## Academic year 2023-2024

### I Year scheme & syllabus

| Course Code | Course Title | Credits | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | Total credits | Hours |
| **23MATS11** | **Mathematics for Computer Science Engineering stream -1** | 2 | 2 | 2 | 4 | 6 |
| **23MATC11** | **Mathematics for Civil Engineering stream -1** | 2 | 2 | 2 | 4 | 6 |
| **23MATE11** | **Mathematics for Electrical and Electronics Engineering stream-1** | 2 | 2 | 2 | 4 | 6 |
| **23MATM11** | **Mathematics for Mechanical** Engineering **-1** | 2 | 2 | 2 | 4 | 6 |
| **23MATS21** | **Mathematics for Computer Science Engineering stream -2** | 2 | 2 | 2 | 4 | 6 |
| **23MATC21** | **Mathematics for Civil Engineering-2** | 2 | 2 | 2 | 4 | 6 |
| **23MATE21** | **Mathematics for Electrical and Electronics Engineering stream-2** | 2 | 2 | 2 | 4 | 6 |
| **23MATM21** | **Mathematics for Mechanical Engineering -2** | 2 | 2 | 2 | 4 | 6 |

## II Year scheme & syllabus

| Course Code | Course Title | Credits | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | Total credits | Hours |
| 22MA301 | Mathematics for Computer Science Engineering | 2 | 2 | 0 | 3 | 4 |
| 22MA301 | Mathematics for Information Science Engineering | 3 | 2 | 0 | 4 | 5 |
| 22MA301 | Mathematics for Electronics and Communication Engineering | 3 | 2 | 0 | 4 | 5 |
| 22MA301 | Mathematics for Electrical and Electronics Engineering | 2 | 2 | 0 | 3 | 4 |
| 22MA301 | Mathematics for Mechanical Engineering | 2 | 2 | 0 | 3 | 4 |
| 22MA401 | Statistics and Probability for Computer Science | 2 | 2 | 0 | 3 | 4 |
| 22MA401 | Linear algebra and Applications for ALML and CSBS | 2 | 2 | 0 | 3 | 4 |
| 22MA302 | Discrete Mathematical Structures (Elective course - IS) | 2 | 2 | 0 | 3 | 4 |
| 22MA402 | Discrete Mathematical Structures (Elective course - CS/ALML) | 2 | 2 | 0 | 3 | 4 |
| 22AEC401 | Statistics with R Lab for machine learning (Ability Enhancement Course - E&E) | 0 | 0 | 2 | 1 | 2 |
| 22BCM301 | Bridge Course Mathematics - I | 3 | 0 | 0 | 0 | 3 |
| 22BCM401 | Bridge Course Mathematics - II | 3 | 0 | 0 | 0 | 3 |

## Open Elective scheme & syllabus

| Course Code | Open Electives | Credits | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | Total credits | Hours |
| 21OEMA61 | Operation Research | 3 | 0 | 0 | 3 | 3 |
| 21OEMA62 | Linear Algebra and numerical methods | 3 | 0 | 0 | 3 | 3 |
| 21OEMA63 | Numerical Methods | 3 | 0 | 0 | 3 | 3 |
| 21OEMA64 | Linear Programming | 3 | 0 | 0 | 3 | 3 |
| 21OEMA65 | Graph Theory and Combinatorics | 3 | 0 | 0 | 3 | 3 |
| 21OEMA69 | Linear Algebra and Statistics With python/R Programming | 2 | 0 | 2 | 3 | 4 |

# MALNAD COLLEGE OF ENGINEERING, HASSAN

**(An Autonomous Institution Affiliated to VTU, Belgaum)**

**Autonomous Programme**

**Bachelor of Engineering**

## DEPARTMENT OF MATHEMATICS

SYLLABUS

I & II Semester (2023 Admitted Batch)

(1st year)

**Academic Year 2023-24**

## PROGRAM OUTCOMES (POs)

**Engineering Graduates will be able to:**

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and computer science and business systems to the solution of complex engineering and societal problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering and business problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problem**s: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering and business practices.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in business societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering and business practices.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering, business and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

## Scheme of evaluation (Theory courses)

| Assessment | Marks |
|---|---|
| Three CIE's | 30 |
| Integrated LAB | 20 |
| SEE | 50 |
| Total | 100 |

## Scheme of evaluation (lab courses-IPCC)

| Assessment | Marks |
|---|---|
| Manual solving | 04 |
| Record writing and observation | 03 |
| Executing the Programme with correct output | 08 |
| Final CIE | 05 |
| Total | 20 |

| Examination | Maximum marks | Minimum marks to qualify |
|---|---|---|
| CIE | 50 | 20(12 +8) |
| SEE | 50 | 20 |

| Course Title | Mathematics for Computer Science Engineering stream -1 | | |
|---|---|---|---|
| **Course Code** | 23MATS11 | **Course Type** | IPCC |
| **SEE duration** | 3hours | **(L-T-P-C)** | (2-2-2-4) |
| **CIE(Theory) marks** | 30 | **Hours / Week** | 06 |
| **CIE(Practical)/Activity marks** | 20 | **SEE marks** | 50 |

**Course Objective**: To train the students to acquire knowledge in calculus and numerical methods so as to solve basic engineering application problems.

**Course Outcomes (COs):** At the end of course, student will be able to:

| COs | Outcomes | POs | PSOs |
|---|---|---|---|
| **CO1** | Compute Taylor series, partial derivatives, pedal equation, curvature, and solve simple problems connected with multiple integrals, Counting principle, bayes theorem on probability, evolutes, errors and approximation. | PO1 | - |
| **CO2** | Inspect for extreme values [the maximum output of a function (experimental data-)], analyze the region of integration connected with multiple integrals so as to determine the area, volume. | PO1, PO2 | - |
| **CO3** | Apply the numerical methods to compute: The area of a region, root (input) of an equation for the given output, missing input or output of the given experimental data (interpolation/extrapolation). | PO1 | - |
| **CO4** | Model the real-life problems/engineering application problems and solve the same. | PO1, PO2 | - |
| **CO5** | Write the program in python for the mathematical procedures connected with calculus , numerical methods , differential equations ,vector calculus, execute the same and provides correct output. | PO1, PO2 | - |

**CO-PO Mapping:**

| | PO1 | PO2 |
|---|---|---|
| CO1 | 3 | - |
| CO2 | 3 | 2 |
| CO3 | 3 | - |
| CO4 | 3 | 2 |
| CO5 | 3 | 2 |

**Course Contents:**

| MODULE –1 | 12 Hrs. |
|---|---|

**Differential Calculus:** Definition of average growth rate and its illustrative examples. Definition of differentiability, Statement of Taylor's theorem, Taylor's series for a function of one variable - Illustrative examples.Polar coordinates, Polar curves, angle between the radius vector and the tangent, angle between two curves, Pedal equations. Curvature and Radius of curvature – Cartesian.

**Applications -**Optimization (extremevalues of a single variable)- Extremevalues of a single variable-cost and revenue.

**Self Study:**Brief introduction to evolutes and involutes. Indeterminate forms - L'Hospital's rule, problems. Extreme values of a single variable.

| MODULE –2 | 13 Hrs. |
|---|---|

**Partial differentiation:** Definition of Partial derivative, Physical and geometrical interpretation of partial differentiationand Illustrative examples. Evaluation of Jacobians, Statement of Taylor theorem for a function of two variables and illustrative examples on Taylor's series.Expansion of a function as a Maclaurin's series for function of one variable and two variables-illustrative examples.Extreme values of functions of two variables

**Applications -**.To express the experimental data interms of quadratic equation (function of one variable) and hence to find the maximum value of the experimental data (curve fitting).Application of total derivative- controlling sag in an uniformly loaded beam.

**Self Study:**Lagrange's method of undermined multifliers.Errors and approximations- Application in Computer Science Engineering.

| MODULE –3 | 13 Hrs. |
|---|---|

**Numerical Methods:** Numerical Solution of algebraic & transcendental equations by Bisection method, Newton Raphson method, Finite differences- Interpolation-Definition of forward, backward differences, Newton's forward and backward interpolation formulae, Lagrange's interpolation formulae.

**Numerical Integration:** Evaluation of a line integral by Trapezoidal rule, Simpson's 1/3rd and 3/8th rule, Weddle's rule. Illustrative examples from engineering field.

**Applications**- General applications connected with business cost and revenue.Errors in finite precision.

**Self Study:** Inverse Lagrange's interpolation formula, central difference formula- Bessel's formula to find the relation between the input and output of an experimental data using suitable interpolation formula. Application of arc length-application to make sheets of corrugated iron roofing. Approximate solutions of ODE related to Computer Science Engineering.

| **MODULE – 4** | **12 hrs.** |
|---|---|

**Multiple Integrals:** Introduction to coordinate systems. Double integrals in Cartesian & Polar form. Application to find area and volume. Evaluation of triple integrals in Cartesian co-ordinate system.

**Probability Theory**: Counting principle - sum rule, product rule, permutation and combination, review of probability- applications of Baye's theorem.

**Application** - applications connected with Computer science. to find mass and moment for the thin plate covering the region in the xy plane.

**Self-Study:**. Definitions and properties of Beta and gamma functions, Simple Problems,

**List of Programmes:**

1. Computation of roots using - bisection method, Newton Raphson method.
2. To compute the extreme values of a function of two variables.
3. Interpolation by- Newton's forward & Lagrange's interpolation formula.
4. Numerical integration- line integral (Trapezoidal rule , Weddle's rule)
5. Numerical integration- line integral (Simpson's $1/3^{rd}$ rule , Simpson's $3/8^{th}$ rule)
6. Solution of first order differential equation and plotting the graph.
7. Finding angle between polar curves & computing the curvature of a given curve.
8. Finding partial derivatives, Jacobians.
9. Computing area by line integral & double integral.
10. Expressing the function of one variable & two variables using Taylor's & Maclaurin's series.

**NOTE:**

1.Proofs are not required for any theorems and properties.

2.There should not be any questions from self study part in semester End Examination.

**Text Books :**

1. Dr. B. S. Grewal, Higher Engineering Mathematics, Khanna Publications, 44th edition, 2016.

2. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley India P.v.t. Ltd. 8th Edition, (Wiley student edition) 2004.

3. Thomas Finney, Calculus, 9th edition, Pearson education, 2002

Discrete mathematics by J.K. Sharma.

**Reference Books:**

1. R. K. Jain and S. R. K. Jain & S. R. K. Iyengar, Numerical methods, New age International p.v.t. Publishers, 6th edition, 2014.

2. N.P. Bali and Manish Goyal, A textbook of Engineering Mathematics, Laxmi Publications, Reprint, 2010.

**Web links**

- http://nptel.ac.in/courses.phd?disciplineID=111
- http://www.class-central.com/subject/math(MOOCs)
- http://academicerath.org/

| Course Title | Mathematics for Civil Engineering stream -1 | | |
|---|---|---|---|
| **Course Code** | **23MATC11** | **Course Type** | IPCC |
| **SEE duration** | **3hours** | **(L-T-P-C)** | (2-2-2-4) |
| **CIE(Theory) marks** | **30** | **Hours / Week** | 06 |
| **CIE(Practical)/Activity marks** | **20** | **SEE marks** | 50 |

**Course Objective**: To train the students to acquire knowledge in calculus and numerical methods so as to solve basic engineering application problems.

**Course Outcomes (COs):** At the end of course, student will be able to:

| COs | Outcomes | POs | PSOs |
|---|---|---|---|
| **CO1** | Compute Taylor series, partial derivatives, pedal equation, curvature, and solve simple problems connected with multiple integrals, evolutes, errors and approximation. | PO1 | - |
| **CO2** | Inspect for extreme values [the maximum output of a function (experimental data-)], analyze the region of integration connected with multiple integrals so as to determine the area, volume. | PO1, PO2 | - |
| **CO3** | Apply the numerical methods to compute: The area of a region, root (input) of an equation for the given output, missing input or output of the given experimental data (interpolation/extrapolation). | PO1 | - |
| **CO4** | Model the real-life problems/engineering application problems and solve the same. | PO1, PO2 | - |
| **CO5** | Write the program in python for the mathematical procedures connected with calculus, numerical methods, differential equations, vector calculus, execute the same and provides correct output. | PO1, PO2 | - |

**CO-PO Mapping:**

| | PO1 | PO2 |
|---|---|---|
| **CO1** | **3** | **-** |
| **CO2** | **3** | **2** |
| **CO3** | **3** | **-** |
| **CO4** | **3** | **2** |
| **CO5** | **3** | **2** |

**Course Contents:**

| MODULE –1 | 12 Hrs. |
|---|---|

**Differential Calculus:** Definition of average growth rate and its illustrative examples. Definition of differentiability, Statement of Taylor's theorem, Taylor's series for a function of one variable - Illustrative examples.Polar coordinates, Polar curves, angle between the radius vector and the tangent, angle between two curves, Pedal equations. Curvature and Radius of curvature – Cartesian.

