	1	3	2	
CO5	2	3	1	3						3	3	2	2	2	3

Weightage: 1-Slightly, 2-Moderately, 3-Strongly

Numerical Methods

By Dr. MANSOOR P. | MES College of Engineering, Kuttippuram

Join (/update_profile_and_register?user_email=&raw_slug=/cec25_ma24) Learners enrolled: 540

www.youtube.com unexpectedly closed the connection.

In Mathematical applications, there are several instances in which no direct methods are available for solving higher degree algebraic equations or transcendental equations, ie., the equations involving circular, logarithmic or exponential functions. Such equations are solved by numerical methods. The simultaneous linear algebraic equations occur quite often in various fi... engineering and science, Generally, the matrix inversion method or Cramer's rule have been using to solve these equatio...

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these methods be ... en the system consist large number of unknown variables. In such cases, numerical techniques can b... ...e solutions. If the values of a function f(x) are given for some finite values of x, then using the interpolation we can find the numerical value of f(x) for any other value of x in the given interval. We are familiar with various analytical methods in order to solve many ordinary differential equations. In physical problems, there are large numbers of ordinary differential equations which cannot be solved by analytical methods.In these cases, numerical solutions can be computed using various numerical methods.

The course is developed to enable the undergraduate students to get a comprehensive understanding of numerical techniques in solving various mathematical problems. We will begin the course with the methods of finding solution of algebraic and transcendental equations using

bisection method, regula falsi method, fixed point iteration method, Newton Raphson method and Horner's method. The direct and indirect methods of solving linear system of algebraic equations will be discussed in this course. It include Gauss elimination method, Gauss Jordan method, Factorization method, Gauss Jacobi iteration method and gauss Seidel iteration method. This course also covers interpolation of equal and unequal intervals, numerical differentiation and numerical integration. Towards the end, the method finding numerical solution of first order
ordinary differential equations will be discussed. After the successful completion of this course, the learner would be familiarized with the way of solving complicated mathematical problems numerically using the appropriate numerical technique.

Summary

Course Status :	Upcoming
Course Type :	Core
Language for course content :	English
Duration :	12 weeks
Category :	◦ Mathematics
Credit Points :	4
Level :	Undergraduate
Start Date :	07 Jul 2025
End Date :	31 Oct 2025
Enrollment Ends :	31 Aug 2025
Exam Date :	
Translation Languages :	English
NCrF Level ℹ : (https://www.ugc.gov.in/pdfnews/9028476_Report-of-National-Credit-Framework.pdf)	6.0

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Course layout

Weeks Weekly Lecture Topics (Module Titles)

1 Day 1 Module 1 : Bisection method
Day 2 Module 2 : Regula-Falsi method
Day 3 Module 3 : Fixed point iteration method
Day 4 Discussion based on the above topics
Day 5 Assignment

2 Day 1 Module 4 : Newton Raphson method- Part 1
Day 2 Module 5 : Newton Raphson method- Part 2
Day 3 Module 6 : Solution of nonlinear system of equations using Newton Raphson method.
Day 4 Discussion based on the above topics
Day 5 Assignment

3 Day 1 Module 7 : Gauss elimination method
Day 2 Module 8 : Gauss Jordan method
Day 3 Module 9 : Method of Triangularisation
Day 4 Module 10: Crout's triagularisation method
Day 5 Discussion based on the above topics
Day 6 Assignment

4 Day 1 Module 11 : Gauss Jacobi iterative method of iteration
Day 2 Module 12 : Gauss Seidel method of iteration
Day 3 Module 13 : Forward finite differences
Day 4 Module 14: Backward finite differences
Day 5 Discussion based on the above topics
Day 6 Assignment

5 Day 1 Module 15 : Central differences

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Day 2 Module 16 | Interpolation
Day 3 Module 17: d Interpolation
Day 4 Discussion based on the above topics
Day 5 Assignment

