1. Scheme and Syllabus

1. 2018 Scheme

CALCULUS AND LINEAR ALGEBRA

Semester	: I	CIE Marks	: 40
Course Code	: 18MAT11	SEE Marks	: 60
Teaching Hours/week (L:T:P)	: 3:2:0	Exam Hours	: 03
	Credits : 04		

Course Learning Objectives: This course Calculus and Linear Algebra **(18MAT11)** will enable students:

- To familiarize the important tools of calculus and differential equations that are essential in all branches of engineering.
- To develop the knowledge of matrices and linear algebra in a comprehensive manner.

MODULE-I

Differential Calculus-1: Review of elementary differential calculus, Polar curves - angle between the radius vector and tangent, angle between two curves, pedal equation. Curvature and radius of curvature- Cartesian and polar forms; Centre and circle of curvature (All without proof-formulae only) –applications to evolutes and involutes.

(RBT Levels: L1 & L2)

MODULE-II

Differential Calculus-2: Taylor's and Maclaurin's series expansions for one variable (statements only), indeterminate forms - L'Hospital's rule. Partial differentiation; Total derivatives-differentiation of composite functions. Maxima and minima for a function of two variables; Method of Lagrange multipliers with one subsidiary condition. Applications of maxima and minima with illustrative examples. Jacobians-simple problems.

(RBT Levels: L1 & L2)

MODULE-III

Integral Calculus: Review of elementary integral calculus.

Multiple integrals: Evaluation of double and triple integrals. Evaluation of double integrals- change of order of integration and changing into polar co-ordinates. Applications to find area volume and centre of gravity

Beta and Gamma functions: Definitions, Relation between beta and gamma functions and simple problems.

(RBT Levels: L1 & L2)

MODULE-IV

Ordinary differential equations (ODE's) of first order:

Exact and reducible to exact differential equations. Bernoulli's equation.

Applications of ODE's-orthogonal trajectories, Newton's law of cooling and L-R circuits. Nonlinear differential equations: Introduction to general and singular solutions ; Solvable for p only; Clairaut's and reducible to Clairaut's equations only. **(RBT Levels : L1, L2 & L3)**

MODULE-V

Linear Algebra: Rank of a matrix-echelon form. Solution of system of linear equations – consistency. Gauss-elimination method, Gauss –Jordan method and Approximate solution by Gauss-Seidel method. Eigen values and eigenvectors-Rayleigh's power method. Diagonalization of a square matrix of order two.
(RBT Levels : L1, L2 & L3)

Textbooks:

1. B.S. Grewal: Higher Engineering Mathematics, Khanna Publishers, 43rd Ed., 2015.
2. E. Kreyszig: Advanced Engineering Mathematics, John Wiley & Sons, 10th Ed.(Reprint), 2016.

Reference books:

1. C.Ray Wylie, Louis C.Barrett : "Advanced Engineering Mathematics", 6th Edition, 2. McGraw-Hill Book Co., New York, 1995.
2. James Stewart : "Calculus –Early Transcendentals", Cengage Learning India Private Ltd., 2017.
3. B.V.Ramana: "Higher Engineering Mathematics" 11th Edition, Tata McGraw-Hill, 2010.
4. Srimanta Pal & Subobh C Bhunia: "Engineering Mathematics", Oxford University Press, 3rd Reprint, 2016.
5. Gupta C.B., Singh S.R. and Mukesh Kumar: "Engineering Mathematics for Semester I & II", Mc-Graw Hill Education (India) Pvt.Ltd., 2015.

Web links and Video Lectures:

1. http://nptel.ac.in/courses.php?disciplineID=111
2. http://www.class-central.com/subject/math(MOOCs)
3. http://academicearth.org/
4. VTU EDUSAT PROGRAMME - 20

Course Outcomes: On completion of this course, students are able to:

CO1 : Apply the knowledge of calculus to solve problems related to polar curves and its applications in determining the bentness of a curve.

CO2 : Learn the notion of partial differentiation to calculate rates of change of multivariate functions and solve problems related to composite functions and Jacobians.

Advanced Calculus and Numerical Methods

(Common to all branches)

[As per Choice Based Credit System (CBCS) scheme]

(Effective from the academic year 2018-19)

Course Code : 18MAT21	**CIE Marks : 40**
Contact Hours/Week : 05(3L+2T)	**SEE Marks: 60**
Total Hours:50 (8L+2T per module)	**Exam Hours:03**
Semester : II	**Credits: 04 (3:2:0)**

Course Learning Objectives: This course viz., Advanced Calculus and Numerical Methods (**18MAT21**) aims to prepare the students:

- To familiarize the important tools of vector calculus, ordinary/partial differential equations and

power series required to analyse the engineering problems.

- To apply the knowledge of interpolation/extrapolation and numerical integration technique whenever

analytical methods fail or very complicated, to offer solutions.

MODULE-I

Vector Calculus:-

Vector Differentiation: Scalar and vector fields. Gradient, directional derivative; curl and divergence-physical interpretation; solenoidal and irrotational vector fields- Illustrative problems.

Vector Integration: Line integrals, Theorems of Green, Gauss and Stokes (without proof). Applications to work done by a force and flux. **(RBT Levels: L1 & L2)**

MODULE-II

Differential Equations of higher order:-Second order linear ODE's with constant coefficients- Inverse differential operators, method of variation of parameters; Cauchy's and Legendre homogeneous equations. Applications to oscillations of a spring and L-C-R circuits. **(RBT Levels: L1 ,L2 and L3)**

MODULE-III

Partial Differential Equations(PDE's):-

Formation of PDE's by elimination of arbitrary constants and functions. Solution of nonhomogeneous PDE by direct integration. Homogeneous PDEs involving derivative with respect to one independent variable only. Solution of Lagrange's linear PDE. Derivation of one dimensional heat and wave equations and solutions by the method of separation of variables. **(RBT Levels: L1, L2 & L3)**

MODULE-IV

Infinite Series: Series of positive terms- convergence and divergence. Cauchy's root test and D'Alembert's ratio test(without proof)- Illustrative examples.

Power Series solutions-Series solution of Bessel's differential equation leading to $J_n(x)$-Bessel's function of first kind-orthogonality. Series solution of Legendre's differential equation leading to $P_n(x)$-Legendre polynomials. Rodrigue's formula (without proof), problems. **(RBT Levels: L1 & L2)**

MODULE-V

Numerical Methods:

Finite differences. Interpolation/extrapolation using Newton's forward and backward difference formulae, Newton's divided difference and Lagrange's formulae (All formulae without proof). Solution of polynomial and transcendental equations – Newton-Raphson and Regula-Falsi methods(only formulae)- Illustrative examples.

Numerical integration: Simpson's (1/3)th and (3/8)th rules, Weddle's rule (without proof) – Problems.

(RBT Levels: L1, L2 & L3)

Text Books:

1. B.S. Grewal: Higher Engineering Mathematics, Khanna Publishers, 43rd Ed., 2015.
2. E. Kreyszig: Advanced Engineering Mathematics, John Wiley & Sons, 10th Ed.(Reprint), 2016.

Reference books:

3. C.Ray Wylie, Louis C.Barrett : "Advanced Engineering Mathematics", 6th Edition, 2. McGraw-Hill Book Co., New York, 1995.
4. James Stewart : "Calculus –Early Transcendentals", Cengage Learning India Private Ltd., 2017.
5. B.V.Ramana: "Higher Engineering Mathematics" 11th Edition, Tata McGraw-Hill, 2010.
6. Srimanta Pal & Subodh C. Bhunia: "Engineering Mathematics",Oxford University Press,3rd Reprint,2016.
7. Gupta C.B., Singh S.R. and Mukesh Kumar: "Engineering Mathematics for Semester I & II", Mc-Graw Hill Education (India) Pvt.Ltd., 2015.

Web links and Video Lectures:

1. http://nptel.ac.in/courses.php?disciplineID=111
2. http://www.class-central.com/subject/math(MOOCs)
3. http://academicearth.org/
4. VTU EDUSAT PROGRAMME – 20

Course Outcomes: On completion of this course, students are able to:

CO1: Illustrate the applications of multivariate calculus to understand the solenoidal and irrotational vectors and also exhibit the inter dependence of line, surface and volume integrals.

CO2: Demonstrate various physical models through higher order differential equations and solve such linear ordinary differential equations.

CO3: Construct a variety of partial differential equations and solution by exact methods/method of separation of variables.

CO4: Explain the applications of infinite series and obtain series solution of ordinary differential equations.

CO5: Apply the knowledge of numerical methods in the modeling of various physical and engineering phenomena.

Question Paper Pattern:

- **The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.**
- The question paper will have ten full questions carrying equal marks.
- Each full question carries 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

B.E.COMMONTO ALLPROGRAMMES Choice Based Credit System (CBCS) and Outcome Based Education (OBE)SEMESTER–III			
TRANSFORMCALCULUS,FOURIERSERIESANDNUMERICALTECHNIQUES			
CourseCode	**18MAT31**	CIEMarks	40
TeachingHours/Week(L:T:P)	(2:2:0)	SEEMarks	60
Credits	03	ExamHours	03
CourseLearningObjectives: • To have an insight into Fourier series, Fourier transforms, Laplacetransforms, Difference equationsandZ-transforms. • To develop the proficiency in variational calculus and solving ODE's arising in engineeringapplications,usingnumericalmethods.			
Module-1			
LaplaceTransform: DefinitionandLaplacetransformsofelementaryfunctions(statementsonly).Laplacetransforms ofPeriodicfunctions (statementonly) andunit-stepfunction – problems. **InverseLaplaceTransform**:Definitionandproblems,Convolutiontheoremtofindtheinverse Laplacetransforms(wit houtProof)andproblems.Solutionof lineardifferentialequationsusingLaplacetransforms.			
Module-2			
FourierSeries:Periodicfunctions,Dirichlet'scondition.Fourierseriesofperiodicfunctionsperiod2πandarbitraryperi od. HalfrangeFourierseries. Practical harmonic analysis.			
Module-3			
FourierTransforms: InfiniteFouriertransforms,Fouriersineandcosinetransforms.InverseFouriertransforms.Probl ems. **DifferenceEquationsandZ-Transforms:**Differenceequations,basicdefinition,z-transform-definition,Standard z-transforms, Damping and shifting rules, initial value and final value theorems (without proof) andproblems,Inverse z-transformandapplicationsto solvedifference equations.			
Module-4			
NumericalSolutionsofOrdinaryDifferentialEquations(ODE's): NumericalsolutionofODE'soffirstorderandfirstdegree-Taylor'sseriesmethod,ModifiedEuler'smethod. Runge-Kuttamethodoffourthorder,Milne'sandAdam-Bashforthpredictorandcorrectormethod(Noderivationsofformulae)-Problems.			
Module-5			

NumericalSolutionofSecondOrderODE's: Runge-KuttamethodandMilne'spredictorandcorrectormethod.(No derivationsofformulae).
CalculusofVariations: Variationoffunctionandfunctional,variationalproblems,Euler'sequation, Geodesics,hangingchain,problems.

Courseoutcomes: Attheendofthecoursethe studentwillbe ableto:

- CO1:UseLaplacetransformandinverseLaplacetransforminsolvingdifferential/integralequationarisinginn etworkanalysis,controlsystems andotherfields of engineering.
- CO2:DemonstrateFourierseriestostudythebehaviourofperiodicfunctionsandtheirapplicationsinsystemco mmunications, digitalsignalprocessingandfieldtheory.
- CO3:MakeuseofFouriertransformandZ-transformtoillustratediscrete/continuousfunctionarisinginwave and heatpropagation, signalsand systems.
- CO4:Solvefirstandsecondorderordinarydifferentialequationsarisinginengineeringproblemsusingsingles tep and multistep numericalmethods.
- CO5:Determinetheexternalsoffunctionalsusingcalculusofvariationsandsolveproblemsarisingindynamics ofrigidbodies andvibrationalanalysis.

Questionpaperpattern:

- Thequestionpaperwillhavetenfullquestionscarryingequalmarks.
- Eachfull questionwillbefor 20marks.
- Therewill betwofullquestions(withamaximumof four sub-questions)fromeachmodule.
- Eachfull questionwillhavesub-questioncoveringallthetopicsunder amodule.
- Thestudentswill havetoanswerfivefullquestions,selectingonefullquestionfromeachmodule.

Sl. No.	Titleof theBook	Name the of Author/s	Nameof thePublisher	Edition and Year
Textbooks				
1	Advanced Engineering Mathematics	E.Kreyszig	JohnWiley&Sons	10th Edition, 2016
2	HigherEngineeringMathematics	B.S. Grewal	KhannaPublishers	44th Edition, 2017
3	EngineeringMathematics	SrimantaPal etal	Oxford University Press	3rdEdition,2016
ReferenceBooks				
1	Advanced Engineering Mathematics	C. Ray Wylie, LouisC.Barrett	McGraw-Hill BookCo	6thEdition, 1995
2	Introductory Methods of NumericalAnalysis	S.S.Sastry	PrenticeHallofIndia	4thEdition 2010
3	HigherEngineeringMathematics	B.V.Ramana	McGraw-Hill	11thEdition,2010
4	A Textbook of Engineering Mathematics	N.P.Bali and ManishGoyal	LaxmiPublications	6thEdition, 2014
5	Advanced Engineering Mathematics	ChandrikaPrasad andReena Garg	KhannaPublishing,	2018

WeblinksandVideoLectures:

1. http://nptel.ac.in/courses.php?disciplineID=111
2. http://www.class-central.com/subject/math(MOOCs)
3. http://academicearth.org/
4. VTUEDUSATPROGRAMME–20

COMPLEXANALYSIS,PROBABILITYANDSTATISTICALMETHODS

(Effectivefromtheacademic year2018-2019)

SEMESTER–IV

SubjectCode	**18MAT41**	**CIEMarks**	40
NumberofContactHours/Week	2:2:0	**SEEMarks**	60
TotalNumberofContactHours	40	**ExamHours**	3 Hrs

CREDITS –3

CourseLearningObjectives: Thiscourse(18MAT41)willenablestudentsto:

- To provide an insight into applications of complex variables, conformal mapping and specialfunctionsarisinginpotentialtheory, quantummechanics,heatconductionandfieldtheory.
- Todevelopprobabilitydistributionofdiscrete,continuousrandomvariablesandjointprobabilitydistribution occurringindigitalsignalprocessing,designengineeringandmicrowaveengineering.

Module1

Calculus of complex functions: Review offunction of a complex variable, limits, continuity, anddifferentiability. Analytic functions: Cauchy-Riemann equations in cartesian and polar forms andconsequences.Constructionofanalytic functions :Milne-Thomsonmethod-Problems.

RBT:L1, L2

Module2

Conformal transformations: Introduction. Discussion of transformations:$w=z^2$,$w=e^z$, $w=z+\frac{1}{z},(z\neq 0)$.Bilineartransformations-Problems.

Complex integration: Line integral of a complex function-Cauchy's theorem and Cauchy's integralformulaandproblems.

RBT:L1, L2

Module3

Probability Distributions: Review of basic probability theory. Random variables (discrete andcontinuous),probabilitymass/densityfunctions.Binomial,Poisson,exponentialandnormaldistributions-problems(Noderivationformeanandstandarddeviation)-Illustrativeexamples.

RBT:L1,L2, L3

Module4

CurveFitting: Curvefittingbythemethodofleastsquares-fittingthecurvesoftheform-

$y=ax+b$,$y=ax^b$&$y=ax^2+bx+c$.

Statistical Methods: Correlation and regression-Karl Pearson's coefficient of correlation and rankcorrelation-problems.Regressionanalysis- lines ofregression–problems.

RBT:L1,L2, L3

Module5

Joint probability distribution: Joint Probability distribution for two discrete random variables,expectationandcovariance.

SamplingTheory: Introductiontosamplingdistributions,standarderror,Type-IandType-II errors. Test of hypothesis for means, student'st-distribution,Chi-squaredistributionasatestofgoodnessof fit.

RBT:L2,L3,L4

CourseOutcomes: Thestudentwillbeableto:

- Use the concepts of analytic function and complex potentials to solve the problems arisinginelectromagneticfieldtheory.
- Utilize conformal transformation and complex integral arising in aerofoil theory, fluid flowvisualizationandimageprocessing.
- Apply discrete and continuous probability distributions in analyzing the probability modelsarisinginengineeringfield.
- Make use of the correlation and regression analysis to fit a suitable mathematical model forthestatisticaldata.
- Constructjointprobabilitydistributionsanddemonstratethevalidityoftestingthehypothesis.