**Applications -**Stiffness of a beam, strength of a beam.

**Self Study:**Brief introduction to evolutes and involutes. Indeterminate forms - L'Hospital's rule, problems. Extreme values of a single variable.

| MODULE –2 | 13 Hrs. |
|---|---|

**Partial differentiation:** Definition of Partial derivative, Physical and geometrical interpretation of partial differentiationand Illustrative examples. Evaluation of Jacobians, Statement of Taylor theorem for a function of two variables and illustrative examples on Taylor's series.Expansion of a function as a Maclaurin's series for function of one variable and two variables-illustrative examples.Extreme values of functions of two variables.

**Applications -** To express the experimental data interms of quadratic equation (function of one variable) and hence to find the maximum value of the experimental data (curve fitting). Application of total derivative- controlling sag in an uniformly loaded beam.

**Self Study:** Lagrange's method of undermined multifliers. Errors and approximations- Application in Civil engineering.

| MODULE –3 | 13 Hrs. |
|---|---|

**Numerical Methods:** Numerical Solution of algebraic & transcendental equations by Bisection method, Newton Raphson method, Finite differences- Interpolation-Definition of forward, backward differences, Newton's forward and backward interpolation formulae, Lagrange's interpolation formulae.

**Numerical Integration:** Evaluation of a line integral by Trapezoidal rule, Simpson's 1/3rd and 3/8th rule, Weddle's rule. Illustrative examples from engineering field.

**Applications** - finding projectile height from its acceleration, initial velocity and initial position. Estimation of discharge in a stream – an application to hydrology, estimation of discharge in a stream – an application to surveying. Moment, mass and center of mass of a thin rod.

**Self Study:** Inverse Lagrange's interpolation formula, central difference formula- Bessel's formula to find the relation between the input and output of an experimental data using suitable interpolationformula. Application of arc length-application to make sheets of corrugated iron roofing. Approximate solutions of ODE related to Civil Engineering.

| MODULE – 4 | 12 hrs. |
|---|---|

**Multiple Integrals:** Introduction to coordinate systems. Double integrals in Cartesian & Polar form. Application to find area and volume. Evaluation of triple integrals in Cartesian co-ordinate system. Evaluation of triple integrals in cylindrical and Spherical co-ordinate system.

**Applications** - to find mass and moment for the thin plate covering the region in the xy plane. Mass and moment for the object in space. Moment of inertia of a circle about its diametrical axis- an application to engineering Mechanics, computation of deflection of beams using double integral.

**Self-Study:** Definitions and properties of Beta and gamma functions, Simple Problems.

**List of Programes:**

1. Computation of roots using - bisection method, Newton Raphson method.
2. To compute the extreme values of a function of two variables.
3. Interpolation by- Newton's forward & Lagrange's interpolation formula.
4. Numerical integration- line integral (Trapezoidal rule , Weddle's rule)
5. Numerical integration- line integral (Simpson's $1/3^{rd}$ rule , Simpson's $3/8^{th}$ rule)
6. Solution of first order differential equation and plotting the graph.
7. Finding angle between polar curves & computing the curvature of a given curve.
8. Finding partial derivatives, Jacobians.
9. Computing area by line integral & double integral.
10. Expressing the function of one variable & two variables using Taylor's & Maclaurin's series.

**NOTE:**

1. Proofs are not required for any theorems and properties.
2. There should not be any questions from self study part in semester End Examination.

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**Reference Books:**

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2. N.P. Bali and Manish Goyal, A textbook of Engineering Mathematics, Laxmi Publications, Reprint, 2010.

**Web links**

- http://nptel.ac.in/courses.phd?disciplineID=111
- http://www.class-central.com/subject/math(MOOCs)
- http://academicerath.org/

| Course Title | Mathematics for Electrical and Electronics Engineering stream-1 | | |
|---|---|---|---|
| Course Code | 23MATE11 | Course Type | IPCC |
| SEE duration | 3hours | (L-T-P-C) | (2-2-2-4) |
| CIE(Theory) marks | 30 | Hours / Week | 06 |
| CIE(Practical)/Activity marks | 20 | SEE marks | 50 |

**Course Objective**: To train the students to acquire knowledge in calculus and numerical methods so as to solve basic engineering application problems.

**Course Outcomes (COs):** At the end of course, student will be able to:

| COs | Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | Compute Taylor series, partial derivatives, pedal equation, curvature, and solve simple problems connected with multiple integrals, Counting principle, bayes theorem on probability, evolutes, errors and approximation. | PO1 | - |
| CO2 | Inspect for extreme values [the maximum output of a function (experimental data-)], analyze the region of integration connected with multiple integrals so as to determine the area, volume. | PO1, PO2 | - |
| CO3 | Apply the numerical methods to compute: The area of a region, root (input) of an equation for the given output, missing input, or output of the given experimental data (interpolation/extrapolation). | PO1 | - |
| CO4 | Model the real-life problems/engineering application problems and solve the same. | PO1, PO2 | - |
| CO5 | Write the program in python for the mathematical procedures connected with calculus, numerical methods, differential equations, vector calculus, execute the same and provides correct output. | PO1, PO2 | - |

**CO-PO Mapping:**

| | PO1 | PO2 |
|---|---|---|
| CO1 | 3 | - |
| CO2 | 3 | 2 |
| CO3 | 3 | - |
| CO4 | 3 | 2 |
| CO5 | 3 | 2 |

| **Course Contents:** | |
|---|---|
| **MODULE –1** | **12 Hrs.** |
| **Differential Calculus:** Definition of average growth rate and its illustrative examples. Definition of differentiability, Statement of Taylor's theorem, Taylor's series for a function of one variable - Illustrative examples.Polar coordinates, Polar curves, angle between the radius vector and the tangent, angle between two curves, Pedal equations. Curvature and Radius of curvature – Cartesian.<br><br>**Applications -**Optimization (extremevalues of a single variable)- to find the peak current in an circuit.<br><br>**Self Study:**Brief introduction to evolutes and involutes. Indeterminate forms - L'Hospital's rule, problems. Extreme values of a single variable. | |
| **MODULE –2** | **13 Hrs.** |
| **Partial differentiation:** Definition of Partial derivative, Physical and geometrical interpretation of partial differentiationand Illustrative examples. Evaluation of Jacobians, Statement of Taylor theorem for a function of two variables and illustrative examples on Taylor's series.Expansion of a function as a Maclaurin's series for function of one variable and two variables-illustrative examples.Extreme values of functions of two variables.<br><br>**Applications -** To express the experimental data interms of quadratic equation (function of one variable) and hence to find the maximum value of the experimental data (curve fitting). Application of total derivative- controlling sag in an uniformly loaded beam.<br><br>**Self Study:** Lagrange's method of undermined multifliers. Errors and approximations- Application in Electrical Engineering. | |
| **MODULE –3** | **13 Hrs.** |
| **Numerical Methods:** Numerical Solution of algebraic & transcendental equations by Bisection method, Newton Raphson method, Finite differences- Interpolation-Definition of forward, backward differences, Newton's forward and backward interpolation formulae, Lagrange's interpolation formulae.<br><br>**Numerical Integration:** Evaluation of a line integral by Trapezoidal rule, Simpson's 1/3rd and 3/8th rule, Weddle's rule. Illustrative examples from engineering field.<br><br>**Applications**- Application of root finding- ion concentration, Forcing electrons together, To estimate the total amount of pollutant produced due to production of electricity by burning oil.<br><br>**Self Study:** Inverse Lagrange's interpolation formula, central difference formula- Bessel's formula to find the relation between the input and output of an experimental data using suitable interpolation formula. Application of arc length-application to make sheets of corrugated iron roofing. Approximate solutions of ODE related to Electrical Engineering. | |
| **MODULE – 4** | **12 hrs.** |

**Multiple Integrals:** Introduction to coordinate systems. Double integrals in Cartesian & Polar form. Application to find area and volume. Evaluation of triple integrals in Cartesian co-ordinate system.

**Probability Theory**: Counting principle - sum rule, product rule, permutation and combination, review of probability- applications of Baye's theorem.

**Application** - Brief note on the applications connected with field and wave theory. Calculation optimal power in an electrical circutes.

**Self-Study:** Definitions and properties of Beta and gamma functions, Simple Problems.

**List of Programmes:**

1. Computation of roots using - bisection method, Newton Raphson method.
2. To compute the extreme values of a function of two variables.
3. Interpolation by- Newton's forward & Lagrange's interpolation formula.
4. Numerical integration- line integral (Trapezoidal rule , Weddle's rule)
5. Numerical integration- line integral (Simpson's $1/3^{rd}$ rule , Simpson's $3/8^{th}$ rule)
6. Solution of first order differential equation and plotting the graph.
7. Finding angle between polar curves & computing the curvature of a given curve.
8. Finding partial derivatives, Jacobians.
9. Computing area by line integral & double integral.
10. Expressing the function of one variable & two variables using Taylor's & Maclaurin's series.

**NOTE:**

1. Proofs are not required for any theorems and properties.

2. There should not be any questions from self study part in semester End Examination.

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2. N.P. Bali and Manish Goyal, A textbook of Engineering Mathematics, Laxmi Publications, Reprint, 2010.

**Web links**

- http://nptel.ac.in/courses.phd?disciplineID=111
- http://www.class-central.com/subject/math(MOOCs)
- http://academicerath.org/

| Course Title | Mathematics for Mechanical Engineering -1 | | |
|---|---|---|---|
| **Course Code** | **23MATM11** | **Course Type** | **IPCC** |
| **SEE duration** | **3hours** | **(L-T-P-C)** | **(2-2-2-4)** |
| **CIE(Theory) marks** | **30** | **Hours / Week** | **06** |
| **CIE(Practical)/Activity marks** | **20** | **SEE marks** | **50** |

**Course Objective**: To train the students to acquire knowledge in calculus and numerical methods so as to solve basic engineering application problems.

**Course Outcomes (COs):** At the end of course, student will be able to:

| COs | Outcomes | POs | PSOs |
|---|---|---|---|
| **CO1** | Compute Taylor series, partial derivatives, pedal equation, curvature, and solve simple problems connected with multiple integrals, evolutes, errors and approximation. | PO1 | - |
| **CO2** | Inspect for extreme values [the maximum output of a function (experimental data-)], analyze the region of integration connected with multiple integrals so as to determine the area, volume. | PO1, PO2 | - |
| **CO3** | Apply the numerical methods to compute: The area of a region, root (input) of an equation for the given output, missing input, or output of the given experimental data (interpolation/extrapolation). | PO1 | - |
| **CO4** | Model the real-life problems/engineering application problems and solve the same. | PO1, PO2 | - |
| **CO5** | Write the program in python for the mathematical procedures connected with calculus, numerical methods, differential equations, vector calculus, execute the same and provides correct output. | PO1, PO2 | - |

**CO-PO Mapping:**

| | PO1 | PO2 |
|---|---|---|
| **CO1** | **3** | **-** |
| **CO2** | **3** | **2** |
| **CO3** | **3** | **-** |
| **CO4** | **3** | **2** |
| **CO5** | **3** | **2** |

**Course Contents:**

| MODULE –1 | 12 Hrs. |
|---|---|

**Differential Calculus:** Definition of average growth rate and its illustrative examples. Definition of differentiability, Statement of Taylor's theorem, Taylor's series for a function of one variable - Illustrative examples.Polar coordinates, Polar curves, angle between the radius vector and the tangent, angle between two curves, Pedal equations. Curvature and Radius of curvature – Cartesian.

**Applications -**Stiffness of a beam, strength of a beam.

**Self Study:** Brief introduction to evolutes and involutes. Indeterminate forms - L'Hospital's rule, problems. Extreme values of a single variable.

| MODULE –2 | 13 Hrs. |
|---|---|

**Partial differentiation:** Definition of Partial derivative, Physical and geometrical interpretation of partial differentiationand Illustrative examples. Evaluation of Jacobians, Statement of Taylor theorem for a function of two variables and illustrative examples on Taylor's series.Expansion of a function as a Maclaurin's series for function of one variable and two variables-illustrative examples.Extreme values of functions of two variables.

**Applications -**Applications of Optimization (extremevalues of a single variable)- metal fabrication.Application of total derivative- controlling sag in an uniformly loaded beam.

**Self Study:** Lagrange's method of undermined multifliers. Errors and approximations- Application in Mechanical Engineering.

| MODULE – 3 | 13 hrs. |
|---|---|

**Numerical Methods:** Numerical Solution of algebraic & transcendental equations by Bisection method, Newton Raphson method, Finite differences- Interpolation-Definition of forward, backward differences, Newton's forward and backward interpolation formulae, Lagrange's interpolation formulae.

**Numerical Integration:** Evaluation of a line integral by Trapezoidal rule, Simpson's 1/3rd and 3/8th rule, Weddle's rule. Illustrative examples from engineering field.

**Applications** - Amount of work required to put a satellite in an orbit.To estimate the length of the tank in a design of an airoplane wich has a constantan cross sectional area in each wing.

**Self Study:** Inverse Lagrange's interpolation formula, central difference formula- Bessel's formula to find the relation between the input and output of an experimental data using suitable interpolation formula. Application of arc length-application to make sheets of corrugated iron roofing. Approximate solutions of ODE related to Mechanical Engineering.

| MODULE – 4 | 12 hrs. |
|---|---|

**Multiple Integrals:** Introduction to coordinate systems. Double integrals in Cartesian & Polar form. Application to find area and volume. Evaluation of triple integrals in Cartesian co-ordinate system. Evaluation of triple integrals in cylindrical and Spherical co-ordinate system.

