**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.**<br>**Vector Differentiation:** Scalar and vector fields. Gradient, directional derivative, curl and divergence - physical interpretation, solenoidal and irrotational vector fields. Problems.<br>**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.<br><br>**Self-Study:** Volume integral and Gauss divergence theorem.<br>**Applications:** Heat and mass transfer, oil refinery problems, environmental engineering, velocity and acceleration of moving particles, analysis of streamlines.<br>**(RBT Levels: L1, L2 and L3)** |
| **Module-3:Partial Differential Equations (PDEs)(8 hours)** |
| **Importance of partial differential equations for Mechanical Engineering application.**<br>Formation of PDE's by elimination of arbitrary constants and functions. Solution of non-homogeneous 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.<br><br>**Self-Study:** Solution of the one-dimensional heat equation and wave equation by the method of separation of variables.<br>**Applications:** Vibration of a rod/membrane.<br>**(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.**<br>Solution of algebraic and transcendental equations: Regula-Falsi and Newton-Raphson methods (only formulae). Problems.<br>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.<br>**Numerical integration**: Trapezoidal, Simpson's $(1/3)^{rd}$ and $(3/8)^{th}$ rules(without proof). Problems.<br><br>**Self-Study:** Bisection method, Lagrange's inverse Interpolation.<br>**Applications:** Finding approximate solutions to solve mechanical engineering problems involving numerical data.<br>**(RBT Levels: L1, L2 and L3)** |
| **Module-5:Numerical Methods -2(8 hours)** |
| **Introduction to various numerical techniques for handling Mechanical Engineering applications.**<br>**Numerical Solution of Ordinary Differential Equations (ODEs):**<br>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.<br><br>**Self-Study:** Adam-Bashforth method.<br><br>**Applications:** Finding approximate solutions to solve mechanical engineering problems. |

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

**List of Laboratory experiments (2 hours/week per batch/ batch strength 15)**
**10 lab sessions + 1 repetition class + 1 Lab Assessment**

| | |
|---|---|
| **1** | Program to compute surface area, volume and centre of gravity |
| **2** | Evaluation of improper integrals |
| **3** | Finding gradient, divergent, curl and their geometrical interpretation |
| **4** | Verification of Green's theorem |
| **5** | Solution of one-dimensional heat equation and wave equation |
| **6** | Solution of algebraic and transcendental equations by Regula-Falsi and Newton-Raphson method |
| **7** | Interpolation/Extrapolation using Newton's forward and backward difference formula |
| **8** | Computation of area under the curve using Trapezoidal, Simpson's $(1/3)^{rd}$ and $(3/8)^{th}$ rule |
| **9** | Solution of ODE of first order and first degree by Taylor's series and Modified Euler's method |
| **10** | Solution of ODE of first order and first degree by Runge-Kutta $4^{th}$ order and Milne's predictor-corrector method |

**Suggested software's:** Mathematica/MatLab/Python/Scilab

**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):**

**Integrated Course (IC):** Theory Integrated with practical Courses. **(4 Credits)**

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 90-100% 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 15th 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" CengagePublications, 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