QuestionPaperPattern:

- Thequestionpaperwillhavetenquestions.
- EachfullQuestionconsistingof20marks
- Therewill be2 fullquestions(with a maximumof foursubquestions)fromeachmodule.
- Eachfull question willhavesubquestionscoveringallthe topicsunderamodule.
- Thestudentswillhavetoanswer5fullquestions,selectingonefullquestionfrom eachmodule.

Textbooks:

1. E.Kreyszig,AdvancedEngineeringMathematics,JohnWiley&Sons,10th Edition,2016
2. B.S.Grewal,Higher Engineering Mathematics, Khanna Publishers,44th Edition,2017
3. SrimantaPaletal,Engineering Mathematics,Oxford UniversityPress,3rd Edition,2016

ReferenceBooks:

1. C.Ray Wylie, Louis C.Barrett , Advanced Engineering Mathematics, McGraw-Hill Book Co, 6th Edition,1995
2. S.S.Sastry, Introductory Methods of Numerical Analysis, Prentice Hall of India, 4th Edition2010
3. B.V.Ramana,HigherEngineeringMathematics,McGraw-Hill,11th Edition,2010
4. N.P.Bali and Manish Goyal, A Text Book of Engineering Mathematics, Laxmi Publications, 6th Edition,2014

WeblinksandVideoLectures:

1. http://nptel.ac.in/courses.php?disciplineID=111
2. http://www.class-central.com/subject/math(MOOCs)
3. http://academicearth.org/
4. VTUEDUSATPROGRAMME–20

ADDITIONAL MATHEMATICS – I

(Mandatory Learning Course: Common to All Programs)
(A Bridge course for Lateral Entry students under Diploma quota to BE/B. Tech. programs)

CourseCode:18MATDIP31CIE **Marks:40**
SEEMarks:60
TeachingHours/Week(L:T:P):(2:1:0)Credits:0
Exam Hours:03

Course Learning Objectives:

•To provide basic concepts of complex trigonometry, vector algebra, differential and integral calculus.
•To provide an insight into vector differentiation and first order ODE's.

Module-1

Complex Trigonometry: Complex Numbers: Definitions and properties. Modulus and amplitude of a complex number, Argand's diagram, De-Moivre's theorem (without proof).
Vector Algebra: Scalar and vectors. Addition and subtraction and multiplication of vectors- Dot and Cross products, problems.

Module-2

Differential Calculus: Review of elementary differential calculus. Polar curves –angle between the radius vector and the tangent pedal equation- Problems. Maclaurin's series expansions, problems.
Partial Differentiation: Euler's theorem for homogeneous functions of two variables. Total derivatives - differentiation of composite function. Application to Jacobians of order two.

Download FullNotes Given Below

Module-3

Vector Differentiation: Differentiation of vector functions. Velocity and acceleration of a particle moving on a space curve. Scalar and vector point functions. Gradient, Divergence, Curl and Laplacian (Definitions only). Solenoidal and irrotational vector fields-Problems.

Download FullNotes Given Below

Module-4

Integral Calculus: Review of elementary integral calculus. Statement of reduction formulae for sin ,cos , sin × cos and evaluation of these with standard limits-Examples. Double and triple integrals, problems.

Module-5

Ordinary differential equations (ODE's): Introduction-solutions of first order and first-degree differential equations: Variable Separable methods, exact and linear differential equations of order one. Application to Newton's law of cooling.

Course Outcomes: At the end of the course the student will be able to:

•CO1: Apply concepts of complex numbers and vector algebra to analyze the problems arising in a related area.
CO2: Use derivatives and partial derivatives to calculate the rate of change of multivariate functions.
•CO3: Analyze position, velocity, and acceleration in two and three dimensions of vector-valued functions.
•CO4: Learn techniques of integration including the evaluation of double and triple integrals.

CO5: Identify and solve first-order ordinary differential equations.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.

Textbook

1Higher Engineering MathematicsB.S. GrewalKhanna Publishers43rd Edition, 2015

Reference Books

1Advanced Engineering MathematicsE. KreyszigJohn Wiley & Sons10th Edition, 2015
2Engineering Mathematics Vol.IRohitKhuranaCengage Learning2015

ADDITIONALMATHEMATICS–II

(MandatoryLearningCourse:CommontoAllBranches)

(A Bridge course for Lateral Entry students under Diploma quota to BE/B.Tech programmes)(Effectivefromthe academicyear 2018-2019)

SEMESTER–IV

SubjectCode	**18MATDIP41**	**CIEMarks**	40
NumberofContactHours/Week	2:1:0	**SEEMarks**	60
TotalNumberofContactHours	40	**ExamHours**	3 Hrs

CREDITS –0

CourseLearningObjectives: Thiscourse(18MATDIP41)willenablestudentsto:

- To provide essential concepts of linear algebra, second & higher order differential equationsalongwithmethodstosolvethem.
- Toprovideaninsightintoelementaryprobabilitytheoryandnumericalmethods.

Module1

Linear Algebra: Introduction - rank of matrix by elementary row operations - Echelon form.Consistency of system of linear equations - Gauss elimination method. Eigen values and eigenvectors of asquarematrix. Problems.

RBT:L2, L2

Module2

Numerical Methods: Finite differences. Interpolation/extrapolation using Newton's forward andbackwarddifferenceformulae(Statementsonly)-problems.Solutionofpolynomialandtranscendentalequations–Newton-RaphsonandRegula-Falsimethods(onlyformulae)-Illustrative examples. Numerical integration: Simpson's one third rule and Weddle's rule (withoutproof)Problems.

RBT:L1,L2, L3

Module3

HigherorderODE's: Lineardifferentialequationsofsecond andhigher orderequationswithconstantcoefficients.Homogeneous/non-homogeneousequations.Inversedifferentialoperators.*[ParticularIntegralrestrictedtoR(x)=*e^{ax},sin*ax*/cos*axf orf*$(D)_{y=R}(x)$.]

RBT:L1, L2

Module4

Partial Differential Equations(PDE's):- Formation of PDE's by elimination of arbitrary constantsandfunctions.Solutionofnon-homogeneousPDEbydirectintegration.HomogeneousPDEsinvolvingderivative withrespecttooneindependentvariableonly.

RBT:L1, L2

Module5

Probability: Introduction. Sample space and events. Axioms of probability. Addition &multiplicationtheorems.Conditionalprobability,Bayes's theorem,problems.

RBT:L1, L2

CourseOutcomes: Thestudentwillbeableto:

- Solvesystemsoflinearequationsusingmatrixalgebra.
- Apply theknowledgeofnumericalmethodsin modellingand solving engineeringproblems.
- Makeuseofanalyticalmethodstosolvehigherorderdifferentialequations.
- Classifypartialdifferentialequationsandsolvethembyexactmethods.
- Applyelementaryprobabilitytheoryandsolverelatedproblems.

QuestionPaperPattern:

- Thequestionpaperwillhavetenquestions.

- EachfullQuestionconsistingof20marks
- Therewill be2 fullquestions(with a maximumof foursubquestions)fromeachmodule.
- Eachfull question willhavesubquestionscoveringallthe topicsunderamodule.
- Thestudentswillhavetoanswer5fullquestions,selectingonefullquestionfrom eachmodule.

Textbooks:

1.B.S.Grewal,HigherEngineeringMathematics,KhannaPublishers,43rdEdition,2015

ReferenceBooks:

1. E.Kreyszig,AdvancedEngineeringMathematics,JohnWiley&Sons,10thEdition,2016
2. N.P.Bali and Manish Goyal, A Text Book of Engineering Mathematics, Laxmi Publications, 6thEdition,2014
3. RohitKhurana,EngineeringMathematicsVol.I, CengageLearning,1stEdition,2015.

2,2021 Scheme

I Semester

CALCULUS AND DIFFERENTIAL EQUATIONS			
Course Code	**21MAT11**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	2:2:0:1	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course objectives: The goal of the course Calculus and Differential Equations - 21MAT11 is

- To facilitate the students with a concrete foundation of differential calculus
- To solve the first and higher-order ordinary differential equations enabling them to acquire the knowledge of these mathematical tools.
- To develop the knowledge of matrices and linear algebra in a comprehensive manner.

Teaching-Learning Process (General Instructions):

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop student's theoretical and applied mathematical skills.
2. State the need for Mathematics with Engineering Studies and Provide real-life examples.
3. Support and guide the students for self–study.
4. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress.
5. Encourage the students for group learning to improve their creative and analytical skills.
6. Show short related video lectures in the following ways:
   - As an introduction to new topics (pre-lecture activity).
   - As a revision of topics (post-lecture activity).
   - As additional examples (post-lecture activity).
   - As an additional material of challenging topics (pre-and post-lecture activity).
   - As a model solution of some exercises (post-lecture activity).

Module-1: Differential Calculus - 1	
Polar curves, angle between the radius vector and the tangent, angle between two curves. Pedal equations. Curvature and Radius of curvature - Cartesian, Parametric, Polar and Pedal forms. Problems. **Self-study:** Centre and circle of curvature, evolutes and involutes. **(RBT Levels: L1, L2 and L3)**	
Teaching-Learning Process	Chalk and talk method / Power Point Presentation
Module-2: Differential Calculus - 2	

Taylor's and Maclaurin's series expansion for one variable (Statement only) – problems. Indeterminate forms-L'Hospital's rule. Partial differentiation, total derivative-differentiation of composite functions. Jacobian and problems. Maxima and minima for a function of two variables. Problems. **Self-study:** Euler's Theorem and problems. Method of Lagrange undetermined multipliers with single constraint. **(RBT Levels: L1, L2 and L3)**

Teaching-Learning Process	Chalk and talk method / Power Point Presentation

Module-3: Ordinary Differential Equations (ODE's) of first order	
Linear and Bernoulli's differential equations. Exact and reducible to exact differential equations. Applications of ODE's-Orthogonal trajectories, Newton's law of cooling. **Nonlinear differential equations:** Introduction to general and singular solutions; Solvable for p only; Clairaut's equations, reducible to Clairaut's equations. Problems. **Self-Study:** Applications of ODE's: L-R circuits. Solvable for x and y. **(RBT Levels: L1, L2 and L3)**	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation
Module-4: Ordinary Differential Equations of higher order	
Higher-order linear ODE's with constant coefficients - Inverse differential operator, method of variation of parameters, Cauchy's and Legendre homogeneous differential equations. Problems. **Self-Study:** Applications to oscillations of a spring and L-C-R circuits. **(RBT Levels: L1, L2 and L3)**	
Teaching Learning Process	Chalk and talk method / Power Point Presentation
Module-5: Linear Algebra	
Elementary row transformationofa matrix, Rank of a matrix. Consistency and Solution of system of linear equations; Gauss-elimination method, Gauss-Jordan method and Approximate solution by Gauss-Seidel method. Eigenvalues and Eigenvectors-Rayleigh's power method to find the dominant Eigenvalue and Eigenvector. **Self-Study**: Solution of system of equations by Gauss-Jacobi iterative method. Inverse of a square matrix by Cayley- Hamilton theorem**.** **(RBT Levels: L1, L2 and L3).**	
Teaching Learning Process	Chalk and talk method / Power Point Presentation

Course outcomes (Course Skills Set)

- After successfully completing the course, the student will be able to understand the topics.
- Apply the knowledge of calculus to solve problems related to polar curves and its applications in determining the bentness of a curve.
- Learn the notion of partial differentiation to calculate rate of change of multivariate functions and solve problems related to composite functions and Jacobian.
- Solve first-order linear/nonlinear ordinary differential equations analytically using standard methods.
- Demonstrate various models through higher order differential equations and solve such linear ordinary differential equations.
- Test the consistency of a system of linear equations and to solve them by direct and iterative methods.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together Continuous Internal Evaluation:

Three Unit Tests each of 20 Marks (duration 01 hour)

1. First test at the end of 5^{th} week of the semester
2. Second test at the end of the 10^{th} week of the semester
3. Third test at the end of the 15^{th} week of the semester

Two assignments each of 10 Marks

4. First assignment at the end of 4^{th} week of the semester
5. Second assignment at the end of 9^{th} week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for 20 Marks (duration 01 hours)

6. At the end of the 13^{th} week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be scaled down to 50 marks

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (duration 03 hours)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books

1. B. S. Grewal: "Higher Engineering Mathematics", Khanna publishers, 44th Ed.2018
2. E. Kreyszig: "Advanced Engineering Mathematics", John Wiley & Sons, 10th Ed. (Reprint), 2016.

Reference Books

1. V. Ramana: "Higher Engineering Mathematics" McGraw-Hill Education, 11th Ed.
2. Srimanta Pal & Subodh C. Bhunia: "Engineering Mathematics" Oxford University Press, 3rd Reprint, 2016.
3. N.P Bali and Manish Goyal: "A textbook of Engineering Mathematics" Laxmi Publications, Latest edition.
4. C. Ray Wylie, Louis C. Barrett: "Advanced Engineering Mathematics" McGraw – Hill Book Co.Newyork, Latest ed.
5. Gupta C.B, Sing S.R and Mukesh Kumar: "Engineering Mathematic for Semester I and II", Mc-Graw Hill Education(India) Pvt. Ltd 2015.
6. H.K.Dass and Er. Rajnish Verma: "Higher Engineering Mathematics" S.Chand Publication (2014).
7. James Stewart: "Calculus" Cengage publications, 7th edition, 4th Reprint 2019.

Web links and Video Lectures (e-Resources):

- http://.ac.in/courses.php?disciplineID=111
- http://www.class-central.com/subject/math(MOOCs)
- http://academicearth.org/
- VTU e-Shikshana Program
- VTU EDUSAT Program

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Quizzes
- Assignments
- Seminars

II Semester

ADVANCED CALCULUS AND NUMERICAL METHODS			
Course Code	**21MAT21**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	2:2:0:1	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course objectives: The goal of the course Advanced Calculus and Numerical Methods - 21MAT21 is,

- To facilitate the students with a concrete foundation of integral calculus.
- To facilitate the students with concrete foundation of vector calculus, partial differential equations and numerical methods enabling them to acquire the knowledge of these mathematical tools.

Teaching-Learning Process (General Instructions):

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different type of innovative teaching methods may be adopted so that the delivered lessons shall develop student's theoretical and applied mathematical skills.
2. State the need for Mathematics with Engineering Studies and Provide real-life examples
3. Support and guide the students for self-study.
4. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress
5. Encourage the students for group learning to improve their creative and analytical skills
6. Show short related video lectures in following ways:

- As an introduction to new topics (pre-lecture activity).
- As a revision of topics (post-lecture activity).
- As additional examples (post-lecture activity).
- As an additional material of challenging topics (pre and post lecture activity). ● As a model solution of some exercises (post-lecture activity)

Module-1: Integral Calculus

Multiple Integrals: Evaluation of double and triple integrals, evaluation of double integrals by change of order of integration, changing into polar coordinates. Applications to find: Area and Volume by double integral.Problems.

Beta and Gamma functions: Definitions, properties, relation between Beta and Gamma functions. Problems.

Self-Study: Center of gravity.