**Applications** - to find mass and moment for the thin plate covering the region in the xy plane. Mass and moment for the object in space. Moment of inertia of a circle about its diametrical axis- an application to engineering Mechanics, computation of deflection of beams using double integral

**Self-Study:** Definitions and properties of Beta and gamma functions, Simple Problems.

**List of Programmes:**

1. Computation of roots using - bisection method, Newton Raphson method.
2. To compute the extreme values of a function of two variables.
3. Interpolation by- Newton's forward & Lagrange's interpolation formula.
4. Numerical integration- line integral (Trapezoidal rule , Weddle's rule)
5. Numerical integration- line integral (Simpson's $1/3^{rd}$ rule , Simpson's $3/8^{th}$ rule)
6. Solution of first order differential equation and plotting the graph.
7. Finding angle between polar curves & computing the curvature of a given curve.
8. Finding partial derivatives, Jacobians.
9. Computing area by line integral & double integral.
10. Expressing the function of one variable & two variables using Taylor's & Maclaurin's series.

**NOTE:**

1.Proofs are not required for any theorems and properties.

2.There should not be any questions from self study part in semester End Examination.

**Text Books :**

1. Dr. B. S. Grewal, Higher Engineering Mathematics, Khanna Publications, 44th edition, 2016.

2. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley India P.v.t. Ltd. 8th Edition, (Wiley student edition) 2004.

3.Thomas Finney, Calculus, 9th edition, Pearson education, 2002

**Reference Books:**

1. R. K. Jain and S. R. K. Jain & S. R. K. Iyengar, Numerical methods, New age International p.v.t. Publishers, 6th edition, 2014.

2. N.P. Bali and Manish Goyal, A textbook of Engineering Mathematics, Laxmi Publications, Reprint, 2010.

**Web links**

- http://nptel.ac.in/courses.phd?disciplineID=111
- http://www.class-central.com/subject/math(MOOCs)
- http://academicerath.org/

## Programming in Python

Course outcome of Mathematical procedures using Python Programme:

**CO5:** At the end of the course, students will be able to write the Programme in Python for the Mathematical procedures connected with calculus, numerical methods, differential equations, vector calculus, execute the same and provides correct output.

| | PO1 | PO2 | P05 |
|---|---|---|---|
| CO5 | 3 | 2 | 1 |

| Course Title | Mathematics for Computer Science Engineering stream -2 | | |
|---|---|---|---|
| **Course Code** | **23MATS21** | **Course Type** | **IPCC** |
| **SEE duration** | **3 hour** | **(L-T-P-C)** | **(2-2-2-4)** |
| **CIE(Theory) marks** | **30** | **Hours / Week** | **06** |
| **CIE(Practicals)/Activity marks** | **20** | **SEE marks** | **50** |

**Course Objective**: To train the students to acquire knowledge in differential equations and vector calculus, so as to solve basic engineering application problems.

**Course Outcomes (COs):** At the end of course, student will be able to

| COs | Outcomes | POs | PSOs |
|---|---|---|---|
| **CO1** | Apply suitable methods to solve the simple problems connected with ordinary differential equations/partial differential equations and vector calculus, number theory. | PO1 | - |
| **CO2** | Examine the higher order problems (more difficult problems) that are connected with differential equations/partial differential equations and solve. | PO1, PO2 | - |
| **CO3** | Examine and compute the vector calculus problems/applications connected with gradient, divergence and curl. | PO1, PO2 | - |
| **CO4** | Model the real-life problems/ Engineering application problems and hence solve the same. | PO1, PO2 | - |
| **CO5** | Write the program in python for the mathematical procedures connected with calculus, numerical methods, differential equations, vector calculus, execute the same and provides correct output. | PO1, PO2 | - |

**CO-PO Mapping:**

| | PO1 | PO2 |
|---|---|---|
| **CO1** | **3** | **-** |
| **CO2** | **3** | **2** |
| **CO3** | **3** | **2** |
| **CO4** | **3** | **2** |
| **CO5** | **3** | **2** |

**Course Contents:**

| MODULE –1 | 12 Hrs. |
|---|---|

**Ordinary Differential Equations: First order first degree-**Linear differential equations, Exact differential equations, Power series solutions.

**Applicatons** - Mathematical modelling through differential equations of first order first degree and solution-modelling of population growth, finding initial velocity of the space vehicle so that it has to escape from earth. Modelling of infected diseases, carbon dating half-life period, mixing problem involving one tank, two tank.Application of first order differential equation- Autonomous equation and population dynamics-Application- Logistic model- Natural growth of halibut population in certain areas of Pacific Ocean, Harvesting a renewable resource.

**Self-Study**- Bernoulli's differential equations, 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 in Cartesian form, illustrative examples Applications to find the orthogonal trajectories -streamlines of flow in the channel, curves of constant temperature in a body. Equi-potential lines in an electric field between two concentric cylinders**.**

| MODULE –2 | 13 Hrs. |
|---|---|

**Ordinary Differential Equations: Higher order -** Linear differential equation with constant coefficients - Solutions of homogeneous equations. Particular solution of non- homogenous differential equations by inverse differential operator method for the following standard forms, exponential, polynomial, trigonometric and their product. Method of variation of parameters to solve linear differential equation with constant coefficients. Matrix method to solve homogeneous differential equations of order 2, degree 1.

**Applications --** Oscillatory Electrical circuit, LC Circuit, LCR Circuit, LC Circuit with e.m.f , LCR Circuit with e.m.f – Electro-Mechanical Analogy.

**Self-Study-** Method of undetermined coefficients, LDE with variable coefficients (Cauchy's and Legendre's differential equations).

| MODULE –3 | 13 Hrs. |
|---|---|

**Numerical solution of first order, first degree ODE:** Taylor's series method, Runge-Kutta (RK) method of fourth order, Milne's predictor corrector methods, and Adam-Bashforth method.

**Partial Differential Equations**: Solving PDE by variable separable method, solution of non-homogeneous PDE by direct integration. Numerical solution of a Laplace equation, Poisson equation by finite difference approximation method using standard five point formula, diagonal formula and iterative formulas.

**Applications -** To find all possible solutions of one-dimensional heat equation and two-dimensional wave equation.

**Self-Study-** Homogeneous PDEs involving derivatives with respect to one independent variable only. Solution of Lagrange's linear PDE. To find all possible solutions of two-dimensional Laplace equation. Application connected with Computer science Engineering.

| **MODULE – 4** | **12 hrs.** |
|---|---|

**Vector Calculus:** Velocity & acceleration of a vector point function, moment of a force, velocity of a rotating body, rotation of a rigid body, Gradient, divergence & curl. Physical & Geometrical Interpretation of dot product, Gradient, divergence & curl, irrotational vectors, illustrative examples from engineering field.

**Number theory** -Properties of integers- division algorithm, GCD and LCM, Congruence relations, residue classes, congruence equations, applications of congruences on cryptography.

**Applications -**Modelling projectile motion( vector approach).

**Self-Study- Curvilinear coordinates:** Scale factors, base vectors, and transformation between Cartesian and curvilinear systems, orthogonality- Problems.

**List of Programmes:**

1. Solution of first order ordinary differential equation using Taylor series & Range-kutta method.
2. Solution of partial differential equation ( Laplace & Poisson equations)
3. Finding gradient, divergence and curl.
4. Computation of area, volume and center of gravity.
5. Verification of Green's theorem in vector integration.
6. Solution of system of equations by Gauss elimination method.
7. Solution of $2^{nd}$ order differential equations (by variation of parameter method).
8. Numerical solution of simultaneous differential equations by Range-kutta method.
9. Solution of system of linear equations using Gauss-Seidal iteration method.
10. Product of matrices & finding Inverse of a matrix.

**NOTE:**
1.Proofs are not required for any theorems and properties.
2.There should not be any questions from self study part in semester End Examination.

**Text Books :**

1. Dr. B. S. Grewal, Higher Engineering Mathematics, Khanna Publications, 44th edition, 2016.

2. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley India Pvt. Ltd. 8th Edition (Wiley student edition) 2004.

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2. N.P. Bali and Manish Goyal, A textbook of Engineering Mathematics, Laxmi Publications, Reprint, 2010

**Web links**

- http://nptel.ac.in/courses.phd?disciplineID=111
- http://www.class-central.com/subject/math(MOOCs)
- http://academicerath.org/

| Course Title | Mathematics for Civil Engineering-2 | | |
|---|---|---|---|
| Course Code | 23MATC 21 | Course Type | IPCC |
| SEE duration | 3 hour | (L-T-P-C) | (2-2-2-4) |
| CIE(Theory) marks | 30 | Hours / Week | 06 |
| CIE(Practical's)/Activity marks | 20 | SEE marks | 50 |

**Course Objective**: To train the students to acquire knowledge in Differential equations and vector calculus so as to solve basic engineering application problems.

**Course Outcomes (COs):** At the end of course, student will be able to:

| COs | Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | Apply suitable methods to solve the simple problems connected with ordinary differential equations/partial differential equations and vector calculus. | PO1 | - |
| CO2 | Examine the higher order problems (more difficult problems) that are connected with differential equations/partial differential equations and solve. | PO1, PO2 | - |
| CO3 | Examine and compute the vector calculus problems/applications connected with gradient, divergence and curl. | PO1, PO2 | - |
| CO4 | Model the real-life problems/ Engineering application problems and hence solve the same. | PO1, PO2 | - |
| CO5 | Write the program in python for the mathematical procedures connected with calculus, numerical methods, differential equations, vector calculus, execute the same and provides correct output. | PO1, PO2 | - |

**CO-PO Mapping:**

| | PO1 | PO2 |
|---|---|---|
| CO1 | 3 | - |
| CO2 | 3 | 2 |
| CO3 | 3 | 2 |
| CO4 | 3 | 2 |
| CO5 | 3 | 2 |

**Course Contents:**

| MODULE –1 | 12 Hrs. |
|---|---|

**Ordinary Differential Equations: First order first degree-**Linear differential equations, Exact differential equations,

**Applicatons** - Mathematical modelling through differential equations of first order first degree and solution-modelling of population growth, finding initial velocity of the space vehicle so that it has to escape from earth. Modelling of infected diseases, carbon dating half-life period, mixing problem involving one tank, two tank.Application of first order differential equation- Autonomous equation and population dynamics-Application- Logistic model- Natural growth of halibut population in certain areas of Pacific Ocean, Harvesting a renewable resource.

**Self-Study**-Bernoulli's differential equations, 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 in Cartesian form, illustrative examples. Applications to find the orthogonal trajectories -streamlines of flow in the channel, curves of constant temperature in a body. Equi-potential lines in an electric field between two concentric cylinders**.**

| MODULE –2 | 13 Hrs. |
|---|---|

**Ordinary Differential Equations: Higher order -** Linear differential equation with constant coefficients - Solutions of homogeneous equations. Particular solution of non- homogenous differential equations by inverse differential operator method for the following standard forms, exponential, polynomial, trigonometric and their product. Method of variation of parameters to solve linear differential equation with constant coefficients. Matrix method to solve homogeneous differential equations of order 2, degree 1.

**Applications -** Mechanical Vibrations-A Spring mass system $mu^{II}(t)+ku^{I}(t)+gu(t)=f(t)$- Undamped free vibrations, damped free vibrations, forced vibrations with damping, forced vibrations without damping.

**Self-Study**- Method of undetermined coefficients, LDE with variable coefficients (Cauchy's and Legendre's differential equations). Mechanical system and transmission lines.

| MODULE –3 | 13 Hrs. |
|---|---|

**Numerical solution of first order, first degree ODE:** Taylor's series method, Runge-Kutta (RK) method of fourth order, Milne's predictor corrector methods, Adam-Bash forth method.

**Partial Differential Equations**: Solving PDE by variable separable method. Solution of non-homogeneous PDE by direct integration. Numerical solution of a Laplace equation, Poisson equation by finite difference approximation method using standard five point formula, diagonal formula and iterative formulas.

**Applications -** To find all possible solutions of one-dimensional heat equation and two-dimensional wave equation. Application connected with Civil Engineering.

**Self-Study-** Homogeneous PDEs involving derivatives with respect to one independent variable only. Solution of Lagrange's linear PDE. To find all possible solutions of two-dimensional Laplace equation.

| **MODULE – 4** | **12 hrs.** |
|---|---|

**Vector Calculus:** Velocity & acceleration of a vector point function, moment of a force, velocity of a rotating body, rotation of a rigid body, Gradient, divergence & curl. Physical & Geometrical Interpretation of dot product, Gradient, divergence & curl, irrotational vectors, illustrative examples from engineering field.

**Nonlinear differential equations:** Introduction to general and singular solutions, Solvable for p only, Clairaut's equations, reducible to Clairaut's equations - Finding the solution by the method of undetermined coefficients.

**Applications -**Modelling projectile motion( vector approach). Analysis of stream lines and electic potentials.

**Self-Study- Curvilinear coordinates:** Scale factors, base vectors, and transformation between Cartesian and curvilinear systems, orthogonality- Problems.