**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**

**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.**<br>**Vector Differentiation:** Scalar and vector fields. Gradient, directional derivative, curl and divergence - physical interpretation, solenoidal and irrotational vector fields. Problems.<br>**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.<br><br>**Self-Study:** Volume integral and Gauss divergence theorem.<br>**Applications:** Heat and mass transfer, oil refinery problems, environmental engineering. Analysis of streamlines, velocity and acceleration of a moving particle.<br>**(RBT Levels: L1, L2 and L3)** |
| **Module-3:Partial Differential Equations (PDEs)(8 hours)** |
| **Importance of partial differential equations for Civil Engineering applications**<br>Formation of PDE's by elimination of arbitrary constants and functions. Solution of non-homogeneous 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.<br>**Self-Study:** Solution of one-dimensional heat equation and wave equation by the method of separation of variables.<br>**Applications:** Design of structures (vibration of rod/membrane)<br>**(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.**<br>Solution of algebraic and transcendental equations: Regula-Falsi and Newton-Raphson methods (only formulae). Problems.<br>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.<br>**Numerical integration**: Trapezoidal, Simpson's $(1/3)^{rd}$ and $(3/8)^{th}$ rules (without proof). Problems.<br><br>**Self-Study:** Bisection method, Lagrange's inverse Interpolation**.**<br>**Applications:** Estimating the approximate roots, extremum values, area, volume, and surface area. Finding approximate solutions to civil engineering problems.<br>**(RBT Levels: L1, L2 and L3)** |
| **Module-5:Numerical Methods -2(8 hours)** |
| **Introduction to various numerical techniques for handling Civil Engineering applications.**<br>**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.<br><br>**Self-Study:** Adam-Bashforth method.<br>**Applications:** Finding approximate solutions to ODE related to civil engineering fields.<br>**(RBT Levels: L1, L2 and L3)** |

**List of Laboratory experiments (2 hours/week per batch/ batch strength 15)**
**10 lab sessions + 1 repetition class + 1 Lab Assessment**

| | |
|---|---|
| 1 | Program to compute surface area, volume and centre of gravity |
| 2 | Evaluation of improper integrals |
| 3 | Finding gradient, divergent, curl and their geometrical interpretation |
| 4 | Verification of Green's theorem |
| 5 | Solution of one-dimensional heat equation and wave equation |
| 6 | Solution of algebraic and transcendental equations by Regula-Falsi and Newton-Raphson method |
| 7 | Interpolation/Extrapolation using Newton's forward and backward difference formula |
| 8 | Computation of area under the curve using Trapezoidal, Simpson's $(1/3)^{rd}$ and $(3/8)^{th}$ rule |
| 9 | Solution of ODE of first order and first degree by Taylor's series and Modified Euler's method |
| 10 | Solution of ODE of first order and first degree by Runge-Kutta $4^{th}$ order and Milne's predictor-corrector method |

**Suggested software's:** Mathematica/MatLab/Python/Scilab

**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 90-100% 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, 44$^{th}$Ed., 2021.
2. **E. Kreyszig**: "Advanced Engineering Mathematics", John Wiley & Sons, 10$^{th}$Ed., 2018.

**Reference Books**

1. **V. Ramana:** "Higher Engineering Mathematics" McGraw-Hill Education, 11$^{th}$ Ed., 2017
2. **Srimanta Pal & Subodh C.Bhunia**: "Engineering Mathematics" Oxford University Press, 3$^{rd}$Ed., 2016.
3. **N.P Bali and Manish Goyal**: "A Textbook of Engineering Mathematics" Laxmi Publications, 10$^{th}$Ed., 2022.
4. **C. Ray Wylie, Louis C. Barrett:** "Advanced Engineering Mathematics" McGraw – Hill Book Co., New York, 6$^{th}$ 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, 3$^{rd}$ Ed.,2014.
7. **James Stewart: "**Calculus" Cengage Publications, 7$^{th}$Ed., 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