(RBT Levels: L1, L2 and L3)

Teaching-Learning Process	Chalk and talk method / Power Point Presentation

Module-2: Vector Calculus

Vector Differentiation: Scalar and vector fields. Gradient, directional derivative, curl and divergence - physical interpretation, solenoidal and irrotational vector fields. Problems. **Vector Integration:** Line integrals, Surface integrals. Applications to work done by a force and flux. Statement of Green's theorem and Stoke's theorem. Problems. **Self-Study**: Volume integral and Gauss divergence theorem**.** **(RBT Levels: L1, L2 and L3)**	
Teaching-Learning Process	Chalk and talk method / Power Point Presentation

Module-3: Partial Differential Equations (PDE's)	
Formation of PDE's by elimination of arbitrary constants and functions. Solution of nonhomogeneous PDE by direct integration. Homogeneous PDEs involving derivative with respect to one independent variable only. Solution of Lagrange's linear PDE. Derivation of one-dimensional heat equation and wave equation. **Self-Study**: Solution of one-dimensional heat equation and wave equation by the method of separation of variables. **(RBT Levels: L1, L2 and L3)**	
T eaching-Learning Process	Chalk and talk method / Power Point Presentation
Module-4: Numerical methods -1	
Solution of polynomial and transcendental equations: Regula-Falsi and Newton-Raphson methods (only formulae). Problems. Finite differences, Interpolation using Newton's forward and backward difference formulae, Newton's divided difference formula and Lagrange's interpolation formula (All formulae without proof). Problems. N**umerical integration**: Simpson's $(1/3)^{rd}$ and $(3/8)^{th}$ rules(without proof). Problems. S**elf-Study**: Bisection method, Lagrange's inverse Interpolation, Weddle's rule. **(RBT Levels: L1, L2 and L3)**	
Teaching-Learning Process	Chalk and talk method / Power Point Presentation
Module-5: Numerical methods -2	
Numerical Solution of Ordinary Differential Equations (ODE's): Numerical solution of ordinary differential equations of first order and first degree: Taylor's series method, Modified Euler's method, Runge-Kutta method of fourth order, Milne's predictor-corrector formula (No derivations of formulae). Problems. **Self-Study:** Adam-Bashforth method. **(RBT Levels: L1, L2 and L3)**	
Teaching-Learning Process	Chalk and talk method/Power Point Presentation

Course outcomes (Course Skills Set)

After successfully completing the course, the student will be able to understand the topics:

- Apply the concept of change of order of integration and change of variables to evaluate multiple integrals and their usage in computing the area and volume.
- Illustrate the applications of multivariate calculus to understand the solenoidal and irrotational vectors and also exhibit the inter dependence of line, surface and volume integrals.
- Formulate physical problems to partial differential equations and to obtain solution for standard practical PDE's.
- Apply the knowledge of numerical methods in modelling of various physical and engineering phenomena.
- Solve first order ordinary differential equations arising in engineering problems.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE).

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books

1. **B.S. Grewal**: "Higher Engineering Mathematics", Khanna publishers, 44 th Ed.2018
2. **E. Kreyszig**: "Advanced Engineering Mathematics", John Wiley & Sons, 10th Ed.(Reprint), 2016.

Reference Books:

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3. **N.P Bali and Manish Goyal**: "A text book of Engineering Mathematics" Laxmi Publications, Latest edition
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5. **Gupta C.**B, **Sing S.R and Mukesh kumar**: "Engineering Mathematics for Semester I and II", Mc-Graw Hill Education(India) Pvt.Ltd. 2015
6. **H.**K.**Dass and Er. Rajnish Verma:** "Higher Engineering Mathematics" S. Chand Publication (2014).
7. **James Stewart: "**Calculus" Cengage publications, 7th edition, 4th Reprint 2019.

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- http://.ac.in/courses.php?disciplineID=111
- http://www.class-central.com/subject/math(MOOCs)
- http://academicearth.org/
- VTU e-Shikshana Program
- VTU EDUSAT Program

Activity Based Learning (Suggested Activities in Class) / Practical Based learning

- Quizzes
- Assignments
- Seminars

B. E.(Common to all branches)

Choice Based Credit System (CBCS) and Outcome-Based Education (OBE)

SEMESTER - III

TRANSFORM CALCULUS, FOURIER SERIES AND NUMERICAL TECHNIQUES			
Course Code	**21MAT 31**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	2:2:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course objectives: The goal of the course Transform Calculus, Fourier series and Numerical techniques 21MAT 31 is

- To have an insight into solving ordinary differential equations by using Laplace transform techniques
- Learn to use the Fourier series to represent periodical physical phenomena in engineering analysis.
- To enable the students to study Fourier Transforms and concepts of infinite Fourier Sine and Cosine transforms and to learn the method of solving difference equations by the ztransform method.
- To develop proficiency in solving ordinary and partial differential equations arising in engineering applications, using numerical methods

Module-1: Laplace Transform

Definition and Laplace transforms of elementary functions (statements only). Problems on Laplace'sTransform of $f(t)$, $t^n f(t)$, $f(t)/t$ Laplace transforms of Periodic functions (statement only) and unit-step function – problems.

Inverse Laplace transforms definition and problems, Convolution theorem to find the inverse Laplace transforms (without Proof) problems.Laplace transforms of derivatives, solution ofdifferential equations.**(8 Hours)**

Self-study: Solution of simultaneous first-order differential equations.

(RBT Levels: L1, L2 and L3)

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2: Fourier Series

Introduction toinfinite series, convergence and divergence. Periodic functions, Dirichlet's condition. Fourier series of periodic functions with period 2π and arbitrary period. Half range Fourier series. Practical harmonic analysis.**(8 Hours)**

Self-study: Convergence of series by D'Alembert's Ratio test and, Cauchy'sroot test.

(RBT Levels: L1, L2 and L3)

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-3: Infinite Fourier Transforms and Z-Transforms

Infinite Fourier transforms definition, Fourier sine and cosine transforms. Inverse Fourier transforms, Inverse Fourier cosine and sine transforms. Problems. Difference equations, z-transform-definition, Standard z-transforms, Damping and shifting rules, Problems. Inverse z-transform and applications to solve difference equations.**(8 Hours)Self Study**: Initial value and final value theorems, problems. **(RBT Levels: L1, L2 and L3)**	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-4: Numerical Solution of Partial Differential Equations	
Classifications of second-order partial differential equations, finite difference approximations to derivatives, Solution of Laplace's equationusing standard five-point formula. Solution of heat equation by Schmidt explicit formula and Crank- Nicholson method, Solution of the Wave equation. Problems. **(8 Hours)** **Self Study**: Solution of Poisson equations using standard five-point formula. **(RBT Levels: L1, L2 and L3)**	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation
Module-5: Numerical Solution of Second-Order ODEs and Calculus of Variations	
Second-order differential equations - Runge-Kutta method and Milne's predictor and corrector method. (No derivations of formulae). Calculus of Variations:Functionals, Euler's equation, Problems on extremals of functional. Geodesics on a plane,Variationalproblems.**(8 Hours)** **Self Study:** Hanging chain problem **(RBT Levels: L1, L2 and L3)**	
Course outcomes: After successfully completing the course, the students will beable : ➢ To solve ordinary differential equations using Laplace transform. ➢ Demonstrate the Fourier series to study the behaviour of periodic functions and their applications in system communications, digital signal processing and field theory. ➢ To use Fourier transforms to analyze problems involving continuous-time signals and to apply Z-Transform techniques to solve difference equations ➢ To solve mathematical models represented by initial or boundary value problems involving partial differential equations ➢ Determine the extremals of functionals using calculus of variations and solve problems arising in dynamics of rigid bodies and vibrational analysis.	

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks (duration 01 hour**)
2. First test at the end of 5th week of the semester
3. Second test at the end of the 10th week of the semester
4. Third test at the end of the 15th week of the semester

Two assignments each of 10 Marks

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

1.At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

- The question paper will be set for 100 marks and marks scored will be proportionally scaled down to 50 marks
- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
- The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books:

1. **B.S.Grewal**:"HigherEngineeringMathematics",Khannapublishers,44thEd.2018
2. **E.Kreyszig**:"AdvancedEngineeringMathematics",JohnWiley&Sons,10thEd.(Reprint),2016.

Reference Books

3. **V.Ramana:**"HigherEngineeringMathematics"McGraw-HillEducation,11thEd.
4. **SrimantaPal&SubodhC.Bhunia:**"EngineeringMathematics"OxfordUniversityPress,3rdReprint, 2016.
5. **N.P Bali and Manish Goyal**: "A textbook of Engineering Mathematics" Laxmi Publications, Latest edition.
6. **C. Ray Wylie, Louis C. Barrett:** "Advanced Engineering Mathematics" McGraw – Hill Book Co.Newyork, Latested.
7. **Gupta C.B, Sing S.R and Mukesh Kumar:** "Engineering Mathematic for Semester I and II", Mc-Graw Hill Education(India) Pvt. Ltd2015.
8. **H.K.DassandEr.RajnishVerma:**"HigherEngineeringMathematics"S.ChandPublication(2014).
9. **JamesStewart:"**Calculus"Cengagepublications,7thedition,4thReprint2019.

Web links and Video Lectures (e-Resources):

- http://.ac.in/courses.php?disciplineID=111
- http://www.class-central.com/subject/math(MOOCs) http://academicearth.org/
- http://www.bookstreet.in.
- VTU e-ShikshanaProgram
- VTU EDUSATProgram

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning.

- Quizzes
- Assignments
- Seminars

B.E MATHS SYLLABUS (Except CS, ME and allied branches)
Choice Based Credit System (CBCS) and Outcome-Based Education (OBE)
(Effective from the academic year 2022-2023)
SEMESTER – IV

COMPLEX ANALYSIS, PROBABILITY AND STATISTICAL METHODS

Course Code	**21MAT41**	**CIE Marks**	**50**
Teaching Hours/Week (L: T:P)		**SEE Marks**	**50**
Total Number of Contact Hours	**40**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**3**

Course Objectives: This course(21MAT41) will enable students to:

1. Provide insight into applications of complex variables, conformal mapping arising in potential theory, quantum mechanics, heat conduction and field theory.
2. Special functions familiarize the Power series solution required to analyse the Engineering Problems.
3. To have insight into Statistical methods, Correlation and regression analysis.
4. To develop probability distribution of discrete and continuous random variables, Joint probability distribution occurs in digital signal processing, design engineering and microwave engineering.

Teaching-Learning Process (General Instructions):

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied mathematical skills.
2. State the need for Mathematics with Engineering Studies and Provide real-life examples.
3. Support and guide the students for self—study.
4. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress.
5. Encourage the students for group learning to improve their creative and analytical skills.
6. Show short related video lectures in the following ways:
   - As an introduction to new topics (pre-lecture activity).
   - As a revision of topics (post-lectureactivity).
   - As additional examples (post-lecture activity).
   - As an additional material ofchallenging topics (pre-and post-lecture activity).
   - As a model solution for some exercises ost-lecture active

Module — 1

Complex Analysis: Review of a function of a complex variable, limits, continuity and differentiability. Analytic functions: Cauchy-Riemann equations in cartesian and polar forms and consequences. Construction of analytic functions by Milne-Thomson method, Problems. Complex integration: Line integral of a complex function, Cauchy's theorem and Cauchy's integral formula and problems. (8 Hours) Self-Study: Conformal transformations: Discussion of transformations: $w = z^2$, $w\ e^z$, $w = z + 1/z$ ($z \neq 0$). Bilinear transformations- Problems.

(RBT Levels: Ll, L2 and L3)	
Pedagogy	Chalk and Board, Problem based learning
Module – 2	
Special functions: Series solution of Bessel's differential equation leading to Jn(x) Bessel's function of the first kind, Properties, Orthogonality of Bessel's functions. Series solution of Legendre's differential equation leading to Pn(x)-Legendre polynomials. Rodrigue's formula (without proof), problems. (8 Hours) Self Study: Recurrence Relations. (RBT Levels: Ll, L2 and L3)	
Pedagogy	Chalk and Board, Problem based learning
Module – 3	
Statistical Methods: Correlation and regression-Karl Pearson's coefficient of correlation and rank correlation, problems. Regression analysis, lines of regression, problems. Curve Fitting: Curve fitting by the method of least squares, fitting the curves of the forms $y = ax + b$, $y = ax^b$ and $y = ax^2 + bx + c$. (8 Hours) Self-study: Angle between two regression lines, problems. (RBT Levels: Ll, L2 and L3)	
Pedagogy	Chalk and Board, Problem based learning
Module – 4	
Probability Distributions: Review of basic probability theory. Random variables (discrete and continuous), probability mass and density functions. Mathematical expectation, mean and variance. Binomial, Poisson and normal distributions- problems (derivations for mean and standard deviation for Binomial and Poisson distributions only)-lllustrative examples. (8 Hours) Self-study: Exponential distribution. (RBT Levels: Ll, L2 and L3)	
Pedagogy	Chalk and Board, Problem based learning
Module – 5	
Joint probability distribution: Joint Probability distribution for two discrete random variables, expectation, covariance and correlation. Sampling Theory: Introduction to sampling distributions, standard error, Type-I and TypeIl errors. Test of hypothesis for means, student's t-distribution, Chi-square distribution as a test of goodness of fit. (8 Hours) Self-Study: Point estimation and interval estimation. (RBT Levels: Ll, L2 and L3)	

Pedagogy	Chalk and Board, Problem based learning
Course Outcomes	

Course Outcomes: At the end of the courses, the students will be able to:

1. Use the concepts of an analytic function and complex potentials to solve the problems arising in electromagnetic field theory. Utilize conformal transformation and complex integral arising in aerofoil theory, fluid flow visualization and image processing.
2. Obtain Series Solutions of Ordinary Differential Equation.
3. Make use of the correlation and regression analysis to fit a suitable mathematical model for the statistical data.
4. Apply discrete and continuous probability distributions in analysing the probability models arising in the engineering field.
5. Construct joint probability distributions and demonstrate the validity of testing the hypothesis.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE).

Continuous Internal Evaluation:

Three Unit Tests each of 20 Marks (duration 01 hour)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of 10 Marks

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for 20 Marks (duration 01 hours)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be scaled down to 50 marks

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course). CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (duration 03 hours)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module.

The students have to answer 5 full questions, selecting one full question from each module.

Textbooks:

1. Higher Engineering Mathematics, B. S. Grewal Khanna Publishers 44th Edition, 2017.
2. Advanced Engineering Mathematics, E. Kreyszig: John Wiley & Sons, 10th Ed. (Reprint), 2016.

References:

1. Advanced Engineering Mathematics C. Ray Wylie, Louis C.Barrett McGraw-Hill 6th Edition 1995.
2. Higher Engineering Mathematics B. V. Ramana McGraw-Hill 11th Edition,2010.
3. A Text-Book of Engineering Mathematics N. P. Bali and Manish Goyal Laxmi Publications 2014.
4. Advanced Engineering Mathematics Chandrika Prasad and Reena Garg Khanna Publishing, 2018.

Web links and Video Lectures (e-Resources):

http://nptel.ac.in/courses.php?disciplinelD=11

1 http://www.class-

central.com/subiect/math(MOOCs)

http://academicearth.org/

http://www.bookstreet.in.

VTU EDUSAT PROGRAMME - 20
VTU e-Shikshana Program

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

Quizzes
Assignments
Seminars

B.E COMPUTER SCIENCE AND ALLIED ENGINEERING BRANCHES

Choice Based Credit System (CBCS) and Outcome-Based Education (OBE)

(Effective from the academic year 2022-2023)

SEMESTER – IV

Mathematical Foundations for Computing, Probability & Statistics			
Course Code	**21MATCS41**	CIE Marks	50
Teaching Hours/Week (L: T:P)	2:2:0	SEE Marks	50
Total Number of Contact Hours	40	Total Marks	100
Credits	03	Exam Hours	3

Course Objectives:

This course(21MATCS41) will enable students to:

1. Understand an intense foundational introduction to fundamental concepts in discrete mathematics.
2. Interpret, identify, and solve the language associated with logical structure, sets, relations and functions, modular arithmetic.
3. To have insight into Statistical methods, Correlation and regression analysis. Fitting of curves.
4. To develop probability distribution of discrete and continuous random variables. Joint probability distribution occurs in digital signal processing, design engineering and microwave engineering.

Teaching-Learning Process (General Instructions):

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied mathematical skills.
2. State the need for Mathematics with Engineering Studies and Provide real-life examples.
3. Support and guide the students for self–study.
4. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress.
5. Encourage the students for group learning to improve their creative and analytical skills.
6. Show short related video lectures in the following ways:
   - As an introduction to new topics (pre-lecture activity).
   - As a revision of topics (post-lecture activity).
   - As additional examples (post-lecture activity).
   - As an additional material of challenging topics (pre-and post-lecture activity).

   As a model solution for some exercises (post-lecture activity).