**List of Programmes:**

1. Solution of first order ordinary differential equation using Taylor series & Range-kutta method.
2. Solution of partial differential equation ( Laplace & Poisson equations)
3. Finding gradient, divergence and curl.
4. Computation of area, volume and center of gravity.
5. Verification of Green's theorem in vector integration.
6. Solution of system of equations by Gauss elimination method.
7. Solution of $2^{nd}$ order differential equations (by variation of parameter method).
8. Numerical solution of simultaneous differential equations by Range-kutta method.
9. Solution of system of linear equations using Gauss-Seidal iteration method.
10. Product of matrices & finding Inverse of a matrix.

**NOTE:**

1.Proofs are not required for any theorems and properties.

2.There should not be any questions from self study part in semester End Examination.

**Text Books :**

1. Dr. B. S. Grewal, Higher Engineering Mathematics, Khanna Publications, 44th edition, 2016.

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2.N.P. Bali and Manish Goyal, A textbook of Engineering Mathematics, Laxmi Publications, Reprint, 2010

**Web links**

- http://nptel.ac.in/courses.phd?disciplineID=111
- http://www.class-central.com/subject/math(MOOCs)
- http://academicerath.org/

| Course Title | Mathematics for Electrical and Electronics Engineering stream-2 | | |
|---|---|---|---|
| **Course Code** | **23MATE21** | **Course Type** | **IPCC** |
| **SEE duration** | **3 hour** | **(L-T-P-C)** | **(2-2-2-4)** |
| **CIE(Theory) marks** | **30** | **Hours / Week** | **06** |
| **CIE(Practical's)/Activity marks** | **20** | **SEE marks** | **50** |

**Course Objective**: To train the students to acquire knowledge in differential equations and vector calculus so as to solve basic engineering application problems.

**Course Outcomes (COs):** At the end of course, student will be able to:

| COs | Outcomes | POs | PSOs |
|---|---|---|---|
| **CO1** | Apply suitable methods to solve the simple problems connected with ordinary differential equations/partial differential equations and vector calculus, graph theory. | PO1 | - |
| **CO2** | Examine the higher order problems (more difficult problems) that are connected with differential equations/partial differential equations and solve. | PO1, PO2 | - |
| **CO3** | Examine and compute the vector calculus problems/applications connected with gradient, divergence and curl. | PO1, PO2 | - |
| **CO4** | Model the real-life problems/ Engineering application problems and hence solve the same. | PO1, PO2 | - |
| **CO5** | Write the program in python for the mathematical procedures connected with calculus, numerical methods, differential equations, vector calculus, execute the same and provides correct output. | PO1, PO2 | - |

**CO-PO Mapping:**

| | PO1 | PO2 |
|---|---|---|
| **CO1** | **3** | **-** |
| **CO2** | **3** | **2** |
| **CO3** | **3** | **2** |
| **CO4** | **3** | **2** |
| **CO5** | **3** | **2** |

**Course Contents:**

| MODULE –1 | 12 Hrs. |
|---|---|

**Differential Equations (DE): first order first degree-**Linear differential equations, Bernoulli's differential equations, Exact differential equations, and Power series solutions.

**Applicatons** : Mathematical modelling through differential equations of first order first degree and solution-modelling of population growth, finding initial velocity of the space vehicle so that it has to escape from earth. Modelling of infected diseases, carbon dating half-life period, mixing problem involving one tank, two tank.

Application of first order differential equation- Autonomous equation and population dynamics- Application- Logistic model- Natural growth of halibut population in certain areas of Pacific Ocean, Harvesting a renewable resource.

**Self-study**-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 in Cartesian form, illustrative examples Applications to find the orthogonal trajectories -streamlines of flow in the channel, curves of constant temperature in a body. Equi-potential lines in an electric field between two concentric cylinders**.**

| MODULE –2 | 13 Hrs. |
|---|---|

**Linear differential equation with constant coefficients** - Solutions of homogeneous equations. Particular solution of non- homogenous differential equations by inverse differential operator method for the following standard forms, exponential, polynomial, trigonometric and their product. Method of variation of parameters to solve linear differential equation with constant coefficients. Matrix method to solve homogeneous differential equations of order 2, degree 1.

**Applications of second order, first degree Differential equations --**

Oscillatory Electrical circuit, LC Circuit, LCR Circuit, LC Circuit with e.m.f, LCR Circuit with e.m.f – Electro-Mechanical Analogy. Applications of second order, first degree Differential equations – Transmission lines, Highway engineering.

**Self-study**-method of undetermined coefficients, LDE with variable coefficients (Cauchy's and Legendre's differential equations).

| MODULE –3 | 13 Hrs. |
|---|---|

**Numerical solution of first order, first degree ODE:** Taylor's series method, Runge-Kutta (RK) method of fourth order, Milne's predictor corrector methods.

**Partial Differential Equations**. Solving PDE by variable separable method, Solution of non-homogeneous PDE by direct integration, Numerical solution of a Laplace equation, Poisson equation by finite difference approximation method using standard five point formula, diagonal formula and iterative formulas.

**Applications:** Applications - To find all possible solutions of one-dimensional heat equation and two-dimensional wave equation. Estimating the approximate solutions of ODE for electric circuits.

**Self-Study-** Homogeneous PDEs involving derivatives with respect to one independent variable only. Solution of Lagrange's linear PDE. To find all possible solutions of two-dimensional Laplace equation. Application connected with Electrical Engineering.

| **MODULE – 4** | **12 hrs.** |
|---|---|

**Vector Calculus:** Velocity & acceleration of a vector point function, moment of a force, velocity of a rotating body, rotation of a rigid body, Gradient, divergence &curl. Physical& Geometrical Interpretation of dot product, Gradient, divergence & curl, irrotational vectors, illustrative examples from engineering field.

**Graph theory:** Introduction to graph theory, types of graphs, subgraphs, trees, spanning subgraphs, shortest path algorithms.

**Applications:**

Modelling projectile motion( vector approach), Analysis of streamlines and electric potentials.

**Self – study:** .**Curvilinear coordinates:** Scale factors, base vectors, and transformation between Cartesian and curvilinear systems, orthogonality-Problems.

**List of Programmes:**

1. Solution of first order ordinary differential equation using Taylor series & Range-kutta method.
2. Solution of partial differential equation ( Laplace & Poisson equations)
3. Finding gradient, divergence and curl.
4. Computation of area, volume and center of gravity.
5. Verification of Green's theorem in vector integration.
6. Solution of system of equations by Gauss elimination method.
7. Solution of $2^{nd}$ order differential equations (by variation of parameter method).
8. Numerical solution of simultaneous differential equations by Range-kutta method.
9. Solution of system of linear equations using Gauss-Seidal iteration method.
10. Product of matrices & finding Inverse of a matrix.

**NOTE:**

1.Proofs are not required for any theorems and properties.

2.There should not be any questions from self study part in semester End Examination.

**Text Books :**

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2. N.P. Bali and Manish Goyal, A textbook of Engineering Mathematics, Laxmi Publications, Reprint, 2010

**Web links**

- http://nptel.ac.in/courses.phd?disciplineID=111
- http://www.class-central.com/subject/math(MOOCs)
- http://academicerath.org/

| Course Title | Mathematics for Mechanical Engineering -2 | | |
|---|---|---|---|
| **Course Code** | **23MATM21** | **Course Type** | **IPCC** |
| **SEE duration** | **3 hour** | **(L-T-P-C)** | **(2-2-2-4)** |
| **CIE(Theory) marks** | **30** | **Hours / Week** | **06** |
| **CIE(Practical's)/Activity marks** | **20** | **SEE marks** | **50** |

**Course Objective**: To train the students to acquire knowledge in differential equations and vector calculus so as to solve basic engineering application problems.

**Course Outcomes (COs):** At the end of course, student will be able to:

| COs | Outcomes | POs | PSOs |
|---|---|---|---|
| **CO1** | Apply suitable methods to solve the simple problems connected with ordinary differential equations/partial differential equations and vector calculus. | PO1 | - |
| **CO2** | Examine the higher order problems (more difficult problems) that are connected with differential equations/partial differential equations and solve. | PO1, PO2 | - |
| **CO3** | Examine and compute the vector calculus problems/applications connected with gradient, divergence and curl. | PO1, PO2 | - |
| **CO4** | Model the real-life problems/ Engineering application problems and hence solve the same. | PO1, PO2 | - |
| **CO5** | Write the program in python for the mathematical procedures connected with calculus, numerical methods, differential equations, vector calculus, execute the same and provides correct output. | PO1, PO2 | - |

**CO-PO Mapping:**

| | PO1 | PO2 |
|---|---|---|
| **CO1** | **3** | **-** |
| **CO2** | **3** | **2** |
| **CO3** | **3** | **2** |
| **CO4** | **3** | **2** |
| **CO5** | **3** | **2** |

**Course Contents:**

| MODULE –1 | 12 Hrs. |
|---|---|

**Ordinary Differential Equations - first order first degree-**Linear differential equations, Exact differential equations and Power series solutions.

**Applications:** Mathematical modelling through differential equations of first order first degree and solution-modelling of population growth, finding initial velocity of the space vehicle so that it has to escape from earth. Modelling of infected diseases, carbon dating half-life period, mixing problem involving one tank, two tank.

Application of first order differential equation- Autonomous equation and population dynamics- Application- Logistic model- Natural growth of halibut population in certain areas of Pacific Ocean, Harvesting a renewable resource. Motion of a simple pendulum, Deflection of beams.

**Self-study**--Bernoulli's differential equations, 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 in Cartesian form, illustrative examples Applications to find the orthogonal trajectories -streamlines of flow in the channel, curves of constant temperature in a body. Equi-potential lines in an electric field between two concentric cylinders

| MODULE –2 | 13 Hrs. |
|---|---|

**Linear differential equation with constant coefficients** - Solutions of homogeneous equations. Particular solution of non- homogenous differential equations by inverse differential operator method for the following standard forms, exponential, polynomial, trigonometric and their product. Method of variation of parameters to solve linear differential equation with constant coefficients. Matrix method to solve homogeneous differential equations of order 2, degree 1.

**Applications of second order, first degree Differential equations: -** Mechanical Vibrations-A Spring mass system $mu^{II}(t)+ku^{I}(t)+gu(t)=f(t)$-Undamped free vibrations, damped free vibrations, forced vibrations with damping, forced vibrations without damping.

**Self-study—**method of undetermined coefficients , LDE with variable coefficients (Cauchy's and Legendre's differential equations). Method of variation of parameters to solve linear differential equation with constant coefficients. Mechanical system and transmission lines.

| MODULE –3 | 13 Hrs. |
|---|---|

**Numerical solution of first order, first degree ODE:** Taylor's series method, Runge-Kutta (RK) method of fourth order, Milne's predictor corrector methods.

**Partial Differential Equations**. Solving PDE by variable separable method, Solution of non-homogeneous PDE by direct integration, Numerical solution of a Laplace equation, Poisson equation by finite difference approximation method using standard five point formula, diagonal formula and iterative formulas.

**Applications: Applications -** To find all possible solutions of one-dimensional heat equation and two-

dimensional wave equation. Finding approximate solutions to solve mechanical engineering problems. Vibration of a rod/membrane.

**Self-Study-** Homogeneous PDEs involving derivatives with respect to one independent variable only. Solution of Lagrange's linear PDE. To find all possible solutions of two-dimensional Laplace equation. Application connected with Mechanical Engineering.

| **MODULE – 4** | **12 hrs.** |
|---|---|

**Vector Calculus:** Velocity & acceleration of a vector point function, moment of a force, velocity of a rotating body, rotation of a rigid body, Gradient, divergence & curl. Physical & Geometrical Interpretation of dot product, irrotational vectors, illustrative examples from engineering field.

**Nonlinear differential equations:** Introduction to general and singular solutions, Solvable for p only, Clairaut's equations, reducible to Clairaut's equations - Finding the solution by the method of undetermined coefficients.

**Applications:** Modelling projectile motion( vector approach), Formulation and solution of Cantilever beam. Analysis of stream lines and electic potentials.

**Self – study: Curvilinear coordinates:** Scale factors, base vectors, and transformation between Cartesian and curvilinear systems, orthogonality. Problems

**List of Programmes:**

1. Solution of first order ordinary differential equation using Taylor series & Range-kutta method.
2. Solution of partial differential equation ( Laplace & Poisson equations)
3. Finding gradient, divergence and curl.
4. Computation of area, volume and center of gravity.
5. Verification of Green's theorem in vector integration.
6. Solution of system of equations by Gauss elimination method.
7. Solution of $2^{nd}$ order differential equations (by variation of parameter method).
8. Numerical solution of simultaneous differential equations by Range-kutta method.
9. Solution of system of linear equations using Gauss-Seidal iteration method.
10. Product of matrices & finding Inverse of a matrix.

**NOTE:**

1.Proofs are not required for any theorems and properties.

2.There should not be any questions from self study part in semester End Examination.