**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**

**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.**<br>**Vector Differentiation:** Scalar and vector fields. Gradient, directional derivative, curl and divergence - physical interpretation, solenoidal and irrotational vector fields. Problems.<br>**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.<br><br>**Self-Study:** Volume integral and Gauss divergence theorem.<br>**Applications:** Conservation of laws, Electrostatics, Analysis of streamlines and electric potentials.<br><br>**(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.**<br>**Vector spaces:** Definition and examples, subspace, linear span, Linearly independent and dependent sets, Basis and dimension.<br>**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.<br><br>**Self-study:** Angles and Projections.Rotation, reflection, contraction and expansion.<br>**Applications:** Image processing, AI & ML, Graphs and networks, Computer graphics.<br>**(RBT Levels: L1, L2 and L3)** |
| **Module-3:Laplace Transform(8 hours)** |
| **Importance of Laplace Transform for EC & EE engineering applications.**<br>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 s-domain, 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.<br>**Inverse Laplace Transforms:**<br>Definition, properties, evaluation using different methods, convolution theorem (without proof), problems, and applications to solve ordinary differential equations.<br>**Self-Study:** Verification of convolution theorem.<br>**Applications:** Signals and systems, Control systems, LR, CR & LCR circuits.<br>**(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.**<br>Solution of algebraic and transcendental equations: Regula-Falsi method and Newton-Raphson method (only formulae). Problems.<br>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.<br>N**umerical integration**: Trapezoidal, Simpson's $(1/3)^{rd}$ and $(3/8)^{th}$ rules(without proof). Problems.<br><br>**Self-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 predictor-corrector 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)**

**List of Laboratory experiments (2 hours/week per batch/ batch strength 15)**
**10 lab sessions + 1 repetition class + 1 Lab Assessment**

| | |
|---|---|
| **1** | Finding gradient, divergent, curl and their geometrical interpretation and Verification of Green's theorem |
| **2** | Computation of basis and dimension for a vector space and Graphical representation of linear transformation |
| **3** | Visualization in time and frequency domain of standard functions |
| **4** | Computing inverse Laplace transform of standard functions |
| **5** | Laplace transform of convolution of two functions |
| **6** | Solution of algebraic and transcendental equations by Regula-Falsi and Newton-Raphson method |
| **7** | Interpolation/Extrapolation using Newton's forward and backward difference formula |
| **8** | Computation of area under the curve using Trapezoidal, Simpson's $(1/3)^{rd}$ and $(3/8)^{th}$ rule |
| **9** | Solution of ODE of first order and first degree by Taylor's series and Modified Euler's method |
| **10** | Solution of ODE of first order and first degree by Runge-Kutta $4^{th}$ order and Milne's predictor-corrector method |

**Suggested software's:** Mathematica/MatLab/Python/Scilab

**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 90-100% 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, 44$^{th}$Ed., 2021.
2. **E. Kreyszig**: “Advanced Engineering Mathematics”, John Wiley & Sons, 10$^{th}$Ed., 2018.

**Reference Books**

1. **V. Ramana:** “Higher Engineering Mathematics” McGraw-Hill Education, 11$^{th}$ Ed., 2017
2. **Srimanta Pal & Subodh C.Bhunia**: “Engineering Mathematics” Oxford University Press, 3$^{rd}$Ed., 2016.
3. **N.P Bali and Manish Goyal**: “A Textbook of Engineering Mathematics” Laxmi Publications, 10$^{th}$Ed., 2022.
4. **C. Ray Wylie, Louis C. Barrett:** “Advanced Engineering Mathematics” McGraw – Hill Book Co., New York, 6$^{th}$ 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, 3$^{rd}$ Ed.,2014.
7. **James Stewart: “**Calculus” Cengage Publications, 7$^{th}$Ed., 2019.
8. **David C Lay:** “Linear Algebra and its Applications”, Pearson Publishers, 4$^{th}$ Ed., 2018.
9. **Gareth Williams:** “Linear Algebra with applications”, Jones Bartlett Publishers Inc., 6$^{th}$ Ed., 2017.
10. **Gilbert Strang:** “Linear Algebra and its Applications”, Cengage Publications, 4$^{th}$ Ed., 2022.