Module – 1	
Fundamentals of Logic: Basic connectives and truth tables, Logical equivalence – The laws of Logic, Logical implication – Rules of Inference. Fundamentals of Logic contd.: The Use of Quantifiers, Quantifiers, Definitions, and the Proofs of Theorems. **(8 Hours)** **Self-study:** Problems on Logical equivalence. **(RBT Levels: L1, L2 and L3)**	
Pedagogy	Chalk and Board, Problem based learning
Module – 2	
Relations and Functions: Cartesian Products and Relations, Functions – Plain and One-to-One, Onto Functions. Function Composition, and Inverse Functions. **Relations:** Properties of Relations, Computer Recognition – Zero-One Matrices and Directed Graphs, Partial Orders – Hasse Diagrams, Equivalence Relations and Partitions. **Introduction to Graph Theory:** Definitions and Examples, Subgraphs, Complements, and Graph Isomorphism, Vertex Degree, Euler Trails and Circuits. **(8 Hours)** **Self-study:** The Pigeon-hole Principle, problems and its applications **(RBT Levels: L1, L2 and L3)**	
Pedagogy	Chalk and Board, Problem based learning
Module – 3	
Statistical Methods: Correlation and regression-Karl Pearson's coefficient of correlation and rank correlation-problems. Regression analysis- lines of regression –problems. **Curve Fitting:** Curve fitting by the method of least squares- fitting the curves of the form- $y = ax + b$, $y = ax^b$ *and* $y = ax^2 + bx + c$ **(8 Hours)** **Self-study:** Angle between two regression lines, problems. Fitting of the curve $y = ab^x$ **(RBT Levels: L1, L2 and L3)**	
Pedagogy	Chalk and Board, Problem based learning
Module – 4	
Probability Distributions: Review of basic probability theory. Random variables (discrete and continuous), probability mass and density functions. Mathematical expectation, mean and variance. Binomial, Poisson and normal distributions- problems (derivations for mean and standard deviation for Binomial and Poisson distributions only)-Illustrative examples. **Self-study:** exponential distribution. **(8 Hours)** **(RBT Levels: L1, L2 and L3)**	
Pedagogy	Chalk and Board, Problem based learning
Module – 5	
Joint probability distribution: Joint Probability distribution for two discrete random variables, expectation, covariance and correlation. **Sampling Theory**: Introduction to sampling distributions, standard error, Type-I and Type-II errors. Test of hypothesis for means, student's t-distribution, Chi-square distribution as a test of goodness of fit. **(8 Hours)** **Self-Study:** Point estimation and interval estimation. **(RBT Levels: L1, L2 and L3)**	
Pedagogy	Chalk and Board, Problem based learning

Course Outcomes

Course Outcomes: At the end of the courses, the students will be able to:

1. Apply the concepts of logic for effective computation and relating problems in the Engineering domain.
2. Analyse the concepts of functions and relations to various fields of Engineering. Comprehend the concepts of Graph Theory for various applications of Computational sciences.
3. Apply discrete and continuous probability distributions in analysing the probability models arising in the engineering field.
4. Make use of the correlation and regression analysis to fit a suitable mathematical model for the statistical data.
5. Construct joint probability distributions and demonstrate the validity of testing the hypothesis.

ASSESSMENT PATTERN (BOTH CIE AND SEE)

The weightage of Continuous Internal Evaluation (CIE) is 100%. The minimum passing mark for the CIE is 40% of the maximum marks (400 marks out of 100). A student shall be deemed to have satisfied the academic requirements if the student secures not less than 40% (40 Marks out of 100)in the CIE.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of the 4th week of the semester
5. Second assignment at the end of the 9th week of the semester

Course Seminar suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

Or

Learning MATHS tools and solving a few problems from each module using MATHS tools (e.g. MATLAB, SciLab etc)

6. Conducting at least 05 labs sessions within the Academic Duration.

The sum of three tests, two assignments, and a seminar/Lab sessions using MATHS tools will be out of 100 marks.

The student shall secure minimum 40% of marks of course to qualify and become eligible for award of degree.

Textbooks:

1. Ralph P. Grimaldi and B V Ramana, Discrete and Combinatorial Mathematics- An Applied Introduction, Pearson Education, Asia, Fifth edition – 2007. ISBN 978-81-7758-424-0.
2. Higher Engineering Mathematics B. S. Grewal Khanna Publishers 44th Edition, 2017

References:

3. Kenneth H. Rosen, Discrete Mathematics and its Applications, Tata – McGraw Hill, Sixth Edition, Sixth reprint 2008. ISBN-(13):978-0-07-064824-1.
4. C. L. Liu and D P Mohapatra, Elementary Discrete Mathematics, Tata- McGraw Hill, Sixth Edition, ISBN:10:0-07-066913-9.
5. J.P. Tremblay and R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, Tata – McGraw Hill, 35TH reprint 2008. ISBN 13:978-0-07-463113-3.
6. Advanced Engineering Mathematics C. Ray Wylie, Louis C.Barrett McGraw-Hill 6th Edition 1995
7. Higher Engineering Mathematics B. V. Ramana McGraw-Hill 11th Edition,2010
8. A Text-Book of Engineering Mathematics N. P. Bali and Manish Goyal Laxmi Publications 2014
9. Advanced Engineering Mathematics Chandrika Prasad and Reena Garg Khanna Publishing, 2018

List of NPTEL videos for various topics of Discrete Mathematical Structures

https://www.youtube.com/watch?v=9AUCdsmBGmA&list=PL0862D1A947252D20&index=10

https://www.youtube.com/watch?v=oU60TuGHxe0&list=PL0862D1A947252D20&index=11

https://www.youtube.com/watch?v=_BIKq9Xo_5A&list=PL0862D1A947252D20&index=13

https://www.youtube.com/watch?v=RMLR2JHHeWo&list=PL0862D1A947252D20&index=14

https://www.youtube.com/watch?v=nf9e0_ylGdc&list=PL0862D1A947252D20&index=15

https://www.youtube.com/watch?v=7cTWea9YAJE&list=PL0862D1A947252D20&index=24

https://www.youtube.com/watch?v=695iAm935cY&list=PL0862D1A947252D20&index=25

https://www.youtube.com/watch?v=ZECJHfsf4Vs&list=PL0862D1A947252D20&index=26

https://www.youtube.com/watch?v=Dsi7x-A89Mw&list=PL0862D1A947252D20&index=28

https://www.youtube.com/watch?v=xlUFkMKSB3Y&list=PL0862D1A947252D20

https://www.youtube.com/watch?v=0uTE24o3q-o&list=PL0862D1A947252D20&index=2

https://www.youtube.com/watch?v=DmCltf8ypks&list=PL0862D1A947252D20&index=3

https://www.youtube.com/watch?v=jNeISigUCo0&list=PL0862D1A947252D20&index=4

B. E. (Mechanical Engineering & Allied branches)
Choice Based Credit System (CBCS) and Outcome-Based Education (OBE)
SEMESTER - IV

Complex Analysis, Probability and Linear Programming

Course Code	**21MATME41**	CIE Marks	50
Teaching Hours/Week (L: T:P)	(2:2:0)	SEE Marks	50
Credits	03	Exam Hours	03

Course Learning Objectives:

- To provide an insight into applications of complex variables and conformal mapping arising in potential theory, quantum mechanics, heat conduction and field theory.
- To develop probability distribution of discrete, continuous random variables and joint probability distribution occurring in digital signal processing, design engineering and microwave engineering.
- Analyze and solve linear programming models of real-life situations and learn about the applications to transportation and assignment problems.

Teaching-Learning Process (General Instructions):

These are sample Strategies; which teachers can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied mathematical skills.
2. State the need for Mathematics with Engineering Studies and Provide real-life examples.
3. Support and guide the students for self–study.
4. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress.
5. Encourage the students for group learning to improve their creative and analytical skills.

Show short related video lectures in the following ways

- As an introduction to new topics (pre-lecture activity).
- As a revision of topics (post-lecture activity).
- As additional examples (post-lecture activity).
- As an additional material of challenging topics (pre-and post-lecture activity).

As a model solution for some exercises (post-lecture activity).

Module-1

Calculus of complex functions: Analytic functions: Cauchy-Riemann equations in Cartesian and polar forms and consequences. Applications to flow problems

Construction of analytic functions: Milne-Thomson method-Problems. **(8 hours)**

Self-Study: Review of a function of a complex variable, limits, continuity, and differentiability.

(RBT Levels: L1, L2 and L3)

Pedagogy: Chalk and talk method and Powerpoint Presentations

Module-2
Conformal transformations: Introduction. Discussion of transformations $w = z^2$, $w = e^z$, $w = z + \frac{1}{z}$, $(z \neq 0)$. Bilinear transformations- Problems. **Complex integration:** Line integral of a complex function-Cauchy's theorem and Cauchy's integral formula and problems. **(8 hours)** **Self-Study:** Residues, Residue theorem – problems **(RBT Levels: L1, L2 and L3)**
Pedagogy: Chalk and talk method and Powerpoint Presentations
Module-3
Probability Distributions: Review of basic probability theory. Random variables (discrete and continuous), probability mass/density functions. Mean-Variance and Standard Deviations of a random variable. Binomial, Poisson, exponential and normal distributions- problems. **(8 hours)** **Self-Study:** Two-dimensional random variables, marginals pdf's, Independent random variables **(RBT Levels: L1, L2 and L3)**
Pedagogy: Chalk and talk method and Powerpoint Presentations
Module-4
Linear Programming Problems (L.P.P): General Linear programming Problem, Canonical and standard forms of L.P.P. Basic solution, Basic feasible solution, Optimal solution, Simplex Method-Problems. Artificial variables, Big-M method, Two-Phase method-Problems. **(8 hours)** **Self-Study:** Formulation of an L.P.P and optimal solution by Graphical Method. **(RBT Levels: L1, L2 and L3)**
Pedagogy: Chalk and talk method and Powerpoint Presentations
Module-5
Transportation and Assignment Problems: Formulation of transportation problems, Methods of finding initial basic feasible solutions by North-West corner method, Least cost method, Vogel approximation method. Optimal solutions-Problems. Formulation of assignment problems, Hungarian method-Problems. **(8 hours)** **Self-Study**: Degeneracy in Transportation problem. **(RBT Levels: L1, L2 and L3)**
Pedagogy: Chalk and talk method and Powerpoint Presentations
Course outcomes: At the end of the course the student will be able to: • Use the concepts of an analytic function and complex potentials to solve the problems arising in fluid flow. • Utilize conformal transformation and complex integral arising in aerofoil theory, fluid flow visualization and image processing. • Apply discrete and continuous probability distributions in analyzing the probability models arising in the engineering field. • Analyze and solve linear programming models of real-life situations and solve LPP by the simplex method • Learn techniques to solve Transportation and Assignment problems.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE).

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

- The students have to answer 5 full questions, selecting one full question from each module.

Suggested Learning Resources:

Text Books:

1. B. S. Grewal: "Higher Engineering Mathematics", Khanna publishers, 44th Ed.2018
2. E. Kreyszig: "Advanced Engineering Mathematics", John Wiley & Sons,10th Ed. (Reprint),2016.
3. S.D. Sharma: "Operations Research" Kedarnath Publishers Ed. 2012

Reference Books

1. V. Ramana: "*Higher Engineering Mathematics*" McGraw-Hill Education,11th Ed.
2. Mokhtar S.Bazaraa, John J.Jarvis & Hanif D.Sherali(2010*), Linear Programming and Network Flows(* 4th E*dition), John Wiley & sons.*
3. G.Hadley (2002) *Linear Programming, Narosa Publishing House*
4. F.S. Hillier. G.J. Lieberman: Introduction to Operations Research- Concepts and Cases, 9th Edition, Tata Mc-Graw Hill, 2010.
5. Srimanta Pal & Subodh C. Bhunia: "Engineering Mathematics" Oxford University Press,3rdReprint, 2016.
6. N.P Bali and Manish Goyal: "A textbook of Engineering Mathematics" Laxmi Publications, Latest edition.
7. C. Ray Wylie, Louis C. Barrett: "Advanced Engineering Mathematics" McGraw – Hill Book

Additional Mathematics-I
(Mandatory Learning Course: Common to all Programme)
A bridge course for Lateral Entry Students under Diploma quota to BE/B.Tech. programme

Course Code	**21MATDIP31**	CIE Marks	100
Teaching Hours/Week (L:T:P: S)	3:0:0		--
Total Hours of Pedagogy	40 hours		100
Credits	00		

Course objectives:

The mandatory learning course **21MATDIP31** viz., **Additional Mathematics-I** aims to provide basic concepts of complex numbers, vector algebra, differential & integral calculus, vector differentiation and methods of solving first-order differential equations.

Teaching-Learning Process (General Instructions)

These are sample Strategies; which teachers can use to accelerate the attainment of the various course outcomes.

- The lecture method (L) need not be only the traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
- Use of Video/Animation to explain the functioning of various concepts.
- Encourage collaborative (Group Learning) Learning in the class.
- Ask at least three HOT (Higher-order Thinking) questions in the class, which promotes critical thinking.
- Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develops design thinking skills such as the ability to design, evaluate, generalize, and analyse information rather than simply recall it.
- Show the different ways to solve the same problem and encourage the students to come up with creative ways to solve them.
- Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Differential Calculus: Successive differentiation-problems. Taylor's & Maclaurin's series expansions-problems. Partial Differentiation: Euler's theorem (without Proof)-problems on first order derivatives only. Total derivatives-differentiation of composite functions. Jacobians of order two-Problems.

(RBT Levels: L1, L2 and L3) **8 Hours**

Pedagogy	Chalk and talk method/PowerPoint Presentation.

Module-2

Complex Numbers: Definitions and properties. Modulus and amplitude of a complex number, Argand's diagram, De-Moivre's theorem (without proof), Problems.

Vector Algebra: Scalar and vectors. Addition, subtraction and multiplication of vectors- Dot and Cross products, problems. Scalar triple product, Problems. **8 Hours**

(RBT Levels: L1, L2 and L3)

Pedagogy	Chalk and talk method/PowerPoint Presentation.

Module-3

Vector Differentiation: Differentiation of vector functions. Velocity and acceleration of a particle moving on a space curve. Scalar and vector point functions. Gradient, Divergence, Curl-simple problems. Solenoidal and irrotational vector fields-Problems. **8 Hours** **(RBT Levels: L1, L2 and L3)**	
Pedagogy	Chalk and talk method/PowerPoint Presentation.

Module-4	
Integral Calculus: Review of elementary integral calculus. Reduction formulae for $\sin^n$,$\cos^n x$, $\sin^n x \cos^n x$ (without proof) and evaluation of these with standard limits-problems. Double and triple integrals-Simple problems. **8 Hours** **(RBT Levels: L1, L2 and L3)**	
Pedagogy	Chalk and talk method/PowerPoint Presentation.
Module-5	
Ordinary Differential Equations (ODEs): Introduction-solutions of first order and first-degree differential equations: Variable separable method, Homogeneous differential equations, linear differential equations. Exact differential equations. **8 Hours** **(RBT Levels: L1 L2 and L3)**	
Pedagogy	Chalk and talk method/PowerPoint Presentation.

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

- CO1: Use derivatives and partial derivatives to calculate the rate of change of multivariate functions.
- CO2: Apply concepts of complex numbers and vector algebra to analyse the problems arising in a related area.
- CO3: Analyse position, velocity and acceleration in two and three dimensions of vector-valued functions.
- CO4: Learn techniques of integration including the evaluation of double and triple integrals.
- CO5: Identify and solve first-order ordinary differential equations.

Assessment Details (CIE)

The weightage of Continuous Internal Evaluation (CIE) is 100%. The minimum passing mark for the CIE is 40% of the maximum marks(100). A student shall be deemed to have satisfied the academic requirements if the student secures not less than 40% (40 Marks out of 100) in the CIE.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. The first test at the end of 5th week of the semester
2. The second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester Two assignments each of **10 Marks**
4. First assignment at the end of the 4th week of the semester
5. Second assignment at the end of the 9th week of the semester

Course Seminar suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**).
The sum of three tests, two assignments, and a seminar will be out of 100 marks
The student shall secure a minimum of 40% of marks of the course to qualify and become eligible for the award of a degree.

Suggested Learning Resources:

Books

1. Higher Engineering Mathematics, B. S. Grewal, Khanna Publishers, 43rd Edition, 2015.
2. Advanced Engineering Mathematics, E. Kreyszig John, Wiley & Sons, 10th Edition, 2015.
3. Engineering Mathematics, N. P. Bali and Manish Goyal, Laxmi Publishers, 7th Edition, 2007.
4. Higher Engineering Mathematics, H. K. Das and Er. Rajnish Verma, S. Chand & Company PVT.LTD, Third Revised Edition 2014.

Web links and Video Lectures (e-Resources):

- http://.ac.in/courses.php?disciplineID=111
- http://www.class-central.com/subject/math(MOOCs)
- http://academicearth.org/
- VTU EDUSAT PROGRAMME-20

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Quiz
- Group assignment
- Seminars

ADDITIONAL MATHEMATICS-II
(Mandatory Learning Course: Common to all Programme)
A bridge course for Lateral Entry Students under Diploma quota to BE/B.Tech. programme

Course Code:	**21MATDIP41**	CIE Marks	100
Teaching Hours/Week (L:T:P: S):	3:0:0	Total Marks	100
Total Hours of Pedagogy:	40 hours	Credits:	0

Course objectives:
The mandatory course **21MATDIP41** viz., **Additional Mathematics –II** aims to provide essential concepts of Linear algebra, Second and higher-order differential equations, insight into Elementary probability theory and Numerical methods.