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2. N.P. Bali and Manish Goyal, A textbook of Engineering Mathematics, Laxmi Publications, Reprint, 2010

**Web links**

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- http://www.class-central.com/subject/math(MOOCs)
- http://academicerath.org/

## Programming in Python

Course outcome of Mathematical procedures using Python Programme:

**CO5:** At the end of the course, students will be able to write the Programme in Python for the Mathematical procedures connected with calculus, numerical methods, differential equations, vector calculus, execute the same and provides correct output.

| | PO1 | PO2 | P05 |
|---|---|---|---|
| CO5 | 3 | 2 | 1 |

# MALNAD COLLEGE OF ENGINEERING, HASSAN

**(An Autonomous Institution Affiliated to VTU, Belgaum)**

**Autonomous Programmes**

**Bachelor of Engineering**

## DEPARTMENT OF MATHEMATICS

SYLLABUS

III & IV Semester (2022 Admitted Batch)

($2^{nd}$ year)

**Academic Year 2023-24**

## Scheme of evaluation (Theory courses)

| Assessment | Marks |
|---|---|
| Three CIE's | 30 |
| Activities | 20 |
| SEE | 50 |
| Total | 100 |

| Examination | Maximum marks | Minimum marks to qualify |
|---|---|---|
| CIE | 50 | 20(12 +8) |
| SEE | 50 | 20 |

| Course Title | Mathematics for Computer Science Engineering | | |
|---|---|---|---|
| **Course Code** | **22MA301** | **Course Type** | Regular |
| **SEE duration** | 3hours | **(L-T-P-C)** | **(2-2-0-3)** |
| **CIE(Theory) marks** | 30 | **Hours / Week** | 04 |
| **CIE (Activity) marks** | 20 | **SEE marks** | 50 |

**Course Objective:**
To introduce linear algebra and transform calculus which can be employed as tools in solving engineering application problems.

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

| **COs** | **Outcomes** | **POs** | **PSOs** |
|---|---|---|---|
| CO1 | Utilise the concept of consistency of system of equations to solve the engineering application problems and compute the number of linearly independent vectors. | PO1,PO2 | - |
| CO2 | Examine for the existence of diagonalization of matrix, find the suitable matrix of transformations so as to get the required image and analyse the system of equations to compute the number of linearly independent Eigen vectors. | PO1,PO2 | - |
| CO3 | Apply Laplace transform on simple functions and compute Fourier series of periodic functions. | PO1 | - |
| CO4 | Examine for adopting different techniques of integration so as to compute Fourier series, Laplace transform of a given function. | PO1,PO2 | - |
| CO5 | Model the real life problems/engineering application problems and solve the same. | PO1,PO2 | - |

**CO-PO Mapping:**

| | PO1 | PO2 |
|---|---|---|
| CO1 | 3 | 2 |
| CO2 | 3 | 2 |
| CO3 | 3 | - |
| CO4 | 3 | 2 |
| CO5 | 3 | 2 |

**Course Contents**

| | | |
|---|---|---|
| **Module-1** | **Laplace Transforms:** Introduction, Definition, Importance of Laplace transform in engineering applications, properties, Laplace transform of standard functions, Laplace transform of derivatives, Laplace transform of periodic functions, unit-step functions.<br>**Inverse Laplace Transforms**: Definition and general properties, Convolution theorem – illustrative examples, Initial value problems. To solve Applications of initial value problems in engineering using Laplace transform<br>**Self-Study--**Unit impulse functions (Dirac – delta function). Application of Fourier series to Laplace equation. | 10 Hours |
| **Module–2** | **Fourier Series:** Periodic functions and their graphical representation, to find the function for standard graphs, to find Fourier series by change of interval method, To represent the experimental data as a Fourier series using the method - Practical harmonic analysis. application of Fourier series in engineering-To represent the signal (wave form) in terms of Fourier series, Fourier series representation for the excitation described by the wave form, graphs of Fourier series approximating the given function.<br>**Self-Study--** Half range series method. Applications of Fourier transforms/ fast Fourier transforms in computer science engineering. | 10 Hours |
| **Module–3** | **Linear Algebra:** Importance of Matrices in engineering. Rank of a matrix. Consistency of nonhomogeneous and homogeneous system of equations, Solution of the system of linear equations by Gauss | 10 Hours |

| | | |
|---|---|---|
| | elimination method and Gauss – Seidel iterative method. Linearly dependent and independent vectors.<br>Special matrices-matrix of rotation, reflection, translation. To find the matrix of transformation when the image of some points is given. **Applications** of solution of system of equations to balance the chemical equations.<br>**Self-Study--** Traffic flow problem, To find the suitable combination of food stuff so as to get the desired nutrients as prescribed by a dietician. | |
| **Module–4** | **Linear Algebra**: Eigen values and Eigen vectors, properties, Illustrative examples,<br>**Applications**-Stretching of an elastic membrane, to determine the growth of a population model. Role of eigenvalues, eigenvectors in determining natural frequency, mode shapes of equations of motions (Spring mass system).Rayleigh power method to find the highest eigen value.<br>Diagonalization and powers of 3X3 matrices when Eigen values are already given.<br>**Self-Study--** Stability analysis of differential equations which governs the dynamical systems using the concept of eigen value, eigen vectors. Applications of system of equations, eigen value, eigen vectors, linear transformation in computer science. Application of eigen value eigen vectors in data compression, Signature testing, Face recognition. Google page ranking. | 10 Hours |

**Note – 1. Theorems and properties without proof. Applicable to all the Modules.**

**2. Self study part is not included for Semester End Examination.**

**Text Books:**


1. Dr. B. S. Grewal, Higher Engineering Mathematics, Khanna Publications, 44th edition, 2016.
2. Linear algebra by David c lay, 3rd edition, Pearson education, 2002.


**Reference Books:**


1. R K Jain and S R K Iyengar, Advanced engineering mathematics by Narosa publishers, 2nd edition, 2005.
2. Calculus by Thomas Finney, 9th edition, Pearson education, 2002.

3. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley India Pvt. Ltd. 8th Edition (Wiley student edition) 2004.

**Web links**

- http://nptel.ac.in/courses.phd?disciplineID=111
- http://www.class-central.com/subject/math(MOOCs)
- http://academicerath.org/

## ACTIVITIES:

1. To represent sawtooth periodic motion of a follower operated by a Cam which rotates uniformly, in the form of Fourier series.
2. Application of Fourier series to Laplace equation, heat conduction.
3. Fourier series representation for the excitation described by the wave form,
4. Role of eigenvalues, eigenvectors in determining natural frequency, mode shapes of equations of motions (Spring mass system).
5. Lenovo input output method – application to balance the economy of a Country.
6. Applications of factorization of matrices-google recommendation.
7. Jordan canonical form when minimal polynomial and characteristic polynomial is given and its application in Engineering.
8. Diagonalize a matrix and determining the principal stresses.
9. Application of Laplace transformation.
10. Application of Eigen value and Eigen vectors in data compression, Signature testing, Face recognition. Google page ranking.
11. Least square solution of system of equations- a matrix approach
12. Unit impulse functions (Dirac – delta function) - application.

| Course Title | Mathematics for Information Science Engineering | | |
|---|---|---|---|
| **Course Code** | **22MA301** | **Course Type** | Regular |
| **SEE duration** | 3hours | **(L-T-P-C)** | **(3-2-0-4)** |
| **CIE(Theory) marks** | 30 | **Hours / Week** | 05 |
| **CIE (Activity) marks** | 20 | **SEE marks** | 50 |

**Course Objective:**
To introduce linear algebra and transform calculus which can be employed as tools in solving engineering application problems.

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

| **COs** | **Outcomes** | **POs** | **PSOs** |
|---|---|---|---|
| CO1 | Utilise the concept of consistency of system of equations to solve the engineering application problems and compute the number of linearly independent vectors. | PO1,PO2 | - |
| CO2 | Examine for the existence of diagonalization of matrix, find the suitable matrix of transformations so as to get the required image and analyse the system of equations to compute the number of linearly independent Eigen vectors. | PO1,PO2 | - |
| CO3 | Apply Laplace transform on simple functions and compute Fourier series of periodic functions. | PO1 | - |
| CO4 | Examine for adopting different techniques of integration so as to compute Fourier series, Fourier transforms, Laplace transform of a given function. | PO1,PO2 | - |
| CO5 | Model the real life problems/engineering application problems and solve the same. | PO1,PO2 | - |

**CO-PO Mapping:**

| | PO1 | PO2 |
|---|---|---|
| CO1 | 3 | 2 |
| CO2 | 3 | 2 |
| CO3 | 3 | - |
| CO4 | 3 | 2 |
| CO5 | 3 | 2 |

**Course Contents**

| | | |
|---|---|---|
| **Module-1** | **Laplace Transforms:** Introduction, Definition, Importance of Laplace transform in engineering applications, properties, Laplace transform of standard functions, Laplace transform of derivatives, Laplace transform of periodic functions, unit-step functions.<br>**Inverse Laplace Transforms**: Definition and general properties, Convolution theorem – illustrative examples, Initial value problems. To solve Applications of initial value problems in engineering using Laplace transform<br>**Self-Study** Unit impulse functions (Dirac – delta function). Application of Fourier series to Laplace equation, heat conduction. | 13 Hours |
| **Module–2** | **Fourier Series:** Periodic functions and their graphical representation, to find the function for standard graphs, to find Fourier series by change of interval method, To represent the experimental data as a Fourier series using the method - Practical harmonic analysis. application of Fourier series in engineering-To represent the signal (wave form) in terms of Fourier series, Fourier series representation for the excitation described by the wave form, graphs of Fourier series approximating the given function. Fourier sine transform.<br>**Curve fitting**- Piecewise spline interpolation-linear, quadratic, cubic spline method.<br>**Self-Study--** Half range series method. Applications of Fast Fourier transforms, Discrete Fourier transforms in information science engineering. | 13 Hours |

| | | |
|---|---|---|
| **Module–3** | **Linear Algebra:** Importance of Matrices in engineering. Rank of a matrix. Consistency of nonhomogeneous and homogeneous system of equations, Solution of the system of linear equations by Gauss elimination method and Gauss – Seidel iterative method. Linearly dependent and independent vectors.<br>Special matrices-matrix of rotation, reflection, translation. To find the matrix of transformation when the image of some points is given. **Applications** of solution of system of equations to balance the chemical equations.<br>**Self-Study--** Traffic flow problem, To find the suitable combination of food stuff so as to get the desired nutrients as prescribed by a dietician. | 12 Hours |
| **Module–4** | **Linear Algebra**: Eigen values and Eigen vectors, properties, Illustrative examples,<br>**Applications**-Stretching of an elastic membrane, to determine the growth of a population model. Role of eigenvalues, eigenvectors in determining natural frequency, mode shapes of equations of motions (Spring mass system).Rayleigh power method to find the highest eigen value.<br>Diagonalization and powers of 3X3 matrices when Eigen values are already given.<br>**Self-Study--** Stability analysis of differential equations which governs the dynamical systems using the concept of eigen value, eigen vectors. Applications of system of equations, linear transformation in computer science. Application of eigen value eigen vectors in data compression, Signature testing, Face recognition. Google page ranking. | 12 Hours |

**Note – 1. Theorems and properties without proof. Applicable to all the Modules.**

**2. Self study part is not included for Semester End Examination.**

**Text Books:**


1. Dr. B. S. Grewal, Higher Engineering Mathematics, Khanna Publications, 44th edition, 2016.
2. Linear algebra by David c lay, 3rd edition, Pearson education, 2002.

**Reference Books:**


1. R K Jain and S R K Iyengar, Advanced engineering mathematics by Narosa publishers, 2nd edition, 2005.
2. Calculus by Thomas Finney, 9th edition, Pearson education, 2002.
3. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley India Pvt. Ltd. 8th Edition (Wiley student edition) 2004.


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# ACTIVITIES:

a. To represent sawtooth periodic motion of a follower operated by a Cam which rotates uniformly, in the form of Fourier series.
b. Application of Fourier series to Laplace equation, heat conduction.
c. Fourier series representation for the excitation described by the wave form,
d. Role of eigenvalues, eigenvectors in determining natural frequency, mode shapes of equations of motions (Spring mass system).
e. Lenovo input output method – application to balance the economy of a Country.
f. Applications of factorization of matrices-google recommendation.
g. Jordan canonical form when minimal polynomial and characteristic polynomial is given and its application in Engineering.
h. Diagonalize a matrix and determining the principal stresses.
i. Application of Laplace transformation.
j. Application of Eigen value, Eigen vectors in data compression, Signature testing, Face recognition. Google page ranking.
k. Least square solution of system of equations- a matrix approach
l. Unit impulse functions (Dirac – delta function)- application.

| Course Title | Mathematics for Electronics and Communication Engineering | | |
|---|---|---|---|
| **Course Code** | **22MA301** | **Course Type** | Regular |
| **SEE duration** | 3hours | **(L-T-P-C)** | **(3-2-0-4)** |
| **CIE(Theory) marks** | 30 | **Hours / Week** | 05 |
| **CIE (Activity) marks** | 20 | **SEE marks** | 50 |

**Course Objective:**
To introduce linear algebra and transform calculus which can be employed as tools in solving engineering application problems.