**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

**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**

**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.**<br>Scalar and vector fields. Gradient, directional derivative, curl and divergence - physical interpretation, solenoidal and irrotational vector fields. Problems.<br>**Curvilinear coordinates:**Scale factors, base vectors, Cylindrical polar coordinates, Spherical polar coordinates, transformation between cartesian and curvilinear systems, orthogonality. Problems.<br><br>**Self-Study:** Vector integration and Vector line integral.<br>**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.**<br>**Vector spaces:** Definition and examples, subspace, linear span, Linearly independent and dependent sets, Basis and dimension. Problems.<br>**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.<br><br>**Self-study:** Angles and Projections.Rotation, Reflection, Contraction and Expansion.<br>**Applications:** Image processing, AI & ML, Graphs and networks, Computer graphics.<br>**(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.**<br>Solution of algebraic and transcendental equations - Regula-Falsi and Newton-Raphson methods (only formulae). Problems.<br>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.<br>**Numerical integration**: Trapezoidal, Simpson's $(1/3)^{rd}$ and $(3/8)^{th}$ rules(without proof). Problems.<br><br>**Self-Study:** Bisection method, Lagrange's inverse Interpolation.<br>**Applications:** Estimating the approximate roots, extremum values, Area, volume, and surface area. Errors in finite precision.<br>**(RBT Levels: L1, L2 and L3)** |
| **Module-5Numerical Methods -2(8 hours)** |
| **Introduction to various numerical techniques for handling Computer Science & Engineering applications.**<br>**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.<br><br>**Self-Study:** Adam-Bashforth method.<br>**Applications:** Estimating the approximate solutions of ODE.<br>**(RBT Levels: L1, L2 and L3).** |

**List of Laboratory experiments (2 hours/week per batch/ batch strength 15)**
**10 lab sessions + 1 repetition class + 1 Lab Assessment**

| | |
|---|---|
| **1** | Program to compute area, surface area, volume and centre of gravity |
| **2** | Evaluation of improper integrals |
| **3** | Finding gradient, divergent, curl and their geometrical interpretation |
| **4** | Computation of basis and dimension for a vector space and Graphical representation of linear transformation |
| **5** | Computing the inner product and orthogonality |
| **6** | Solution of algebraic and transcendental equations by Ramanujan's, Regula-Falsi and Newton-Raphson method |
| **7** | Interpolation/Extrapolation using Newton's forward and backward difference formula |
| **8** | Computation of area under the curve using Trapezoidal, Simpson's $(1/3)^{rd}$ and $(3/8)^{th}$ rule |
| **9** | Solution of ODE of first order and first degree by Taylor's series and Modified Euler's method |
| **10** | Solution of ODE of first order and first degree by Runge-Kutta $4^{th}$ order and Milne's predictor-corrector method |

**Suggested software's:** Mathematica/MatLab/Python/Scilab

**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 90-100% 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, 44$^{th}$Ed., 2021.
2. **E. Kreyszig**: "Advanced Engineering Mathematics", John Wiley & Sons, 10$^{th}$Ed., 2018.


**Reference Books**


1. **V. Ramana:** "Higher Engineering Mathematics" McGraw-Hill Education, 11$^{th}$ Ed., 2017
2. **Srimanta Pal & Subodh C.Bhunia**: "Engineering Mathematics" Oxford University Press, 3$^{rd}$ Ed., 2016.
3. **N.P Bali and Manish Goyal**: "A Textbook of Engineering Mathematics" Laxmi Publications, 10$^{th}$ Ed., 2022.
4. **C. Ray Wylie, Louis C. Barrett:** "Advanced Engineering Mathematics" McGraw – Hill Book Co., New York, 6$^{th}$ 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, 3$^{rd}$ Ed., 2014.
7. **James Stewart: "**Calculus" Cengage Publications, 7$^{th}$Ed., 2019.
8. **David C Lay:** "Linear Algebra and its Applications", Pearson Publishers, 4$^{th}$ Ed., 2018.
9. **Gareth Williams:** "Linear Algebra with applications", Jones Bartlett Publishers Inc., 6$^{th}$ Ed., 2017.
10. **Gilbert Strang:** "Linear Algebra and its Applications", Cengage Publications, 4$^{th}$ Ed., 2022.


**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

**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**