Teaching-Learning Process (General Instructions)
These are sample Strategies; which teachers can use to accelerate the attainment of the various course outcomes.

- The lecturer method (L) need not be only the traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
- Use of Video/Animation to explain the functioning of various concepts.
- Encourage collaborative (Group Learning) Learning in the class.
- Ask at least three HOT (Higher-order Thinking) questions in the class, which promotes critical thinking.
- Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develops design thinking skills such as the ability to design, evaluate, generalize, and analyse information rather than simply recall it.
- Show the different ways to solve the same problem and encourage the students to come up with creative ways to solve them.
- Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1: Linear Algebra

Introduction, Rank of a matrix by elementary row operations, Consistency of system of linear equations, Solution by Gauss Elimination method. Eigenvalues and eigenvectors of a square matrix. Problems.

RBT Levels: L1, L2 and L3 **8 hours**

Teaching-Learning Process	Chalk and talk method/ Powerpoint presentation

Module-2: Higher-Order Differential Equations

Linear homogeneous/nonhomogeneous differential equations of second and higher-order with constant coefficients. Solution by using the inverse differential operator method. [Particular Integrals restricted to $R(x)=e^{ax}$, sinax/ cosax, x^n]

RBT Levels: L1, L2 and L3 **8 hours**

Teaching-Learning Process	Chalk and talk method/ Powerpoint presentation

Module-3: Probability Theory

Introduction, Sample space and Events, Axioms of Probability. Addition and Multiplication theorem. Conditional Probability. Independent events. Baye's theorem, Problems.

RBT Levels: L1, L2 and L3 **8 hours**

Teaching-Learning Process	Chalk and talk method/ Powerpoint presentation

Module-4: Numerical Method -1

Finite differences, Interpolation/extrapolation using Newton's forward and Backward difference formulae (No derivation), Problems. Solution of polynomial and transcendental equations by Newton–Raphson and Regula–Falsi methods (no derivation), Problems. Numerical Integration: Simson's 1/3 rd rule and 3/8 rule, problems.

RBT Levels: L1, L2 and L3 **8 hours**

Teaching-Learning Process	Chalk and talk method/ Powerpoint presentation

Module-5: Numerical Method -II

Numerical solution of first-order ordinary differential equations: Taylor's series method, Modified Euler's method, Runge-Kutta method of order 4, Milne's predictor-corrector method. Problems.

RBT Levels: L1, L2 and L38 hours

Teaching-Learning Process	Chalk and talk method/ Powerpoint presentation

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

CO1: Test for consistency and solve the system of linear equations
CO2: Solve higher order differential equations
CO3: Apply elementary probability theory and solve related problems
CO4: To interpolate/extrapolate from the given data
CO5: Apply the knowledge of numerical methods in modelling and solving engineering problems

Assessment Details (CIE)

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. The first test at the end of 5th week of the semester
2. The second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester Two assignments each of **10 Marks**
4. First assignment at the end of the 4th week of the semester
5. Second assignment at the end of the 9th week of the semester

Course Seminar suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**).

The sum of three tests, two assignments, and a seminar will be out of 100 marks

The student shall secure a minimum of 40% of marks of the course to qualify and become eligible for the award of a degree.

Suggested Learning Resources: Text Book

1.Higher Engineering Mathematics: B. S. Grewal, Khanna Publishers, New Delhi, 43rd Ed., 2015.

Reference Books:

1. Higher Engineering Mathematics: V. Ramana, McGraw-Hill Education, 11th Ed.
2. Engineering Mathematics: Srimanta Pal & Subodh C. Bhunia, Oxford University Press, 3rd Reprint, 2016.
3. A textbook of Engineering Mathematics: N.P Bali and Manish Goyal, Laxmi Publications, Latest edition.
4. Higher Engineering Mathematics: H.K. Dass and Er. Rajnish Verma, S. Chand Publication (2014).

Weblinks and Video Lectures (e-Resources):

1. http://www.class-central.com/subject/math(MOOCs)
2. http://academicearth.org/
3. http://www.bookstreet.in.
4. VTU e-Shikshana Program
5. VTU EDUSAT Program

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Quizzes
- Assignments
- Seminars

3.Scheme 2022

I Semester

Course Title:	**Mathematics-I for Mechanical Engineering stream**		
Course Code:	**BMATM101**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	2:2:2:0	Exam Hours	03
Total Hours of Pedagogy	40 hours Theory + 10 to 12 Lab slots	Credits	04

Course objectives: The goal of the course**Mathematics-I for Mechanical Engineering stream**(**22MATM11**) is to

- **Familiarize** the importance of calculus associated with one variable and two variables for Mechanical engineering.
- **Analyze** Mechanical engineering problems applying Ordinary Differential Equations.
- **Develop** the knowledge of Linear Algebra referring to matrices.

Teaching-Learning Process
Pedagogy (General Instructions):
These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied mathematical skills.
2. State the need for Mathematics with Engineering Studies and Provide real-life examples.
3. Support and guide the students for self-study.
4. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress.
5. Encourage the students to group learning to improve their creative and analytical skills.
6. Show short related video lectures in the following ways:
   - As an introduction to new topics (pre-lecture activity).
   - As a revision of topics (post-lecture activity).
   - As additional examples (post-lecture activity).
   - As an additional material of challenging topics (pre-and post-lecture activity).
   - As a model solution of some exercises (post-lecture activity).

Module-1:Calculus (8 hours)

Introduction to polar coordinates and curvature relating toMechanical engineering.
Polar coordinates, Polar curves, angle between the radius vector and the tangent, angle between two curves. Pedal equations. Curvature and Radius of curvature - Cartesian, Parametric, Polar and Pedal forms. Problems.

Self-study: Centre and circle of curvature, evolutes and involutes.
Applications: Applied Mechanics, Strength of Materials, Elasticity.
(RBT Levels: L1, L2 and L3)

Module-2:Series Expansion and Multivariable Calculus (8 hours)

Introduction to series expansion and partial differentiation in the field of Mechanical engineering applications.
Taylor's and Maclaurin's series expansion for one variable (Statement only) – problems. Indeterminate forms - L'Hospital's rule, Problems.
Partial differentiation, total derivative - differentiation of composite functions. Jacobian and problems. Maxima and minima for a function of two variables-Problems.

Self-study: Euler's theorem and problems. Method of Lagrange's undetermined multipliers with a single constraint.

Applications: Computation of stress and strain, Errors and approximations in manufacturing process, Estimating the critical points and extreme values, vector calculus.
(RBT Levels: L1, L2 and L3)

Module-3: Ordinary Differential Equations (ODEs) of First Order (8 hours)

Introduction to first-order ordinary differential equations pertaining to the applications for Mechanical engineering.
Linear and Bernoulli's differential equations. Exact and reducible to exact differential equations-

Integrating factors on $\frac{1}{N}\left(\frac{\partial M}{\partial y}-\frac{\partial N}{\partial x}\right)$ and $\frac{1}{M}\left(\frac{\partial N}{\partial x}-\frac{\partial M}{\partial y}\right)$ Orthogonal trajectories, Newton's law of cooling.
Nonlinear differential equations: Introduction to general and singular solutions,solvable for p only, Clairaut's equations, **r**educible to Clairaut's equations - Problems.

Self-Study: Applications of ODEs: L-R circuits. Solvable for x and y.

Applications: Rate of Growth or Decay, Conduction of heat.
(RBT Levels: L1, L2 and L3)

Module-4:Ordinary Differential Equations of Higher Order(8 hours)

Importance of higher-order ordinary differential equations in Mechanical engineering applications.

Higher-order linear ODEs with constant coefficients - Inverse differential operator, method of variation of parameters, Cauchy's and Legendre homogeneous differential equations - Problems.

Self-Study: Formulation and solution of oscillations of a spring. Finding the solution by the method of undetermined coefficients.
Applications: Applications to oscillations of a spring, Mechanical systems and Transmission lines.
(RBT Levels: L1, L2 and L3)

Module-5: Linear Algebra (8 hours)

Introduction of linear algebra related to Mechanical engineering applications.
Elementary row transformationofa matrix, Rank of a matrix. Consistency and solution of a system of linear equations - Gauss-elimination method, Gauss-Jordan method and approximate solution by Gauss-Seidel method. Eigenvalues and Eigenvectors, Rayleigh's power method to find the dominant Eigenvalue and Eigenvector.

Self-Study: Solution of a system of equations by Gauss-Jacobi iterative method. Inverse of a square matrix by Cayley- Hamilton theorem.

Applications of Linear Algebra: Network Analysis, Balancing equations.
(RBT Levels: L1, L2 and L3)

Course outcome (Course Skill Set)
At the end of the course the student will be able to:

CO1 Apply the knowledge of calculus to solve problems related to polar curves.
CO2 Learn the notion of partial differentiation to compute rate of change of multivariate functions.
CO3 Analyse the solution of linear and non-linear ordinary differential equations.
CO4 Make use of matrix theory for solving the system of linear equations and compute eigenvalues and eigenvectors.
CO5 familiarize with modern mathematical tools namely MATHEMATICA/ MATLAB/ PYTHON/SCILAB

Course Title:	Mathematics-I for Civil Engineering stream		
Course Code:	**BMATC101**	**CIE Marks**	**50**
Course Type (Theory/Practical/Integrated)	**Integrated**	**SEE Marks**	**50**
		Total Marks	**100**
Teaching Hours/Week (L:T:P: S)	**2:2:2:0**	**Exam Hours**	**03**
Total Hours of Pedagogy	**40 hours Theory + 10 to12 Lab slots**	**Credits**	**04**

Course objectives: The goal of the course **Mathematics-I for Civil Engineering stream**(**22MATC11**) is to

- Familiarize the importance of calculus associated with onevariable and two variables for Civil engineering.
- Analyze Civil engineering problems applying Ordinary Differential Equations.
- Develop the knowledge of Linear Algebra referring to matrices.

Teaching-Learning Process

Pedagogy (General Instructions):

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied mathematical skills.
2. State the need for Mathematics with Engineering Studies and Provide real-life examples.
3. Support and guide the students for self–study.
4. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress.
5. Encourage the students to group learning to improve their creative and analytical skills.
6. Show short related video lectures in the following ways:

- As an introduction to new topics (pre-lecture activity).
- As a revision of topics (post-lecture activity).
- As additional examples (post-lecture activity).
- As an additional material of challenging topics (pre-and post-lecture activity).

- As a model solution of some exercises (post-lecture activity).

Module-1:Calculus (8 hours)

Introduction to polar coordinates and curvature relating to Civil engineering.

Polar coordinates, Polar curves, angle between the radius vector and the tangent, and angle between two curves. Pedal equations. Curvature and Radius of curvature - Cartesian, Parametric, Polar and Pedal forms. Problems.

Self-study: Center and circle of curvature, evolutes and involutes.

Applications: Structural design and paths, Strength of materials, Elasticity.

(RBT Levels: L1, L2 and L3)

Module-2:Series Expansion and Multivariable Calculus (8 hours)

Introduction to series expansion and partial differentiation in the field of Civil engineering applications.

Taylor's and Maclaurin's series expansion for one variable (Statement only) – problems. Indeterminate forms - L'Hospital's rule, problems.

Partial differentiation, total derivative - differentiation of composite functions. Jacobian and problems. Maxima and minima for a function of two variables - Problems.

Self-study: Euler's theorem and problems. Method of Lagrange's undetermined multipliers with single constraint.

Applications: Computation of stress and strain, Errors and approximations, Estimating the critical points and extreme values.

(RBT Levels: L1, L2 and L3)

Module-3: Ordinary Differential Equations (ODEs) of First Order (8 hours)

Introduction to first-order ordinary differential equations pertaining to the applications for Civil engineering.

Linear and Bernoulli's differential equations. Exact and reducible to exact differential equations - Integrating factors on $\frac{1}{N}\left(\frac{\partial M}{\partial y}-\frac{\partial N}{\partial x}\right) and \frac{1}{M}\left(\frac{\partial N}{\partial x}-\frac{\partial M}{\partial y}\right)$ Orthogonal trajectories and Newton's law of cooling.

Nonlinear differential equations: Introduction to general and singular solutions, Solvable for p only, Clairaut's equations,reducible to Clairaut's equations - Problems**.**

Self-Study: Applications of ODEs in Civil Engineering problems like bending of the beam, whirling of shaft,solution of non-linear ODE by the method of solvable for x and y.

Applications: Rate of Growth or Decay, Conduction of heat.

(RBT Levels: L1, L2 and L3)

Module-4:Ordinary Differential Equations of Higher Order(8 hours)

Importance of higher-order ordinary differential equations in Civil engineering applications.

Higher-order linear ODEs with constant coefficients - Inverse differential operator, method of variation of parameters, Cauchy's and Legendre's homogeneous differential equations -Problems.

Self-Study: Formulation and solution of Cantilever beam. Finding the solution by the method of undetermined coefficients.

Applications: Oscillations of a spring, Transmission lines, Highway engineering.

(RBT Levels: L1, L2 and L3)

Module-5: Linear Algebra (8 hours)

Introduction of linear algebra related to Civil engineering applications.

Elementary row transformationofa matrix, Rank of a matrix. Consistency and solution of a system of linear equations - Gauss-elimination method, Gauss-Jordan method and approximate solution by Gauss-Seidel method. Eigenvalues and Eigenvectors, Rayleigh's power method to find the dominant Eigenvalue and Eigenvector.

Self-Study: Solution of a system of linear equations by Gauss-Jacobi iterative method. Inverse of a square matrix by Cayley- Hamilton theorem.

Applications: Structural Analysis, Balancing equations.

(RBT Levels: L1, L2 and L3)

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

CO1	Apply the knowledge of calculus to solve problems related to polar curves.
CO2	Learn the notion of partial differentiation to compute rate of change of multivariate functions.
CO3	Analyze the solution of linear and nonlinear ordinary differential equations.
CO4	Make use of matrix theory for solving the system of linear equations and compute eigenvalues and eigenvectors.
CO5	Familiarize with modern mathematical tools namely MATHEMATICA/ MATLAB/ PYTHON/SCILAB

Course Title:	**Mathematics-I for Electrical & Electronics Engineering Stream**		
Course Code:	**BMATE101**	**CIE Marks**	**50**
Course Type (Theory/Practical/Integrated)	**Integrated**	**SEE Marks**	**50**
		Total Marks	**100**
Teaching Hours/Week (L:T:P: S)	**2:2:2:0**	**Exam Hours**	**03**
Total Hours of Pedagogy	**40 hours Theory + 10 to12 Lab slots**	**Credits**	**04**

Course objectives: The goal of the course**Mathematics-I for Electrical & Electronics Engineering stream**(**22MATE11**) is to

- **Familiarize** the importance of calculus associated with one variable and multivariable for Electrical and Electronics engineering.
- **Analyze**Electrical and Electronics engineering problems by applying Ordinary Differential Equations.
- **Familiarize** the important tools in Integral Calculus that are essential in Electrical and Electronics engineering.
- **Develop** the knowledge of Linear Algebra to solve the system of equations.

Teaching-Learning Process

Pedagogy (General Instructions):

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied mathematical skills.
2. State the need for Mathematics with Engineering Studies and Provide real-life examples.
3. Support and guide the students for self–study.
4. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress.
5. Encourage the students to group learning to improve their creative and analytical skills.
6. Show short related video lectures in the following ways:
   - As an introduction to new topics (pre-lecture activity).
   - As a revision of topics (post-lecture activity).
   - As additional examples (post-lecture activity).
   - As an additional material of challenging topics (pre-and post-lecture activity).
   - As a model solution of some exercises (post-lecture activity).

Module-1:Calculus (8 hours)

Introduction to polar coordinates and curvature relating to EC & EE Engineering applications.Polar coordinates, Polar curves, angle between the radius vector and the tangent, angle between two curves. Pedal equations. Curvature and Radius of curvature - Cartesian, Parametric, Polar and Pedal forms. Problems.

Self-study: Center and circle of curvature, evolutes and involutes.

Applications: Communication signals, Manufacturing of microphones, and Image processing.