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

| COs | Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | Utilise the concept of consistency of system of equations to solve the engineering application problems and compute the number of linearly independent vectors. | PO1,PO2 | - |
| CO2 | Examine for the existence of diagonalization of matrix, find the suitable matrix of transformations so as to get the required image and analyse the system of equations to compute the number of linearly independent Eigen vectors. | PO1,PO2 | - |
| CO3 | Apply Laplace transform on simple functions and compute Fourier series of periodic functions. | PO1 | - |
| CO4 | Examine for adopting different techniques of integration so as to compute Fourier series, Fourier transforms, Laplace transform of a given function. | PO1,PO2 | - |
| CO5 | Model the real life problems/engineering application problems and solve the same. | PO1,PO2 | - |

**CO-PO Mapping:**

| | PO1 | PO2 |
|---|---|---|
| CO1 | 3 | 2 |
| CO2 | 3 | 2 |
| CO3 | 3 | - |
| CO4 | 3 | 2 |
| CO5 | 3 | 2 |

**Course Contents**

| | | |
|---|---|---|
| **Module-1** | **Laplace Transforms:** Introduction, Definition, Importance of Laplace transform in engineering applications, properties, Laplace transform of standard functions, Laplace transform of derivatives, Laplace transform of periodic functions, unit-step functions.<br>**Inverse Laplace Transforms**: Definition and general properties, Convolution theorem – illustrative examples, Initial value problems. To solve Applications of initial value problems in engineering using Laplace transform<br>**Self-Study--**Unit impulse functions (Dirac – delta function). Application of Fourier series to Laplace equation, heat conduction. Curve fitting- Piecewise spline interpolation-linear, quadratic, cubic spline method. Double interpolation. | 13 Hours |
| **Module–2** | **Fourier Series:** Periodic functions and their graphical representation, to find the function for standard graphs, to find Fourier series by change of interval method, To represent the experimental data as a Fourier series using the method - Practical harmonic analysis. application of Fourier series in engineering-To represent the signal (wave form) in terms of Fourier series, Fourier series representation for the excitation described by the wave form, graphs of Fourier series approximating the given function. Half range series method. Fourier transforms, Fourier sine transform and cosine transform.<br>**Self Study--** Applications of Fourier series**,** Fast Fourier transforms, Discrete Fourier transforms in electronics engineering. | 13 Hours |

| | | |
|---|---|---|
| **Module–3** | **Linear Algebra:** Importance of Matrices in engineering. Rank of a matrix. Consistency of nonhomogeneous and homogeneous system of equations, Solution of the system of linear equations by Gauss elimination method and Gauss – Seidel iterative method. Linearly dependent and independent vectors.<br>Special matrices-matrix of rotation, reflection, translation. To find the matrix of transformation when the image of some points is given. **Applications** of solution of system of equations to balance the chemical equations.<br>**Self-Study--** Traffic flow problem, To find the suitable combination of food stuff so as to get the desired nutrients as prescribed by a dietician. | 12 Hours |
| **Module–4** | **Linear Algebra**: Eigen values and Eigen vectors, properties, Illustrative examples,<br>**Applications-Stretching** of an elastic membrane, to determine the growth of a population model. Role of eigenvalues, eigenvectors in determining natural frequency, mode shapes of equations of motions (Spring mass system). Rayleigh power method to find the highest eigen value.<br>Diagonalization and powers of 3X3 matrices when Eigen values are already given.<br>**Self-Study--** Stability analysis of differential equations which governs the dynamical systems using the concept of eigen value, eigen vectors. Application of eigen value eigen vectors in electronics engineering. Applications of Jordan canonical forms. | 12 Hours |

**Note – 1. Theorems and properties without proof. Applicable to all the Modules.**

**2. Self study part is not included for Semester End Examination.**

**Text Books:**


1. Dr. B. S. Grewal, Higher Engineering Mathematics, Khanna Publications, 44th edition, 2016.
2. Linear algebra by David c lay, 3rd edition, Pearson education, 2002.


**Reference Books:**


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2. Calculus by Thomas Finney, 9th edition, Pearson education, 2002.

3. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley India Pvt. Ltd. 8th Edition (Wiley student edition) 2004.

**Web links**

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- http://academicerath.org/

## ACTIVITIES:

a. To represent sawtooth periodic motion of a follower operated by a Cam which rotates uniformly, in the form of Fourier series.
b. Application of Fourier series to Laplace equation, heat conduction.
c. Fourier series representation for the excitation described by the wave form,
d. Role of eigenvalues, eigenvectors in determining natural frequency, mode shapes of equations of motions (spring mass system).
e. Lenovo input output method – application to balance the economy of a Country.
f. Applications of factorization of matrices-google recommendation.
g. Jordan canonical form when minimal polynomial and characteristic polynomial is given and its application in Engineering.
h. Diagonalize a matrix and determining the principal stresses.
i. Application of Laplace transformation.
j. Application of Eigen value Eigen vectors in data compression, Signature testing, Face recognition. Google page ranking.
k. Least square solution of system of equations- a matrix approach
l. Unit impulse functions (Dirac – delta function) - application.

| Course Title | Mathematics for Electrical and Electronics Engineering | | |
|---|---|---|---|
| **Course Code** | **22MA301** | **Course Type** | Regular |
| **SEE duration** | 3hours | **(L-T-P-C)** | **(2-2-0-3)** |
| **CIE(Theory) marks** | 30 | **Hours / Week** | 04 |
| **CIE (Activity) marks** | 20 | **SEE marks** | 50 |

**Course Objective:**

To introduce linear algebra and transform calculus which can be employed as tools in solving engineering application problems.

**Course Outcomes:**

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

| COs | Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | Utilise the concept of consistency of system of equations to solve the engineering application problems and compute the number of linearly independent vectors. | PO1,PO2 | - |
| CO2 | Examine for the existence of diagonalization of matrix, find the suitable matrix of transformations so as to get the required image and analyse the system of equations to compute the number of linearly independent Eigen vectors. | PO1,PO2 | - |
| CO3 | Apply Laplace transform on simple functions and compute Fourier series of periodic functions. | PO1 | - |
| CO4 | Examine for adopting different techniques of integration so as to compute Fourier series, Laplace transform of a given function. | PO1,PO2 | - |
| CO5 | Model the real life problems/engineering application problems and solve the same. | PO1,PO2 | - |

**CO-PO Mapping:**

| | PO1 | PO2 |
|---|---|---|
| CO1 | 3 | 2 |
| CO2 | 3 | 2 |
| CO3 | 3 | - |
| CO4 | 3 | 2 |
| CO5 | 3 | 2 |

**Course Contents**

| | | |
|---|---|---|
| **Module-1** | **Laplace Transforms:** Introduction, Definition, Importance of Laplace transform in engineering applications, properties, Laplace transform of standard functions, Laplace transform of derivatives, Laplace transform of periodic functions, unit-step functions.<br>**Inverse Laplace Transforms**: Definition and general properties, Convolution theorem – illustrative examples, Initial value problems. To solve Applications problems- initial value problems connected with Electrical circuit using Laplace transform. To solve the coupled differential equations connected with electrical circuit.<br>**Self-Study--**Unit impulse functions (Dirac – delta function). Application of Fourier series to Laplace equation, heat conduction. Applications of Fourier transforms. | 10 Hours |
| **Module–2** | **Fourier Series:** Periodic functions and their graphical representation, to find the function for standard graphs, to find Fourier series by change of interval method, To represent the experimental data as a Fourier series using the method - Practical harmonic analysis. application of Fourier series in EE engineering-To represent the signal (wave form) in terms of Fourier series, Fourier series representation for the excitation described by the wave form, graphs of Fourier series approximating the given function.<br>**Self-Study--** Half range series method. | 10 Hours |
| **Module–3** | **Linear Algebra:** Importance of Matrices in engineering. Rank of a matrix. Consistency of nonhomogeneous and homogeneous system of equations, Solution of the system of linear equations by Gauss | 10 Hours |

| | | |
|---|---|---|
| | elimination method and Gauss – Seidel iterative method. Linearly dependent and independent vectors.<br>Special matrices-matrix of rotation, reflection, translation. To find the matrix of transformation when the image of some points is given. **Applications** of solution of system of equations to balance the chemical equations.<br>**Self-Study--** Traffic flow problem, To find the suitable combination of food stuff so as to get the desired nutrients as prescribed by a dietician. | |
| **Module–4** | **Linear Algebra**: Eigen values and Eigen vectors, properties, Illustrative examples,<br>**Applications-Stretching** of an elastic membrane, to determine the growth of a population model. Role of eigenvalues, eigenvectors in determining natural frequency, mode shapes of equations of motions (Spring mass system).Rayleigh power method to find the highest eigen value.<br>Diagonalization and powers of 3X3 matrices when Eigen values are already given.<br>**Self-Study--** Stability analysis of differential equations which governs the dynamical systems using the concept of eigen value, eigen vectors. Applications of Jordan canonical forms, diagonalization of a matrix, matrix factorization and applications in EE. | 10 Hours |

**Note – 1. Theorems and properties without proof. Applicable to all the Modules.**

**2. Self study part is not included for Semester End Examination.**

**Text Books:**


1. Dr. B. S. Grewal, Higher Engineering Mathematics, Khanna Publications, 44th edition, 2016.
2. Linear algebra by David c lay, 3rd edition, Pearson education, 2002.


**Reference Books:**


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2. Calculus by Thomas Finney, 9th edition, Pearson education, 2002.
3. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley India Pvt. Ltd. 8th Edition (Wiley student edition) 2004.

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- http://academicerath.org/

# ACTIVITIES:

a. To represent sawtooth periodic motion of a follower operated by a Cam which rotates uniformly, in the form of Fourier series.
b. Application of Fourier series to Laplace equation, heat conduction.
c. Fourier series representation for the excitation described by the wave form,
d. Role of eigenvalues, eigenvectors in determining natural frequency, mode shapes of equations of motions (spring mass system).
e. Lenovo input output method – application to balance the economy of a Country.
f. Applications of factorization of matrices-google recommendation.
g. Jordan canonical form when minimal polynomial and characteristic polynomial is given and its application in Engineering.
h. Diagonalize a matrix and determining the principal stresses.
i. Application of Laplace transformation.
j. Application of Eigen value Eigen vectors in data compression, Signature testing, Face recognition. Google page ranking.
k. Least square solution of system of equations- a matrix approach
l. Unit impulse functions (Dirac – delta function) - application.

| Course Title | Mathematics for Mechanical Engineering | | |
|---|---|---|---|
| **Course Code** | **22MA301** | **Course Type** | Regular |
| **SEE duration** | 3hours | **(L-T-P-C)** | **(2-2-0-3)** |
| **CIE(Theory) marks** | 30 | **Hours / Week** | 04 |
| **CIE (Activity) marks** | 20 | **SEE marks** | 50 |

**Course Objective:**

To introduce linear algebra and transform calculus which can be employed as tools in solving engineering application problems.

**Course Outcomes:**

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

| COs | Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | Utilise the concept of consistency of system of equations to solve the engineering application problems and compute the number of linearly independent vectors. | PO1,PO2 | - |
| CO2 | Examine for the existence of diagonalization of matrix, find the suitable matrix of transformations so as to get the required image and analyse the system of equations to compute the number of linearly independent Eigen vectors. | PO1,PO2 | - |
| CO3 | Apply Laplace transform on simple functions and compute Fourier series of periodic functions. | PO1 | - |
| CO4 | Examine for adopting different techniques of integration so as to compute Fourier series, Laplace transform of a given function. | PO1,PO2 | - |
| CO5 | Model the real life problems/engineering application problems and solve the same. | PO1,PO2 | - |

**CO-PO Mapping:**

| | PO1 | PO2 |
|---|---|---|
| CO1 | 3 | 2 |
| CO2 | 3 | 2 |
| CO3 | 3 | - |
| CO4 | 3 | 2 |
| CO5 | 3 | 2 |

**Course Contents**

| | | |
|---|---|---|
| **Module-1** | **Laplace Transforms:** Introduction, Definition, Importance of Laplace transform in engineering applications, properties, Laplace transform of standard functions, Laplace transform of derivatives, Laplace transform of periodic functions, unit-step functions.<br>**Inverse Laplace Transforms**: Definition and general properties, Convolution theorem – illustrative examples, Initial value problems. To solve Applications of initial value problems in engineering using Laplace transform<br>**Self-Study--**Unit impulse functions (Dirac – delta function).Application of Fourier series to Laplace equation, heat conduction. | 10 Hours |
| **Module–2** | **Fourier Series:** Periodic functions and their graphical representation, to find the function for standard graphs. ( saw tooth wave, triangular wave, sine wave etc)To find Fourier series by change of interval method, To represent the experimental data as a Fourier series using the method - Practical harmonic analysis. Application of Fourier series in mechanical engineering-engineering-To represent the signal (wave form) in terms of Fourier series, Fourier series representation for the excitation described by the wave form, graphs of Fourier series approximating the given function.<br>**Self-Study--** Half range series method. Finite difference methods—Ritz method—solution of linear differential equations. | 10 Hours |
| **Module–3** | **Linear Algebra:** Importance of Matrices in engineering. Rank of a matrix. Consistency of nonhomogeneous and homogeneous system of equations, Solution of the system of linear equations by Gauss | 10 Hours |

| | | |
|---|---|---|
| | elimination method and Gauss – Seidel iterative method. Linearly dependent and independent vectors.<br>Special matrices-matrix of rotation, reflection, translation. To find the matrix of transformation when the image of some points is given. **Applications** of solution of system of equations to balance the chemical equations.<br>**Self-Study--** Traffic flow problem, To find the suitable combination of food stuff so as to get the desired nutrients as prescribed by a dietician. | |
| **Module–4** | **Linear Algebra**: Eigen values and Eigen vectors, properties, Illustrative examples,<br>**Applications-Stretching** of an elastic membrane, to determine the growth of a population model. Role of eigenvalues, eigenvectors in determining natural frequency, mode shapes of equations of motions (Spring mass system). Rayleigh power method to find the highest eigen value.<br>Diagonalization and powers of 3X3 matrices when Eigen values are already given.<br>**Self-Study--** Stability analysis of differential equations which governs the dynamical systems using the concept of eigen value, eigen vectors. Application –to find the principal stresses. | 10 Hours |

**Note –1. Theorems and properties without proof. Applicable to all the Modules.**

**2. Self study part is not included for Semester End Examination.**

**Text Books:**


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2. Linear algebra by David c lay, 3rd edition, Pearson education, 2002.