6 Day 1 Module 18 : Relation connecting finite differences
Day 2 Module 19 : Stirling's Interpolation Formula
Day 3 Module 20 : Gauss' Forward Interpolation Formula
Day 4 Module 21. Gauss' backward Interpolation Formula
Day 5 Discussion based on the above topics
Day 6 Assignment

7 Day 1 Module 22 : Newton's divided difference Interpolation
Day 2 Module 23 : Lagrange's interpolation
Day 3 Module 24 : Differentiation using Newton's forward difference formula
Day 4 Discussion based on the above topics
Day 5 Assignment

8 Day 1 Module 25 : Differentiation using Newton's backward difference formula
Day 2 Module 26: 2Differentiation using Stirling's formula
Day 3 Module 27 : Bessel's formula
Day 4 Discussion based on the above topics
Day 5 Assignment

9 Day 1 Module 28 : Laplace Everett's formula
Day 2 Module 29 : Integration using Trapezoidal rule
Day 3 Module 30: Simpson's one third rule
Day 4 Module 31: Simpson's 3/8 th rule
Day 5 Discussion based on the above topics
Day 6 Assignment

10 Day 1 Module 32 : Evaluation of double integrals using trapezoidal rule
Day 2 Module 33 : Evaluation of double integrals using simpson's rule
Day 3 Module 34 : Solution of ODE using Picard's iteration method
Day 4 Discussion based on the above topics
Day 5 Assignment
11 Day 1 Module 35 : Taylor series method
Day 2 Module 36 : Euler's method
Day 3 Module 37: Second order Runge-Kutta method
Day 4 Discussion based on the above topics
Day 5 Assignment

12 Day 1 Module unge-Kutta method
Day 2 Module 39 r(ctd)
Day 3 Module 40 . Milne's predictor corrector method
Day 4 Discussion based on the above topics
Day 5 Assignment

Books and references

1. Brian Bradie, A Friendly Introduction to Numerical Analysis, Pearson Education, India, 2007.
2. M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, 6th Ed., New age International Publisher, India, 2007.
3. C.F. Gerald and P.O. Wheatley, Applied Numerical Analysis, Pearson Education, India, 2008.
4. Uri M. Ascher and Chen Greif, A First Course in Numerical Methods, 7th Ed., PHI Learning Private Limited, 2013.
5. John H. Mathews and Kurtis D. Fink, Numerical Methods using Matlab, 4th Ed., PHI Learning Private Limited, 2012.

Instructor bio

Dr. MANSOOR P.

MES College Of Engineering, Kuttippuram

Dr. Mansoor P

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Dr. MANSOOR P
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Academic qualification
M.Phil in Mathematics, MSc. Mathematics, BSc., Mathematics
Other Merits:
PhD. in Mathematics with Bharathiar.University, Coimbatore.
Served as Course coordinator for the MOOC on

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MATHEMATICA | Jan - April) under
SWAYAM platfo (https://swayam.gov.in/) (https://swayam.gov.in/nc_details/CEC)
Served as Course coordinator for the MOOC on Calculus
(2019 Jan-April) under SWAYAM platform (https://swayam.gov.in/about) | All Courses | ()
About Swayam
Developed and presented a number of e-content modules
in various Mathematics topic for CEC, MHRD India.
Delivered a number of lectures in Mathematics for DTH
Swayamprabha Channel 8 of MHRD at University of Calicut.
Published research articles in reputed International
Journals.Presented papers in International and Regional Seminars.
Working as translator for translating various NPTEL courses into Malayalam regional language.

Course certificate

* Internal Assessment- Weekly assessments released in the course shall be considered for Internal Marks and will carry 30 percent for the Overall Result. Out of all weekly assignments, the best/top five scores will be considered for the final Internal Assessment marks.

* End-term Assessment-The final exam shall be conducted by NTA, and will carry 70 percent for the overall Result.

* All students who obtain 40% marks in the internal assessment and 40% marks in the end-term proctored exam separately will be eligible for the SWAYAM Credit Certificate.

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