(RBT Levels: L1, L2 and L3)

Module-2:Series Expansion and Multivariable Calculus (8 hours)

Introduction of series expansion and partial differentiation in EC & EE Engineering applications.

Taylor's and Maclaurin's series expansion for one variable (Statement only) – problems. Indeterminate forms - L'Hospital's rule - Problems.

Partial differentiation, total derivative - differentiation of composite functions. Jacobian and problems. Maxima and minima for a function of two variables. Problems.

Self-study: Euler's Theorem and problems. Method of Lagrange's undetermined multipliers with single constraint.

Applications: Series expansion in communication signals, Errors and approximations, and vector calculus.

(RBT Levels: L1, L2 and L3)

Module-3: Ordinary Differential Equations (ODEs) of First Order (8 hours)

Introduction to first-order ordinary differential equations pertaining to the applications for EC & EE engineering.

Linear and Bernoulli's differential equations. Exact and reducible to exact differential equations-

Integrating factors on $\frac{1}{N}\left(\frac{\partial M}{\partial y}-\frac{\partial N}{\partial x}\right)$ and $\frac{1}{M}\left(\frac{\partial N}{\partial x}-\frac{\partial M}{\partial y}\right)$ Orthogonal trajectories, L-R and C-R circuits.

Problems.

Non-linear differential equations: Introduction to general and singular solutions, Solvable for p only, Clairaut's equations,reducible to Clairaut's equations.Problems.

Self-Study: Applications of ODEs, Solvable for x and y.

Applications of ordinary differential equations: Rate of Growth or Decay, Conduction of heat.

(RBT Levels: L1, L2 and L3)

Module-4:Integral Calculus(8 hours)

Introduction to Integral Calculus in EC & EE Engineering applications.

Multiple Integrals: Evaluation of double and triple integrals, evaluation of double integrals by change of order of integration, changing into polar coordinates. Applications to find Area and Volume by double integral.Problems.

Beta and Gamma functions: Definitions, properties, relation between Beta and Gamma functions. Problems.

Self-Study: Volume by triple integration, Centre of gravity.

Applications: Antenna and wave propagation, Calculation of optimum power in electrical circuits, field theory.

(RBT Levels: L1, L2 and L3)

Module-5: Linear Algebra (8 hours)

Introduction of linear algebra related to EC & EE engineering applications.

Elementary row transformationofa matrix, Rank of a matrix. Consistency and Solution of system of linear equations - Gauss-elimination method, Gauss-Jordan method and approximate solution by Gauss-Seidel method. Eigenvalues and Eigenvectors, Rayleigh's power method to find the dominant Eigenvalue and Eigenvector.

Self-Study: Solution of system of equations by Gauss-Jacobi iterative method. Inverse of a square matrix by Cayley- Hamilton theorem.

Applications of Linear Algebra: Network Analysis, Markov Analysis, Critical point of a network system. Optimum solution. **(RBT Levels: L1, L2 and L3)**

Course outcome (Course Skill Set)
At the end of the course the student will be able to:

CO1	apply the knowledge of calculus to solve problems related to polar curves and learn the notion of partial differentiation to compute rate of change of multivariate functions
CO2	analyze the solution of linear and nonlinear ordinary differential equations
CO3	apply the concept of change of order of integration and variables to evaluate multiple integrals and their usage in computing area and volume
CO4	make use of matrix theory for solving the system of linear equations and compute eigenvalues and eigenvectors
CO5	familiarize with modern mathematical tools namely MATHEMATICA/ MATLAB/ PYTHON/SCILAB

Course Title:	**Mathematics-I for Computer Science and Engineering stream**		
Course Code:	**BMATS101**	**CIE Marks**	**50**

Course Type (Theory/Practical/Integrated)	**Integrated**	**SEE Marks**	**50**
		Total Marks	**100**
Teaching Hours/Week (L:T:P: S)	**2:2:2:0**	**Exam Hours**	**03**
Total Hours of Pedagogy	**40 hours Theory + 10 to12 Lab slots**	**Credits**	**04**

Course objectives: The goal of the course**Mathematics-I for Computer Science and Engineering stream**(**22MATS11**) is to

- **Familiarize** the importance of calculus associated with one variable and multivariable for computer science and engineering.
- **Analyze**Computer science and engineering problems by applying Ordinary Differential Equations.
- **Apply** the knowledge of modular arithmetic to computer algorithms.
- **Develop** the knowledge of Linear Algebra to solve the system of equations.

Teaching-Learning Process

Pedagogy (General Instructions):

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied mathematical skills.
2. State the need for Mathematics with Engineering Studies and Provide real-life examples.
3. Support and guide the students for self–study.
4. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress.
5. Encourage the students to group learning to improve their creative and analytical skills.
6. Show short related video lectures in the following ways:
   - As an introduction to new topics (pre-lecture activity).
   - As a revision of topics (post-lecture activity).
   - As additional examples (post-lecture activity).
   - As an additional material of challenging topics (pre-and post-lecture activity).

- As a model solution of some exercises (post-lecture activity).

Module-1:Calculus (8 hours)

Introduction to polar coordinates and curvature relating to Computer Science and Engineering.

Polar coordinates, Polar curves, angle between the radius vector and the tangent, angle between two curves. Pedal equations. Curvature and Radius of curvature - Cartesian, Parametric, Polar and Pedal forms. Problems.

Self-study: Centre and circle of curvature, evolutes and involutes.

Applications: Computer graphics, Image processing. **(RBT Levels: L1, L2 and L3)**

Module-2:Series Expansion and Multivariable Calculus (8 hours)

Introduction of series expansion and partial differentiation in Computer Science & Engineering applications.

Taylor's and Maclaurin's series expansion for one variable (Statement only) – problems. Indeterminate forms - L'Hospital's rule-Problems.

Partial differentiation, total derivative - differentiation of composite functions. Jacobian and problems. Maxima and minima for a function of two variables. Problems.

Self-study: Euler's theorem and problems. Method of Lagrange's undetermined multipliers with single constraint.

Applications: Series expansion in computer programming, Computing errors and approximations.

(RBT Levels: L1, L2 and L3)

Module-3: Ordinary Differential Equations (ODEs) of First Order (8 hours)

Introduction to first-order ordinary differential equations pertaining to the applications for Computer Science & Engineering.

Linear and Bernoulli's differential equations. Exact and reducible to exact differential equations - Integrating factors on $\frac{1}{N}\left(\frac{\partial M}{\partial y}-\frac{\partial N}{\partial x}\right)$ and $\frac{1}{M}\left(\frac{\partial N}{\partial x}-\frac{\partial M}{\partial y}\right)$ Orthogonal trajectories, L-R & C-R circuits. Problems.

Non-linear differential equations: Introduction to general and singular solutions, Solvable for p only, Clairaut's equations,reducible to Clairaut's equations. Problems.

Self-Study: Applications of ODEs, Solvable for x and y. \

Applications of ordinary differential equations: Rate of Growth or Decay, Conduction of heat.

(RBT Levels: L1, L2 and L3)

Module-4: Modular Arithmetic (8 hours)

Introduction of modular arithmetic and its applications in Computer Science and Engineering.

Introduction to Congruence's, Linear Congruence's, The Remainder theorem, Solving Polynomials, Linear Diophantine Equation, System of Linear Congruence's, Euler's Theorem, Wilson Theorem and Fermat's little theorem. Applications of Congruence's-RSA algorithm.

Self-Study: Divisibility, GCD, Properties of Prime Numbers, Fundamental theorem of Arithmetic. **Applications:** Cryptography, encoding and decoding, RSA applications in public key encryption.

(RBT Levels: L1, L2 and L3)

Module-5: Linear Algebra (8 hours)

Introduction of linear algebra related to Computer Science &Engineering.

Elementary row transformationofa matrix, Rank of a matrix. Consistency and Solution of system of linear equations - Gauss-elimination method, Gauss-Jordan method and approximate solution by Gauss-Seidel method. Eigenvalues and Eigenvectors, Rayleigh's power method to find the dominant Eigenvalue and Eigenvector.

Self-Study: Solution of system of equations by Gauss-Jacobi iterative method. Inverse of a square matrix by Cayley- Hamilton theorem.

Applications: Boolean matrix, Network Analysis, Markov Analysis, Critical point of a network system. Optimum solution.

(RBT Levels: L1, L2 and L3).

Course outcome (Course Skill Set)
At the end of the course the student will be able to:

CO1	Apply the knowledge of calculus to solve problems related to polar curves andlearn the notion of partial differentiation to compute rate of change of multivariate functions
CO2	Analyze the solution of linear and nonlinear ordinary differential equations
CO3	Get acquainted and to apply modular arithmetic to computer algorithms
CO4	Make use of matrix theory for solving the system of linear equations and compute eigenvalues and eigenvectors
CO5	Familiarize with modern mathematical tools namely MATHEMATICA/MATLAB/ PYTHON/ SCILAB

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). The minimum passing mark for the SEE is 35% of the maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation(CIE):

The CIE marks for the theory component of the IC shall be 30 marks and for the laboratory component 20 Marks.

CIE for the theory component of the IC

- Three Tests each of 20 Marks; after the completion of the syllabus of 35-40%, 65-70%, and 90100% respectively.
- Two Assignments/two quizzes/ seminars/one field survey and report presentation/one-course project totaling 20 marks.
- Total Marks scored (test + assignments) out of 80 shall be scaled down to 30 marks
- CIE for the practical component of the IC
- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The 15 marks are for conducting the experiment and preparation of the laboratory record, the other 05 marks shall be for the test conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test (duration 03 hours) at the end of the 15^{th} week of the semester/after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to 05 marks.

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IC/IPCC for 20 marks.

- The minimum marks to be secured in CIE to appear for SEE shall be 12 (40% of maximum marks) in the theory component and 08 (40% of maximum marks) in the practical component. The laboratory component of the IC/IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included. The maximum of 05 questions is to be set from the practical component of IC/IPCC, the total marks of all questions should not be more than 25 marks.

The theory component of the IC shall be for both CIE and SEE.

Semester End Examination(SEE):

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (duration 03 hours)

- The question paper shall be set for 100 marks. The medium of the question paper shall be English/Kannada). The duration of SEE is 03 hours.
- The question paper will have 10 questions. Two questions per module. Each question is set for 20 marks. The students have to answer 5 full questions, selecting one full question from each module. The student has to answer for 100 marks and marks scored out of 100 shall be proportionally reduced to 50 marks.

There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module.

II Semester

Course Title:	**Mathematics-II for Civil Engineering stream**		
Course Code:	**BMATC201**	**CIE Marks**	**50**
Course Type (Theory/Practical/Integrated)	**Integrated**	**SEE Marks**	**50**
		Total Marks	**100**
Teaching Hours/Week (L:T:P: S)	**2:2:2:0**	**Exam Hours**	**03**
Total Hours of Pedagogy	**40 hours Theory + 10 to 12 Lab slots**	**Credits**	**04**

Course objectives: The goal of the course**Mathematics-II for Civil Engineering stream** (**22MATC21**) is to

- **Familiarize** the importance of Integral calculus and Vector calculus essential for civil engineering.
- **Analyze** Civil engineering problems by applying Partial Differential Equations.
- **Develop** the knowledge of solving civil engineering problems numerically.

Teaching-Learning Process

Pedagogy (General Instructions):

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied mathematical skills.
2. State the need for Mathematics with Engineering Studies and Provide real-life examples.
3. Support and guide the students for self–study.
4. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress.
5. Encourage the students to group learning to improve their creative and analytical skills.
6. Show short related video lectures in the following ways:
   - As an introduction to new topics (pre-lecture activity).
   - As a revision of topics (post-lecture activity).
   - As additional examples (post-lecture activity).
   - As an additional material of challenging topics (pre-and post-lecture activity).
   - As a model solution of some exercises (post-lecture activity).

Module-1:Integral Calculus (8 hours)

Introduction to Integral Calculus in Civil Engineering applications.

Multiple Integrals: Evaluation of double and triple integrals, evaluation of double integrals by change of order of integration, changing into polar coordinates. Applications to find Area and Volume by double integral.Problems.

Beta and Gamma functions: Definitions, properties, relation between Beta and Gamma functions. Problems.

Self-Study: Volume by triple integration, Center of gravity.

Applications: Applications to mathematical quantities (Area, Surface area, Volume), Analysis of probabilistic models.

(RBT Levels: L1, L2 and L3)

Module-2:Vector Calculus(8 hours)

Introduction to Vector Calculus in Civil Engineering applications.

Vector Differentiation: Scalar and vector fields. Gradient, directional derivative, curl and divergence - physical interpretation, solenoidal and irrotational vector fields. Problems.

Vector Integration: Line integrals, Surface integrals. Applications to work done by a force and flux. Statement of Green's theorem and Stoke's theorem. Problems.

Self-Study: Volume integral and Gauss divergence theorem.

Applications: Heat and mass transfer, oil refinery problems, environmental engineering. Analysis of streamlines, velocity and acceleration of a moving particle.

(RBT Levels: L1, L2 and L3)

Module-3:Partial Differential Equations (PDEs)(8 hours)

Importance of partial differential equations for Civil Engineering applications

Formation of PDE's by elimination of arbitrary constants and functions. Solution of nonhomogeneous PDE by direct integration. Homogeneous PDEs involving derivatives with respect to one independent variable only. Solution of Lagrange's linear PDE.Derivation of one-dimensional heat equation and wave equation.

Self-Study: Solution of one-dimensional heat equation and wave equation by the method of separation of variables.

Applications: Design of structures (vibration of rod/membrane)

(RBT Levels: L1, L2 and L3)

Module-4:Numerical Methods -1(8 hours)

Importance of numerical methods for discrete data in the field of Civil Engineering.

Solution of algebraic and transcendental equations: Regula-Falsi and Newton-Raphson methods (only formulae). Problems.

Finite differences, Interpolation using Newton's forward and backward difference formulae, Newton's divided difference formula and Lagrange's interpolation formula (All formulae without proof). Problems.

N**umerical integration**: Trapezoidal, Simpson's $(1/3)^{rd}$ and $(3/8)^{th}$ rules (without proof). Problems.

Self-Study: Bisection method, Lagrange's inverse Interpolation**.**

Applications: Estimating the approximate roots, extremum values, area, volume, and surface area. Finding approximate solutions to civil engineering problems.

(RBT Levels: L1, L2 and L3)

Module-5:Numerical Methods -2(8 hours)

Introduction to various numerical techniques for handling Civil Engineering applications. Numerical Solution of Ordinary Differential Equations (ODE's): Numerical solution of ordinary differential equations of first order and first degree - Taylor's series method, Modified Euler's method, Runge-Kutta method of fourth order and Milne's predictor-corrector formula (No derivations of formulae). Problems.

Self-Study: Adam-Bashforth method.

Applications: Finding approximate solutions to ODE related to civil engineering fields.

(RBT Levels: L1, L2 and L3)

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

CO1 Apply the knowledge of multiple integrals to compute area and volume.

CO2	Understand the applications of vector calculus refer to solenoidal, irrotational vectors, line integral and surface integral.
CO3	Demonstrate partial differential equations and their solutions for physical interpretations.

CO4	Apply the knowledge of numerical methods in solving physical and engineering phenomena.
CO5	Get familiarize with modern mathematical tools namely MATHEMATICA/MATLAB/PYTHON/SCILAB

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is

50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). The minimum passing mark for the SEE is 35% of the maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation(CIE):

The CIE marks for the theory component of the IC shall be **30 marks** and for the laboratory component **20 Marks**.

CIE for the theory component of the IC

- Three Tests each of 20 Marks**;** after the completion of the syllabus of 35-40%, 65-70%, and 90100% respectively.
- Two Assignments/two quizzes/ seminars/one field survey and report presentation/one-course project totalling 20 marks.

Total Marks scored (test + assignments) out of 80 shall be scaled down to **30 marks**

CIE for the practical component of the IC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The **15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test **(duration 03 hours)** at the end of the 15^{th} week of the semester/after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to **05 marks.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IC/IPCC for **20 marks**.

- The minimum marks to be secured in CIE to appear for SEE shall be 12 (40% of maximum marks) in the theory component and 08 (40% of maximum marks) in the practical component. The laboratory component of the IC/IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included**.** The maximum of 05 questions is to be set from the practical component of IC/IPCC, the total marks of all questions should not be more than 25 marks.

The theory component of the IC shall be for both CIE and SEE.