**Reference Books:**


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2. Calculus by Thomas Finney, 9th edition, Pearson education, 2002.
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## ACTIVITIES:

a. To represent sawtooth periodic motion of a follower operated by a Cam which rotates uniformly, in the form of Fourier series.
b. Application of Fourier series to Laplace equation, heat conduction.
c. Fourier series representation for the excitation described by the wave form,
d. Role of eigenvalues, eigenvectors in determining natural frequency, mode shapes of equations of motions (spring mass system).
e. Lenovo input output method – application to balance the economy of a Country.
f. Applications of factorization of matrices-google recommendation.
g. Jordan canonical form when minimal polynomial and characteristic polynomial is given and its application in Engineering.
h. Diagonalize a matrix and determining the principal stresses.
i. Application of Laplace transformation.
j. Application of Eigen value Eigen vectors in data compression, Signature testing, Face recognition. Google page ranking.
k. Least square solution of system of equations- a matrix approach
l. Unit impulse functions (Dirac – delta function) - application.

| Course Title | Discrete Mathematical Structures<br>Information Science & Engineering | | |
|---|---|---|---|
| **Course Code** | **22MA302** | **Course Type** | Regular |
| **SEE duration** | 3hours | **(L-T-P-C)** | **(2-2-0-3)** |
| **CIE(Theory) marks** | 30 | **Hours / Week** | 04 |
| **CIE (Activity) marks** | 20 | **SEE marks** | 50 |

**Course Objective:**

1. To introduce Discrete structures and principle of Combinatorics which can be employed as tools in the applications of Computer Science & Information Technology.

**Course Outcomes:** Having studied this course, students will be able to

| COs | Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | Apply logic and counting principles to model and analyse problems of Information science & engineering | PO1,PO2 | - |
| CO2 | Apply the concepts of logic to identify methods of mathematical proofs. | PO1,PO2 | - |
| CO3 | Use concepts of functions in analysing problems on algorithms and programs. | PO1,PO2 | - |
| CO4 | Model and analyse programming problems related to Graph theory and coding theory. | PO1,PO2 | - |
| CO5 | Derive mathematical model for real life problems related to Information science and Engineering. | PO1,PO2 | - |

**CO-PO Mapping:**

| | PO1 | PO2 |
|---|---|---|
| CO1 | 3 | 2 |
| CO2 | 3 | 2 |
| CO3 | 3 | 2 |
| CO4 | 3 | 2 |
| CO5 | 3 | 2 |

**Course Content:**

| Modules | Contents | No. of hours |
|---|---|---|
| Module 1 | **Principles of Counting:** The rule of sum and product, permutation principle, combination principle, rule of generalized Permutations and Combinations, counting technique in chess board.<br>**Fundamentals of Logic:** Basic logic connectives and truth tables. Logical equivalence and Tautologies. Statement of laws of logic.<br>**Self-study**: Set theory – set operations, Venn diagram, Inclusion Exclusion principle. | 10 Hours |
| Module 2 | **Fundamentals of Logic contd.:** Logic implication - Rules of inference theory. Application of switching network.<br>**Functions:** Ceiling function, Floor function, Characteristic function, and Application of Stirling numbers of second kind. Application of functions in vending machine<br>**Self-study:** Quantifiers, Relations, Partially ordered sets, Hasse diagram. | 10 Hours |
| Module 3 | Graph theory: Definitions and examples, sub graphs, Trees: Definitions, properties and examples, Rooted trees, Sorting, Weighted trees, and Prefix codes.<br>**Optimization and Matching:** Dijkstra's shortest path algorithm.<br>**Minimal spanning tree:** the Algorithm of Kruskal and prim.<br>**Self-study:** Euler- graphs, Hamiltonian graphs Graph colouring, | 10 Hours |

| | | |
|---|---|---|
| Module 4 | **Coding theory:** Elements of coding theory, the humming matric**,** the parity – check and Generator matrices.<br>**Group codes**: Decoding with coset leaders. Hamming matrices.<br>**Self-study:** sub-groups, cosets, Matrix row operations | 10 Hours |

**Note –1. Theorems and properties without proof. Applicable to all the modules.**

**2. Self study part is not included for Semester End Examination.**

**Textbooks:**

Discrete and Combinatorial Mathematics, R C Grimaldi, Pearson's publications, 5th edition, 2007.

**Reference Books:**

Discrete Mathematical Structures, by D. S. Malik & M. K. Sen, Thomson's Publications, First edition, 2006.

**Web links**

- http://nptel.ac.in/courses.phd?disciplineID=111
- http://www.class-central.com/subject/math(MOOCs)
- http://academicerath.org/

## Activities List

1. Application of switching network
2. Application to algorithm testing using computational complexity.
3. Application of graph theory to study ecosystem
4. Application of graph theory in sociology and psychology
5. Computation of number of different ways n rooks can be arranged on an n x n chess board so that no two rooks can attack each other for all positive integers n.
6. Discuss ways in which the current telephone numbering plan can be extended to accommodate the rapid demand for more telephone numbers.
7. Application of functions in vending machine.

8. Graph Theory: Basic terminologies of a graph. Discussion of connected and disconnected graphs, Euler and Hamilton graphs, planar graphs, discuss ways in which the current telephone numbering plan can be extended to accommodate the rapid demand for more telephone numbers.
9. **Trees:** Definition, properties of a tree. Weighed trees, prefix codes. Modelling of real-life problems using graphical approach and their analysis.

| Course Title | Statistics and Probability for Computer Science | | |
|---|---|---|---|
| **Course Code** | **22MA401** | **Course Type** | Regular |
| **SEE duration** | 3hours | **(L-T-P-C)** | **(2-2-0-3)** |
| **CIE(Theory) marks** | 30 | **Hours / Week** | 04 |
| **CIE (Activity) marks** | 20 | **SEE marks** | 50 |

**Course Objective:** To introduce the concept of probability distribution functions, hypothesis testing, so as to apply in engineering application problems.

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

| COs | Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | Analyze the experimental data using correlation, regression, and solve simple problems on probability and joint probability. | PO1 | - |
| CO2 | Validate an assumption through "hypothesis testing" (that is the assumption is not simply because of chance). | PO1,PO2 | - |
| CO3 | Analyze the problems connected with probability to apply suitable probability distribution and also, predict the probability in the long run for Markov chain based problems. | PO1,PO2 | - |
| CO4 | Model real life problems/engineering application problems and solve the same. | PO1,PO2 | - |

**CO-PO Mapping:**

| | PO1 | PO2 |
|---|---|---|
| **CO1** | **3** | **-** |
| **CO2** | **3** | **2** |
| **CO3** | **3** | **2** |
| **CO4** | **3** | **2** |

**Course Contents:**

| | | |
|---|---|---|
| **Module-1** | **Statistics:** Correlation, Karl Pearson coefficient of correlation and Spearman's rank correlation coefficient. Physical interpretation of numerical value of the rank correlation coefficient. Linear Regression analysis (when the experimental output depends on one input). Illustrative examples from engineering field, multiple regression analysis.(When the experimental output depends on two inputs).<br>**Probability: Discrete Random Variables**: Definitions of PDF & CDF: Expectation and Variance: Binominal pdf- Illustrative examples.<br>**Self-study/Applications:** Poisson probability distribution function-Illustrative examples. | 10 Hours |
| **Module–2** | **Continuous Random Variables:** Definition of PDF and CDF, Expectation and Variance, illustrative examples.<br>**Probability distribution:** Exponential pdf, Normal/Gaussian pdf. Discussion on the choice of PDF. Illustrative examples from engineering field.<br>**Self-study/Applications:** Uniform pdf, Current measurement problems, Digital transmission channel. Detection of signal. | 10 Hours |
| **Module–3** | **Confidence intervals & Hypothesis analysis:** Introduction, Testing a hypothesis, central limit theorem-statement, Level of significance, Simple sampling of attributes, confidence intervals, Test of significance for large samples, Comparison of large samples, Student's t-distribution, Chi-square distribution.<br>**Self-study/Applications:** Propellant burning rate, process-capacity problem, drying time problem, Two catalyst effect on chemical reaction. | 10 Hours |
| **Module–4** | **Joint Probability Distribution & Stochastic Processes**: Concept of joint probability, Joint distributions of discrete random variables, Independent random variables-problems. Joint expectation, co-variance, and correlation.<br>**Markov Chains:** Introduction, stochastic matrices, fixed probability vectors and regular stochastic matrices. Application of Markov chain to determine the voting tendencies. | 10 Hours |

| | | |
|---|---|---|
| | **Self-study/Applications:** Estimating the population distribution of a city due to migration. | |

**Note –1. Theorems and properties without proof. Applicable to all the modules.**

**2. Self study part is not included for Semester End Examination.**

**Text Books:**


1. Dr. B. S. Grewal, Higher Engineering Mathematics, Khanna Publications, 44thEdition, 2016.
2. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley India Pvt. Ltd 9th edition, 2014.
3. B V Ramana Higher Engineering Mathematics, Tata McGraw Hill Publications, 2nd edition, 2007.


**Reference Books:**


1. Scott L.Miller, Donald G. Childers: "Probability and Random Process with application to Signal Processing", Elsevier Academic Press, 2nd Edition, 2013.
2. Statistics for engineers and Scientists, William Navide, Mc-Graw hill education, India pvt. Ltd., 3rd edition 2014.
3. T.Veerarajan: "Probability, Statistics and Random Process", 3rd Edition, Tata McGraw Hill Co., 2008.
4. Theory and problems of probability, Seymour Lipschutz and marclarslipson, Schaum out line series, 2nd edition.


**Web links**

- http://nptel.ac.in/courses.phd?disciplineID=111
- http://www.class-central.com/subject/math(MOOCs)
- http://academicerath.org/

# ACTIVITIES:

1. Negative binomial distribution: Failure of server's problems,
2. Poissondistribution: Contamination problem, flaws in wires.
3. Exponential distribution: lack of memory property.
4. Continuous random variable: Shaft conforms.
5. Continuous random variable: detection of signal, Digital transmission channel.
6. Hypothesis analysis Depression treatment.
7. Hypothesis analysis defect in printed circuit board.
8. Confidence levels: Doping the cement with lead effect on percentage of calcium.
9. Current measurement problems, Propellant burning rate, process-capacity problem, drying time problem, two catalyst effect on chemical reaction.
10. Application of Markov chain in estimating the population distribution of a city due to migration.
11. Application of Multiple regression when exp. output depends on 3, 4,.5 inputs.
12. Application of Markov chain to determine the voting tendencies.
13. Curve fitting.

| Course Title | Linear Algebra and Applications for ALML and CSBS | | |
|---|---|---|---|
| **Course Code** | **22MA401** | **Course Type** | Regular |
| **SEE duration** | 3hours | **(L-T-P-C)** | **(2-2-0-3)** |
| **CIE(Theory) marks** | 30 | **Hours / Week** | 04 |
| **CIE (Activity) marks** | 20 | **SEE marks** | 50 |

**Course Objective**: Students will be trained to acquire knowledge in linear algebra and its applications.

**Course outcomes:** Having studied this course, students will be able to**:**

| COs | Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | Apply suitable solution procedure to solve the linear models of business, engineering, economics and apply matrix factorization to applications such as computer graphics. | PO1,PO2,PO3 | - |
| CO2 | To compute suitable matrices arising in magnification, rotation of images using the knowledge of vector space, matrix of linear transformations. | PO1,PO2,PO3 | - |
| CO3 | Analyze the application-oriented problems connected with difference equations, Markov chain, and discrete dynamical systems by using the concept of Eigen values, Eigen vectors. | PO1,PO2,PO3 | - |
| CO4 | Apply the techniques of singular value decomposition, PCA, to analyze the process of data compression/image processing. | PO1,PO2,PO3 | - |

**CO-PO Mapping:**

| | PO1 | PO2 | PO3 |
|---|---|---|---|
| **CO1** | **3** | **2** | **1** |
| **CO2** | **3** | **2** | **1** |
| **CO3** | **3** | **2** | **1** |
| **CO4** | **3** | **2** | **1** |