Semester End Examination(SEE):

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

- The question paper shall be set for 100 marks. The medium of the question paper shall be English/Kannada). The duration of SEE is 03 hours.
- The question paper will have 10 questions. Two questions per module. Each question is set for 20 marks. The students have to answer 5 full questions, selecting one full question from each module. The student has to answer for 100 marks and **marks scored out of 100 shall be proportionally reduced to 50 marks**.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)Text Books

1.B. S. Grewal: "Higher Engineering Mathematics", Khanna Publishers, 44thEd., 2021.

2.E. Kreyszig: "Advanced Engineering Mathematics", John Wiley & Sons, 10thEd., 2018.

Reference Books

1 **V. Ramana:** "Higher Engineering Mathematics" McGraw-Hill Education, 11th Ed., 2017

2 **Srimanta Pal & Subodh C.Bhunia**: "Engineering Mathematics" Oxford University Press, 3rdEd., 2016.

3.N.P Bali and Manish Goyal: "A Textbook of Engineering Mathematics" Laxmi

Publications, 10thEd., 2022.

4.C. Ray Wylie, Louis C. Barrett: "Advanced Engineering Mathematics" McGraw – Hill Book Co., New York, 6th Ed., 2017.

5.Gupta C.B, Sing S.R and Mukesh Kumar: "Engineering Mathematic for Semester I and II", Mc-Graw Hill Education(India) Pvt. Ltd 2015.

6.H.K. Dass and Er. Rajnish Verma: "Higher Engineering Mathematics" S.Chand

Publication, 3rd Ed.,2014.

7.James Stewart: "Calculus" Cengage Publications, 7thEd., 2019.

Web links and Video Lectures (e-Resources):

- http://nptel.ac.in/courses.php?disciplineID=111
- http://www.class-central.com/subject/math(MOOCs)
- http://academicearth.org/
- VTU e-Shikshana Program
- VTU EDUSAT Program

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quizzes
- Assignments
- Seminar

II Semester

Course Title:	**Mathematics-II for Electrical & Electronics Engineering Stream**		
Course Code:	**BMATE201**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	**Integrated**	**SEE Marks**	**50**
		Total Marks	**100**
Teaching Hours/Week (L:T:P: S)	**2:2:2:0**	**Exam Hours**	**03**
Total Hours of Pedagogy	**40 hours Theory + 10 to12 Lab slots**	**Credits**	**04**

Course objectives: The goal of the course**Mathematics-II for Electrical & Electronics Engineering Stream**(**22MATE21**) is to

- **Familiarize** the importance of Vector calculus, Vector Space and Linear transformation for electronics and electrical engineering.
- **Have an insight** into solving ordinary differential equations by using Laplace transform techniques.
- **Develop** the knowledge of solving electronics and electrical engineering problems numerically.

Teaching-Learning Process

Pedagogy (General Instructions):

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied mathematical skills.
2. State the need for Mathematics with Engineering Studies and Provide real-life examples.
3. Support and guide the students for self–study.
4. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress.
5. Encourage the students to group learning to improve their creative and analytical skills.
6. Show short related video lectures in the following ways:
   - As an introduction to new topics (pre-lecture activity).

- As a revision of topics (post-lecture activity).
- As additional examples (post-lecture activity).
- As an additional material of challenging topics (pre-and post-lecture activity).
- As a model solution of some exercises (post-lecture activity).

Module-1:Vector Calculus (8 hours)

Introduction to Vector Calculus in EC & EE engineering applications.

Vector Differentiation: Scalar and vector fields. Gradient, directional derivative, curl and divergence - physical interpretation, solenoidal and irrotational vector fields. Problems.

Vector Integration: Line integrals, Surface integrals. Applications to work done by a force and flux. Statement of Green's theorem and Stoke's theorem. Problems.

Self-Study: Volume integral and Gauss divergence theorem.

Applications: Conservation of laws, Electrostatics, Analysis of streamlines and electric potentials.

(RBT Levels: L1, L2 and L3)

Module-2:Vector Space and Linear Transformations(8 hours)

Importance of Vector Space and Linear Transformations in the field of EC & EE engineering applications.

Vector spaces: Definition and examples, subspace, linear span, Linearly independent and dependent sets, Basis and dimension.

Linear transformations: Definition and examples, Algebra of transformations, Matrix of a linear transformation. Change of coordinates, Rank and nullity of a linear operator, Rank-Nullity theorem. Inner product spaces and orthogonality.

Self-study: Angles and Projections.Rotation, reflection, contraction and expansion.

Applications: Image processing, AI & ML, Graphs and networks, Computer graphics.

(RBT Levels: L1, L2 and L3)

Module-3:Laplace Transform(8 hours)

Importance of Laplace Transform for EC & EE engineering applications.

Existence and Uniqueness of Laplace transform (LT), transform of elementary functions, region of convergence. Properties–Linearity, Scaling, t-shift property, s-domain shift, differentiation in the sdomain, division by t, differentiation and integration in the time domain. LT of special functions-periodic functions (square wave, saw-tooth wave, triangular wave, full & half wave rectifier), Heaviside Unit step function, Unit impulse function.

Inverse Laplace Transforms:

Definition, properties, evaluation using different methods, convolution theorem (without proof), problems, and applications to solve ordinary differential equations.

Self-Study: Verification of convolution theorem.

Applications: Signals and systems, Control systems, LR, CR & LCR circuits.

(RBT Levels: L1, L2 and L3)

Module-4:Numerical Methods -1(8 hours)

Importance of numerical methods for discrete data in the field of EC & EE engineering applications.

Solution of algebraic and transcendental equations: Regula-Falsi method and Newton-Raphson method (only formulae). Problems.

Finite differences, Interpolation using Newton's forward and backward difference formulae, Newton's divided difference formula and Lagrange's interpolation formula (All formulae without proof). Problems.

N**umerical integration**: Trapezoidal, Simpson's $(1/3)^{rd}$ and $(3/8)^{th}$ rules(without proof). Problems.

S**elf-Study:** Bisection method, Lagrange's inverse Interpolation, Weddle's rule.

Applications: Estimating the approximate roots, extremum values, area, volume, and surface area. **(RBT Levels: L1, L2 and L3)**

Module-5:Numerical Methods -2(8 hours)

Introduction to various numerical techniques for handling EC & EE applications. Numerical Solution of Ordinary Differential Equations (ODEs):

Numerical solution of ordinary differential equations of first order and first degree - Taylor's series method, Modified Euler's method, Runge-Kutta method of fourth order and Milne's predictorcorrector formula (No derivations of formulae). Problems.

Self-Study: Adam-Bashforth method.

Applications: Estimating the approximate solutions of ODE for electric circuits.

(RBT Levels: L1, L2 and L3)

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

CO1 Understand the applications of vector calculus refer to solenoidal, irrotational vectors, lineintegral and surface integral.

CO2 Demonstrate the idea of Linear dependence and independence of sets in the vector space, and linear transformation

CO3 To understand the concept of Laplace transform and to solve initial value problems

CO4 Apply the knowledge of numerical methods in solving physical and engineering phenomena.

CO5 Get familiarize with modern mathematical tools namely MATHEMATICA/MATLAB/PYTHON/ SCILAB

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). The minimum passing mark for the SEE is 35% of the maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation(CIE):

The CIE marks for the theory component of the IC shall be **30 marks** and for the laboratory component **20 Marks**.

CIE for the theory component of the IC

- Three Tests each of 20 Marks**;** after the completion of the syllabus of 35-40%, 65-70%, and 90100% respectively.
- Two Assignments/two quizzes/ seminars/one field survey and report presentation/one-course project totalling 20 marks.

Total Marks scored (test + assignments) out of 80 shall be scaled down to **30 marks**

CIE for the practical component of the IC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The **15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test **(duration 03 hours)** at the end of the 15^{th} week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to **05 marks.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IC/IPCC for **20 marks**.

- The minimum marks to be secured in CIE to appear for SEE shall be 12 (40% of maximum marks) in the theory component and 08 (40% of maximum marks) in the practical component. The laboratory component of the IC/IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included**.** The maximum of 05 questions is

to be set from the practical component of IC/IPCC, the total marks of all questions should not be more than 25 marks.

The theory component of the IC shall be for both CIE and SEE.

Semester End Examination(SEE):

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

- The question paper shall be set for 100 marks. The medium of the question paper shall be English/Kannada). The duration of SEE is 03 hours.
- The question paper will have 10 questions. Two questions per module. Each question is set for 20 marks. The students have to answer 5 full questions, selecting one full question from each module. The student has to answer for 100 marks and **marks scored out of 100 shall be proportionally reduced to 50 marks**.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)Text Books

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2. **E. Kreyszig**: "Advanced Engineering Mathematics", John Wiley & Sons, 10thEd., 2018.

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Web links and Video Lectures (e-Resources):

- http://nptel.ac.in/courses.php?disciplineID=111
- http://www.class-central.com/subject/math(MOOCs)
- http://academicearth.org/
- VTU e-Shikshana Program
- VTU EDUSAT Program

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning Quizzes

- Assignments
- Seminar

II Semester

Course Title:	**Mathematics-II for Computer Science and Engineering stream**		
Course Code:	**BMATS201**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	2:2:2:0	Exam Hours	03
Total Hours of Pedagogy	40 hours Theory + 10 to 12 Lab slots	Credits	04

Course objectives: The goal of the course**Mathematics-II for Computer Science and Engineering stream**(**22MATS21**) is to

- **Familiarize** the importance of Integral calculus and Vector calculus.
- **Learn** vector spaces and linear transformations**.**
- **Develop** the knowledge of numerical methods and apply them to solvetranscendental and differential equations.

Teaching-Learning Process

Pedagogy (General Instructions):

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied mathematical skills.
2. State the need for Mathematics with Engineering Studies and Provide real-life examples.
3. Support and guide the students for self–study.
4. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress.
5. Encourage the students to group learning to improve their creative and analytical skills.
6. Show short related video lectures in the following ways:
   - As an introduction to new topics (pre-lecture activity).
   - As a revision of topics (post-lecture activity).
   - As additional examples (post-lecture activity).
   - As an additional material of challenging topics (pre-and post-lecture activity).
   - As a model solution of some exercises (post-lecture activity).

Module-1Integral Calculus (8 hours)

Introduction to Integral Calculus in Computer Science &Engineering.

Multiple Integrals: Evaluation of double and triple integrals, evaluation of double integrals by change of order of integration, changing into polar coordinates. Applications to find Area and Volume by double integral.Problems.

Beta and Gamma functions: Definitions, properties, relation between Beta and Gamma functions. Problems.

Self-Study: Center of gravity, Duplication formula.

Applications: Antenna and wave propagation, Calculation of optimum value in various geometries. Analysis of probabilistic models.

(RBT Levels: L1, L2 and L3)

Module-2 Vector Calculus(8 hours)

Introduction to Vector Calculus in Computer Science & Engineering.

Scalar and vector fields. Gradient, directional derivative, curl and divergence - physical interpretation, solenoidal and irrotational vector fields. Problems.

Curvilinear coordinates: Scale factors, base vectors, Cylindrical polar coordinates, Spherical polar coordinates, transformation between Cartesian and curvilinear systems, orthogonality. Problems.

Self-Study: Vector integration and Vector line integral.

Applications: Conservation of laws, Electrostatics, Analysis of streamlines.

Module-3Vector Space and Linear Transformations(8 hours)

Importance of Vector Space and Linear Transformations in the field of Computer Science & Engineering.

Vector spaces: Definition and examples, subspace, linear span, Linearly independent and dependent sets, Basis and dimension. Problems.

Linear transformations: Definition and examples, Algebra of transformations, Matrix of a linear transformation. Change of coordinates, Rank and nullity of a linear operator, rank-nullity theorem. Inner product spaces and orthogonality. Problems.

Self-study: Angles and Projections.Rotation, Reflection, Contraction and Expansion.

Applications: Image processing, AI & ML, Graphs and networks, Computer graphics.

(RBT Levels: L1, L2 and L3)

Module-4Numerical Methods -1(8 hours)

Importance of numerical methods for discrete data in the field of computer science & engineering.

Solution of algebraic and transcendental equations - Regula-Falsi and Newton-Raphson methods (only formulae). Problems.

Finite differences, Interpolation using Newton's forward and backward difference formulae, Newton's divided difference formula and Lagrange's interpolation formula (All formulae without proof). Problems.

Numerical integration: Trapezoidal, Simpson's $(1/3)^{rd}$ and $(3/8)^{th}$ rules(without proof). Problems.

S**elf-Study:** Bisection method, Lagrange's inverse Interpolation.

Applications: Estimating the approximate roots, extremum values, Area, volume, and surface area. Errors in finite precision.

(RBT Levels: L1, L2 and L3)

Module-5Numerical Methods -2(8 hours)

Introduction to various numerical techniques for handling Computer Science & Engineering applications.

Numerical Solution of Ordinary Differential Equations (ODE's): Numerical solution of ordinary differential equations of first order and first degree - Taylor's series method, Modified Euler's method, Runge-Kutta method of fourth order and Milne's predictor-corrector formula (No derivations of formulae). Problems.

Self-Study: Adam-Bashforth method.

Applications: Estimating the approximate solutions of ODE.

(RBT Levels: L1, L2 and L3).

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

CO1	Apply the concept of change of order of integration and variables to evaluate multiple integrals and their usage in computing area and volume.
CO2	Understand the applications of vector calculus refer to solenoidal, and irrotational vectors.Orthogonal curvilinear coordinates.
CO3	Demonstrate the idea of Linear dependence and independence of sets in the vector space, and linear transformation
CO4	Apply the knowledge of numerical methods in analysing the discrete data and solving the physical and engineering problems.
CO5	Get familiarize with modern mathematical tools namely MATHEMATICA/ MATLAB /PYTHON/ SCILAB

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). The minimum passing mark for the SEE is 35% of the maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in thetotal of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation(CIE):

The CIE marks for the theory component of the IC shall be **30 marks** and for the laboratory component **20 Marks**.

CIE for the theory component of the IC

 Three Tests each of 20 Marks**;** after the completion of the syllabus of 35-40%, 65-70%, and 90100%

respectively.

- Two Assignments/two quizzes/ seminars/one field survey and report presentation/one-course project totalling 20 marks.

Total Marks scored (test + assignments) out of 80 shall be scaled down to **30 marks**

CIE for the practical component of the IC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The **15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.

- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.

- The laboratory test **(duration 03 hours)** at the end of the 15^{th} week of the semester/after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to **05 marks.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IC/IPCC for **20 marks**.

- The minimum marks to be secured in CIE to appear for SEE shall be 12 (40% of maximum marks) in the theory component and 08 (40% of maximum marks) in the practical component. The laboratory component of the IC/IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included**.** The maximum of 05 questions is to be set from the practical component of IC/IPCC, the total marks of all questions should not be more than 25 marks.

The theory component of the IC shall be for both CIE and SEE.

Semester End Examination(SEE):

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

- The question paper shall be set for 100 marks. The medium of the question paper shall be English/Kannada). The duration of SEE is 03 hours.

- The question paper will have 10 questions. Two questions per module. Each question is set for 20 marks. The students have to answer 5 full questions, selecting one full question from each module. The student has to answer for 100 marks and **marks scored out of 100 shall be proportionally reduced to 50 marks**.

- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

Suggested Learning Resources:

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- http://academicearth.org/
- VTU e-Shikshana Program
- VTU EDUSAT Program

Activity-Based Learning (Suggested Activities in Class)/ Practical-Based Learning □ Quizzes • Assignments • Seminar

II Semester

Course Title:	**Mathematics-II for Mechanical Engineering stream**		
Course Code:	**BMATM201**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	2:2:2:0	Exam Hours	03
Total Hours of Pedagogy	40 hours Theory + 10 to 12 Lab slots	Credits	04

Course objectives: The goal of the course**Mathematics-II for Mechanical Engineering stream**(**22MATM21**) is to

- **Familiarize** the importance of Integral calculus and Vector calculus essential for Mechanical engineering.
- **Analyze** Mechanical engineering problems by applying Partial Differential Equations.
- **Develop** the knowledge of solving Mechanical engineering problems numerically.

Teaching-Learning Process

Pedagogy (General Instructions):

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied mathematical skills.
2. State the need for Mathematics with Engineering Studies and Provide real-life examples.
3. Support and guide the students for self–study.
4. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress.
5. Encourage the students to group learning to improve their creative and analytical skills.
6. Show short related video lectures in the following ways:

- As an introduction to new topics (pre-lecture activity).
- As a revision of topics (post-lecture activity).
- As additional examples (post-lecture activity).
- As an additional material of challenging topics (pre-and post-lecture activity).
- As a model solution of some exercises (post-lecture activity).

Module-1:Integral Calculus (8 hours)

Introduction to Integral Calculus in Mechanical Engineering applications.

Multiple Integrals: Evaluation of double and triple integrals, evaluation of double integrals by change of order of integration, changing into polar coordinates. Applications to find Area and Volume by double integral.Problems.

Beta and Gamma functions: Definitions, properties, relation between Beta and Gamma functions. Problems.

Self-Study: Volume by triple integration, Center of gravity.

Applications: Applications to mathematical quantities (Area, Surface area, Volume), Analysis of probabilistic models.

(RBT Levels: L1, L2 and L3)

Module-2:Vector Calculus(8 hours)

Introduction to Vector Calculus in Mechanical Engineering applications.

Vector Differentiation: Scalar and vector fields. Gradient, directional derivative, curl and divergence - physical interpretation, solenoidal and irrotational vector fields. Problems.

Vector Integration: Line integrals, Surface integrals. Applications to work done by a force and flux. Statement of Green's theorem and Stoke's theorem. Problems.

Self-Study: Volume integral and Gauss divergence theorem.

Applications: Heat and mass transfer, oil refinery problems, environmental engineering, velocity and acceleration of moving particles, analysis of streamlines. **(RBT Levels: L1, L2 and L3)**

Module-3:Partial Differential Equations (PDEs)(8 hours)

Importance of partial differential equations for Mechanical Engineering application.

Formation of PDE's by elimination of arbitrary constants and functions. Solution of nonhomogeneous PDE by direct integration. Homogeneous PDEs involving derivatives with respect to one independent variable only. Solution of Lagrange's linear PDE.Derivation of one-dimensional heat equation and wave equation.

Self-Study: Solution of the one-dimensional heat equation and wave equation by the method of separation of variables.

Applications: Vibration of a rod/membrane.

(RBT Levels: L1, L2 and L3)

Module-4:Numerical Methods -1(8 hours)

Importance of numerical methods for discrete data in the field of Mechanical Engineering. Solution of algebraic and transcendental equations: Regula-Falsi and Newton-Raphson methods (only formulae). Problems.

Finite differences, Interpolation using Newton's forward and backward difference formulae, Newton's divided difference formula and Lagrange's interpolation formula (All formulae without proof). Problems.

Numerical integration: Trapezoidal, Simpson's $(1/3)^{rd}$ and $(3/8)^{th}$ rules(without proof). Problems.

S**elf-Study:** Bisection method, Lagrange's inverse Interpolation.

Applications: Finding approximate solutions to solve mechanical engineering problems involving numerical data.

(RBT Levels: L1, L2 and L3)

Module-5:Numerical Methods -2(8 hours)

Introduction to various numerical techniques for handling Mechanical Engineering applications.

Numerical Solution of Ordinary Differential Equations (ODEs):

Numerical solution of ordinary differential equations of first order and first degree - Taylor's series method, Modified Euler's method, Runge-Kutta method of fourth order and Milne's predictorcorrector formula (No derivations of formulae). Problems.

Self-Study: Adam-Bashforth method.

Applications: Finding approximate solutions to solve mechanical engineering problems.

(RBT Levels: L1, L2 and L3)

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

CO1	Apply the knowledge of multiple integrals to compute area and volume.
CO2	Understand the applications of vector calculus refer to solenoidal, irrotational vectors, line integral and surface integral.
CO3	Demonstrate partial differential equations and their solutions for physical interpretations.
CO4	Apply the knowledge of numerical methods in solving physical and engineering phenomena.
CO5	Get familiarize with modern mathematical tools namely Mathematica/MatLab/Python/Scilab

- Two Assignments/two quizzes/ seminars/one field survey and report presentation/one-course project totalling 20 marks.

Total Marks scored (test + assignments) out of 80 shall be scaled down to **30 marks**

CIE for the practical component of the IC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The **15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
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- The laboratory test **(duration 03 hours)** at the end of the 15^{th} week of the semester/after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to **05 marks.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IC/IPCC for **20 marks**.

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The theory component of the IC shall be for both CIE and SEE.

Semester End Examination(SEE):

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

- The question paper shall be set for 100 marks. The medium of the question paper shall be English/Kannada). The duration of SEE is 03 hours.
- The question paper will have 10 questions. Two questions per module. Each question is set for 20 marks. The students have to answer 5 full questions, selecting one full question from each module. The student has to answer for 100 marks and **marks scored out of 100 shall be proportionally reduced to 50 marks**.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

Suggested Learning Resources:

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- VTU e-Shikshana Program
- VTU EDUSAT Program

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quizzes
- Assignments
- Seminar

COs and POs Mapping (Individual teacher has to fill up)

COs	POs						
	1	2	3	4	5	6	7
CO1							
CO2							
CO3							
CO4							
CO5							

Level 3- Highly Mapped, Level 2-Moderately Mapped, Level 1-Low Mapped, Level 0-Not Mapped

	Mathematics for Computer Science		Semester	3
	Course Code	**BCS301**	CIE Marks	50
	Teaching Hours/Week (L: T:P: S)	3:2:0:0	SEE Marks	50
	Total Hours of Pedagogy	40 hours Theory + 20 Hours Tutorial	Total Marks	100
	Credits	04	Exam Hours	3
	Examination type (SEE)	**Theory**		

Course objectives: This course will enable the students to:

1. To introduce the concept of random variables, probability distributions, specific discrete and continuous distributions with practical application in Computer Science Engineering and social life situations.
2. To Provide the principles of statistical inferences and the basics of hypothesis testing with emphasis on some commonly encountered hypotheses.
3. To Determine whether an input has a statistically significant effect on the system's response through ANOVA testing.

Teaching-Learning Process

Pedagogy (General Instructions):

Teachers can use the following strategies to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied Mathematical skills.
2. State the need for Mathematics with Engineering Studies and Provide real-life examples.
3. Support and guide the students for self–study.
4. You will assign homework, grading assignments and quizzes, and documenting students' progress.
5. Encourage the students to group learning to improve their creative and analytical skills.
6. Show short related video lectures in the following ways:
   - As an introduction to new topics (pre-lecture activity).
   - As a revision of topics (post-lecture activity).
   - As additional examples (post-lecture activity).
   - As an additional material of challenging topics (pre-and post-lecture activity).
   - As a model solution of some exercises (post-lecture activity).

Module-1: Probability Distributions

Probability Distributions: Review of basic probability theory. Random variables (discrete and continuous), probability mass and density functions. Mathematical expectation, mean and variance. Binomial, Poisson and normal distributions- problems (derivations for mean and standard deviation for Binomial and Poisson distributions only)-Illustrative examples. Exponential distribution. **(12 Hours)**

(RBT Levels: L1, L2 and L3)

Pedagogy	Chalk and Board, Problem-based learning

Module-2: Joint probability distribution & Markov Chain

	Joint probability distribution: Joint Probability distribution for two discrete random variables, expectation, covariance and correlation. **Markov Chain:** Introduction to Stochastic Process, Probability Vectors, Stochastic matrices, Regular stochastic matrices, Markov chains, Higher transition probabilities, Stationary distribution of Regular Markov chains and absorbing states. **(12 Hours)** **(RBT Levels: L1, L2 and L3)**	
	Pedagogy	Chalk and Board, Problem-based learning
	Module-3: Statistical Inference 1	
	Introduction, sampling distribution, standard error, testing of hypothesis, levels of significance, test of significances, confidence limits, simple sampling of attributes, test of significance for large samples, comparison of large samples. **(12 Hours)** **(RBT Levels: L1, L2 and L3)**	
	Pedagogy	Chalk and Board, Problem-based learning
	Module-4: Statistical Inference 2	
	Sampling variables, central limit theorem and confidences limit for unknown mean. Test of Significance for means of two small samples, students 't' distribution, Chi-square distribution as a test of goodness of fit. F-Distribution. **(12 Hours)** **(RBT Levels: L1, L2 and L3)**	
	Pedagogy	Chalk and Board, Problem-based learning
	Module-5: Design of Experiments & ANOVA	
	Principles of experimentation in design, Analysis of completely randomized design, randomized block design. The ANOVA Technique, Basic Principle of ANOVA, One-way ANOVA, Two-way ANOVA, Latin-square Design, and Analysis of Co-Variance. **(12 Hours)** **(RBT Levels: L1, L2 and L3)**	
	Pedagogy	Chalk and Board, Problem-based learning

Course outcome (Course Skill Set)

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

1. Explain the basic concepts of probability, random variables, probability distribution
2. Apply suitable probability distribution models for the given scenario.
3. Apply the notion of a discrete-time Markov chain and n-step transition probabilities to solve the given problem
4. Use statistical methodology and tools in the engineering problem-solving process.
5. Compute the confidence intervals for the mean of the population.
6. Apply the ANOVA test related to engineering problems.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment

Test component, there are 25 marks.

- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by the University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.

Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Textbooks:

1. **Ronald E. Walpole, Raymond H Myers, Sharon L Myers & Keying Ye** "Probability & Statistics for Engineers & Scientists", Pearson Education, 9th edition, 2017.
2. **Peter Bruce, Andrew Bruce & Peter Gedeck** "Practical Statistics for Data Scientists" O'Reilly Media, Inc., 2nd edition **2020**.

Reference Books: (Name of the author/Title of the Book/ Name of the publisher/Edition and Year)

1. **Erwin Kreyszig**, "Advanced Engineering Mathematics", John Wiley & Sons, 9th Edition, 2006.
2. **B. S. Grewal** "Higher Engineering Mathematics", Khanna publishers, 44th Ed., 2021.
3. **G Haribaskaran** "Probability, Queuing Theory & Reliability Engineering", Laxmi Publication, Latest Edition, 2006
4. **Irwin Miller & Marylees Miller,** John E. Freund's "Mathematical Statistics with Applications" Pearson. Dorling Kindersley Pvt. Ltd. India, 8th edition, 2014.
5. **S C Gupta and V K Kapoor**, "Fundamentals of Mathematical Statistics", S Chand and Company, Latest edition.
6. **Robert V. Hogg, Joseph W. McKean & Allen T. Craig**. "Introduction to Mathematical Statistics", Pearson Education 7th edition, 2013.
7. **Jim Pitman**. Probability, Springer-Verlag, 1993.
8. **Sheldon M. Ross,** "Introduction to Probability Models" 11th edition. Elsevier, 2014.
9. **A. M. Yaglom and I. M. Yaglom**, "Probability and Information". D. Reidel Publishing Company. Distributed by Hindustan Publishing Corporation (India) Delhi, 1983.
10. **P. G. Hoel, S. C. Port and C. J. Stone**, "Introduction to Probability Theory", Universal Book Stall, (Reprint), 2003.
11. **S. Ross**, "A First Course in Probability", Pearson Education India, 6th Ed., 2002.
12. **W. Feller**, "An Introduction to Probability Theory and its Applications", Vol. 1, Wiley, 3rd

Ed., 1968.
13. **N.P. Bali and Manish Goyal**, A Textbook of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
14. **Veerarajan T**, Engineering Mathematics (for semester III), Tata McGraw-Hill, New Delhi, 2010

Web links and Video Lectures (e-Resources):

http://nptel.ac.in/courses.php?disciplineID=111
http://www.class-central.com/subject/math(MOOCs)
http://academicearth.org/
http://www.bookstreet.in.
VTU EDUSAT PROGRAMME – 20
VTU e-Shikshana Program

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Programming Assignment
- Seminars

AV Mathematics-III for EC Engineering		Semester	3
Course Code	**BMATEC301**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
Examination type (SEE)	Theory		

Course objectives:

- Learn to use the Fourier series to represent periodical physical phenomena in engineering analysis and to enable the student to express non-periodic functions to periodic functions using the Fourier series and Fourier transforms.
- Analyze signals in terms of Fourier transforms
- Develop the knowledge of solving differential equations and their applications in Electronics & Communication engineering.
- To find the association between attributes and the correlation between two variables

Teaching-Learning Process

Pedagogy (General Instructions):

These are sample Strategies, teachers can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied Mathematical skills.
2. State the need for Mathematics with Engineering Studies and Provide real-life examples.
3. Support and guide the students for self–study.
4. You will assign homework, grading assignments and quizzes, and documenting students' progress.
5. Encourage the students to group learning to improve their creative and analytical skills.
6. Show short related video lectures in the following ways:
   - As an introduction to new topics (pre-lecture activity).
   - As a revision of topics (post-lecture activity).
   - As additional examples (post-lecture activity).
   - As an additional material of challenging topics (pre-and post-lecture activity).
   - As a model solution of some exercises (post-lecture activity).

Module-1: Fourier series and practical harmonic analysis

Periodic functions, Dirichlet's condition. Fourier series expansion of functions with period 2π and with arbitrary period: periodic rectangular wave, Half-wave rectifier, rectangular pulse, Saw tooth wave. Half-range Fourier series. Triangle and half range expansions, Practical harmonic analysis, variation of periodic current.**(8 hours)**

(RBT Levels: L1, L2 and L3)

Module-2: Infinite Fourier Transforms

Infinite Fourier transforms, Fourier cosine and sine transforms, Inverse Fourier transforms, Inverse Fourier cosine and sine transforms, discrete Fourier transform (DFT), Fast Fourier transform (FFT). **(8 hours)**

(RBT Levels: L1, L2 and L3)

Module-3: Z Transforms
Definition, Z-transforms of basic sequences and standard functions. Properties: Linearity, scaling, first and second shifting, multiplication by n. Initial and final value theorem. Inverse Z- transforms. Application to difference equations. **(8 hours)** **(RBT Levels: L1, L2 and L3)**

Module-4: Ordinary Differential Equations of Higher Order

Higher-order linear ODEs with constant coefficients - Inverse differential operator, problems.Linear differential equations with variable Coefficients-Cauchy's and Legendre's differential equations–Problems. Application of linear differential equations to L-C circuit and L-C-R circuit.**(8 hours)**

(RBT Levels: L1, L2 and L3)

Module-5: Curve fitting, Correlation, and Regressions

Principles of least squares, Curve fitting by the method of least squares in the form $y = a + bx$, $y = a + bx + cx^2$, and $y = ax^b$. Correlation, Coefficient of correlation, Lines of regression, Angle between regression lines, standard error of estimate, rank correlation.

(RBT Levels: L1, L2 and L3)(8 hours)

Course outcome (Course Skill Set)

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

1. Demonstrate the Fourier series to study the behavior of periodic functions and their applications in system communications, digital signal processing, and field theory.
2. To use Fourier transforms to analyze problems involving continuous-time signals
3. To apply Z-Transform techniques to solve difference equations
4. Understand that physical systems can be described by differential equations and solve such equations
5. Make use of correlation and regression analysis to fit a suitable mathematical model for statistical data

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.
- Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)
- The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books (Name of the author/Title of the Book/Name of the publisher/Edition and Year)

Text Books:

1. **B. S. Grewal**: "Higher Engineering Mathematics", Khanna Publishers, 44thEd., 2021.
2. **E. Kreyszig**: "Advanced Engineering Mathematics", John Wiley & Sons, 10thEd., 2018.

Reference Books:

1. **V. Ramana:** "Higher Engineering Mathematics" McGraw-Hill Education, 11thEd., 2017
2. **Srimanta Pal & Subodh C.Bhunia**: "Engineering Mathematics" Oxford University Press, 3rdEd., 2016.
3. **N.P Bali and Manish Goyal**: "A Textbook of Engineering Mathematics" Laxmi Publications, 10thEd., 2022.
4. **C. Ray Wylie, Louis C. Barrett:** "Advanced Engineering Mathematics" McGraw–Hill Book Co., New York, 6thEd., 2017.
5. **Gupta C.B, Sing S.R and Mukesh Kumar:** "Engineering Mathematic for Semester I and II", McGraw Hill Education(India) Pvt. Ltd 2015.
6. **H.K. Dass and Er. Rajnish Verma:** "Higher Engineering Mathematics" S.Chand Publication, 3rdEd.,2014.
7. **James Stewart: "**Calculus" Cengage Publications, 7thEd., 2019.

Web links and Video Lectures (e-Resources):

- http://nptel.ac.in/courses.php?disciplineID=111
- http://www.class-central.com/subject/math(MOOCs)
- http://academicearth.org/
- VTU e-Shikshana Program
- VTU EDUSAT Program.

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quizzes
- Assignments
- Seminar