**Course Content:**

| Modules | Contents | No. of hours |
|---|---|---|
| Module 1 | **Linear Algebra:** Importance of Matrices in engineering. Rank of a matrix. Consistency of nonhomogeneous and homogeneous system of equations, Solution of the system of linear equations by Gauss elimination method and Gauss – Seidel iterative method. Linearly dependent and independent vectors. Applications of solution of system of equations to balance the chemical equations. Traffic flow problem. To find the suitable combination of food stuff so as to get the desired nutrients as prescribed by a dietician.<br>**Self-Study-** linear models in business and engineering, Partitioned matrices, Matrix factorization, the Leontief input –output model, application to computer graphics. | 10 hours |
| Module 2 | Vector space, subspace, basis of a vector space, dimension of a vector space, introduction to linear transformation, rank, nullity of a linear transformations, matrix of a linear transformation. Special matrices-matrix of rotation, reflection, translation.<br>**Self-Study-** To find the matrix of transformation when the image of some points is given. | 10 Hours |
| Module 3 | Eigen value, Eigen vectors, applications of diagonalization, Jordan canonical form. Application to discrete dynamical systems- coupled differential equations governing the electrical circuits systems, applications to difference equations, applications to web page ranking.<br>**Self-Study-** Stretching of an elastic membrane, to determine the growth of a population model. Role of eigenvalues, eigenvectors in determining natural frequency, mode shapes of equations of motions (Spring mass system). | 10 Hours |
| Module 4 | Orthogonal sets, orthogonal projections, Gram Schmidt process, QR-factorization, lest square problems, multiple regression through matrix approach, singular value decomposition theorem, examples. Principal component analysis- applications of PCA to data compression, image processing. | 10 Hours |

| | | |
|---|---|---|
| | **Self-Study-** Application of eigen value eigen vectors in Signature testing, Face recognition. Stability analysis of differential equations which governs the dynamical systems using the concept of eigen value, eigen vectors. | |

**Note –1. Theorems and properties without proof. Applicable to all the modules.**

**2. Self study part is not included for Semester End Examination.**

**Text Books:**

1. David C. Lay, Steven R. Lay and J.J. Mc Donald: Linear Algebra and its Applications, 5th Edition, Pearson Education Ltd., 2015.

**Reference Books:**

1 E. Kreyszig, "Advanced Engineering Mathematics", 10th edition, Wiley, 2015.
2 R. K. Jain and S. R. K. Jain & S. R. K. Iyengar, Numerical methods, New age International pvt. Publishers, 6$^{th}$edition, 2014.
3 Gilbert Strang: Linear Algebra and its Applications, 4th Edition, Cenage publications, 2014.

**Web links**

- http://nptel.ac.in/courses.phd?disciplineID=111
- http://www.class-central.com/subject/math(MOOCs)
- http://academicerath.org/

## ACTIVITIES:

1. Role of eigenvalues, eigenvectors in determining natural frequency, mode shapes of equations of motions (spring mass system).
2. Lenovo input output method – application to balance the economy of a Country.
3. Applications of factorization of matrices-google recommendation.
4. Jordan canonical form when minimal polynomial and characteristic polynomial is given and its application in Engineering.
5. Diagonalize a matrix and determining the principal stresses.
6. Application of Eigen value Eigen vectors in data compression, Signature testing, Face recognition.
7. Least square solution of system of equations- a matrix approach.
8. Application of Eigen value Eigen vectors in Google page ranking.

| Course Title | Discrete Mathematical Structures<br>Computer Science/ALML/CSBS Engineering | | |
|---|---|---|---|
| **Course Code** | **22MA402** | **Course Type** | Regular |
| **SEE duration** | 3hours | **(L-T-P-C)** | **(2-2-0-3)** |
| **CIE(Theory) marks** | 30 | **Hours / Week** | 04 |
| **CIE (Activity) marks** | 20 | **SEE marks** | 50 |

**Course Objective:**

1. To introduce Discrete structures and principle of Combinatorics which can be employed as tools in the applications of Computer Science & Information Technology.

**Course Outcomes:** Having studied this course, students will be able to

| COs | Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | Apply logic and counting principles to model and analyze problems of computer science & engineering | PO1,PO2 | - |
| CO2 | Apply the concepts of logic to identify methods of mathematical proofs. | PO1,PO2 | - |
| CO3 | Use concepts of functions in analyzing problems on algorithms and programs. | PO1,PO2 | - |
| CO4 | Model and analyze programming problems related to coding theory. | PO1,PO2 | - |
| CO5 | Derive mathematical model for real life problems related to Information science and Engineering. | PO1,PO2 | - |

**CO-PO Mapping:**

| | PO1 | PO2 |
|---|---|---|
| **CO1** | **3** | **2** |
| **CO2** | **3** | **2** |
| **CO3** | **3** | **2** |
| **CO4** | **3** | **2** |
| **CO5** | **3** | **2** |

**Course Content:**

| Modules | Contents | No. of hours |
|---|---|---|
| Module 1 | **Principles of Counting:** The rule of sum and product, permutation principle, combination principle, rule of generalized Permutations and Combinations,<br>**Fundamentals of Logic:** Basic logic connectives and truth tables. Logical equivalence and Tautologies. Statement of laws of logic.<br>**Self-study**: Set theory – set operations, Venn diagram, Inclusion Exclusion principle. | 10 Hours |
| Module 2 | **Fundamentals of Logic contd.:** Logic implication - Rules of inference theory. Application of switching network.<br>**Relations**-definition and elementary properties, Partially ordered sets, Hasse diagram, Lattice.<br>**Self-study:** Quantifiers, methods of proof, equivalence relations, partition of a set induced by a relation | 10 Hours |
| Module 3 | **Functions:** Ceiling function, Floor function, Characteristic function, and Application of Stirling numbers of second kind. Application of functions in vending machine.<br>**Self-study:** one to one and onto functions, Composition of functions | 10 Hours |
| Module 4 | **Coding theory:** Elements of coding theory, the humming matric**,** the parity – check and Generator matrices,<br>**Group codes**: Decoding with coset leaders. Hamming matrices.<br>**Self-study:** sub-groups, cosets, Matrix row operations. | 10 Hours |

**Note –1. Theorems and properties without proof. Applicable to all the modules.**

**2. Self study part is not included for Semester End Examination.**

**Textbooks:**

Discrete and Combinatorial Mathematics, R C Grimaldi, Pearson's publications, 5th edition, 2007.

**Reference Books:**

Discrete Mathematical Structures, by D. S. Malik & M. K. Sen, Thomson's Publications, First edition, 2006.

**Web links**

- http://nptel.ac.in/courses.phd?disciplineID=111
- http://www.class-central.com/subject/math(MOOCs)
- http://academicerath.org/

## Activities List

1. Application of switching network
2. Application to algorithm testing using computational complexity.
3. Computation of number of different ways n rooks can be arranged on an n x n chess board so that no two rooks can attack each other for all positive integers n.
4. Discuss ways in which the current telephone numbering plan can be extended to accommodate the rapid demand for more telephone numbers.
5. Application of functions in vending machine.

| Course Title | Ability Enhancement Course<br>Statistics with R Lab for machine learning<br>Electrical and Electronics Engineering | | |
|---|---|---|---|
| **Course Code** | **22AEC401** | **Course Type** | Regular |
| **SEE duration** | 3hours | **(L-T-P-C)** | **(0-0-2-1)** |
| **Daily evaluation** | 30 | **Hours / Week** | 02 |
| **Final CIE** | 20 | **SEE marks** | 50 |

**Course Objective:** Students will be trained to acquire knowledge in linear algebra and Statistics With python/R Programming and its applications.

**Course Outcomes:** Having studied this course, students will be able to

| COs | Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | Write the programme for the mathematical procedure connected with probability, hypothesis testing, co-relation and regression. | PO1,PO2 | - |
| CO2 | Execute the programme and provide perfect output. | PO1,PO2 | - |

**CO-PO Mapping:**

| | PO1 | PO2 |
|---|---|---|
| **CO1** | **3** | **2** |
| **CO2** | **3** | **2** |

**Course Content:**

**Lab 1**- To predict the conditional probabilities using Bayes theorem.

**Lab 2**- To predict the probability of discrete random variable- Binomial.

**Lab 3**- To predict the probability of discrete random variable- Poisson.

**Lab 4**- To predict the probability of discrete random variable- Hyper geometric.

**Lab 5**- To predict the probability of continuous random variable in an interval (Uniform random variable, exponential variable).

**Lab 6**- To predict the probability of continuous random variable in an interval (Normal random variable).

**Lab 7**- To predict the probability of application connected with Markov process in long run.

**Lab 8**- To compute the confidence interval for mean and standard deviation.

**Lab 9**- Hypothesis testing on application problem connected with mean, variance, proportions when sample size is large.

**Lab10**- Hypothesis testing on application problem connected with mean, variance, proportions when sample size is less (student's T distribution, chi square distribution)

**Lab 11**- Examining the correlation of the experimental data.

**Lab 12**- Carryout linear regression and multiple regression analysis for the experimental data.

**Rubrics for Evaluation**

| Daily Evaluation ( for 30 Marks) | Marks | CO | PO | Level |
|---|---|---|---|---|
| Manual Solving | 8 | CO 1 | P01,PO2 | L3,L4 |
| Record writing & Observation | 6 | CO 1 | PO 1 | L 3 |
| Executing the programme with correct output | 16 | CO 2 | PO 2, PO 5 | L 4 |
| Final CIE | 20 | CO 2 | PO 2, PO 5 | L 4 |

| | | | |
|---|---|---|---|
| **Course Title** | **Bridge Course for Diploma Students**<br>**BRIDGE COURSE MATHEMATICS - I**<br>**(Common to all Branches of Engineering)**<br>**(Audit Course)** | | |
| **Course Code** | **22BCM301** | **Course Type** | Regular |
| **CIE duration** | One and half hour | **(L-T-P-C)** | **(3-0-0-0)** |
| **CIE-1marks** | 50 | **Hours / Week** | 03 |
| **CIE -2 marks** | 50 | | |

**Course Objective – To introduce simple concepts of calculus and numerical methods.**

| COS | **Having studied this course, students will be able to** | **POs** | **PSOs** |
|---|---|---|---|
| CO1 | Solve simple problems on determinants, matrix multiplication, partial differentiation, and integration. | PO1 | - |
| CO2 | Compute the roots of transcendental equations and interpolate when the experimental data is given. | PO1 | - |
| Co3 | Expand the given function in terms of Taylor/ Macluarin's series. | PO1 | - |

**CO-PO Mapping:**

| | **PO1** |
|---|---|
| **CO1** | **1** |
| **CO2** | **1** |
| **CO3** | **1** |

**Course Contents**

| | | |
|---|---|---|
| **Module - 1** | Basic Formulas: Partial fractions. Matrices and determinants: matrix multiplication, evaluation of determinants, finding inverse.<br>Differentiation-I: Review of limit and Continuity, differentiation- Basic formulas, Sum rule, product rule, quotient rule, chain rule and problems.<br>Differentiation-II: Taylor's series, and Macluarin's series of simple functions for single variable, simple problems. | **10 hours** |

| | | |
|---|---|---|
| **Module - 2** | Partial Differentiation: Definition, Illustrative examples on Partial differentiation, Total differentiation, chain rule, Differentiation of composite and implicit functions, Jacobians, illustrative examples and problems, simple problems. | **10 hours** |
| **Module - 3** | Integration: Basic formulas, Illustrative examples, evaluation of definite integrals, Integration by parts, Bernoulli's rule of Integration.<br>Integral calculus: Reduction formula for functions$sin^n x$, $cos^n x$(without proof), Simple problems, Double & triple integration, simple problems with standard limits. | **10 hours** |
| **Module - 4** | Numerical Methods - Numerical Solution of algebraic & transcendental equations by Bisection method, Newton Raphson method, Regular Falsi method.<br>Numerical Interpolation-Definition of forward, backward differences, Newton's forward and backward interpolation formulae, Lagrange's interpolation formula, central difference formulas-Bessel and Stirling formulas, illustrative examples. | **12 hours** |

Note - Theorems and properties without proof. Applicable to all the units.

**Text Books:**


1. Dr. B. S. Grewal, Higher Engineering Mathematics, Khanna Publications, 40th edition (2007).
2. Erwin Kreyszig, Advanced Engineering Mathematics, Tata McGraw Hill Publications, 8th edition (2007).


**Reference Books:**


1. Calculus by Thomas Finney, 9th edition, Pearson education, 2002.
2. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.


**links**

- http://nptel.ac.in/courses.phd?disciplineID=111
- http://www.class-central.com/subject/math(MOOCs)
- http://academicerath.org/

| | |
|---|---|
| **Course Title** | **Bridge Course for Diploma Students**<br>**BRIDGE COURSE MATHEMATICS - II** |

| | (Common to all Branches of Engineering)<br>(Audit Course) | | |
|---|---|---|---|
| **Course Code** | **22BCM401** | **Course Type** | Regular |
| **SEE duration** | 3hours | **(L-T-P-C)** | **(3-0-0-0)** |
| **CIE-1marks** | 50 | **Hours / Week** | 03 |
| **CIE -2 marks** | 50 | | |

**SCourse Objective – Having studied this course, students will be able to**

| | **Outcomes** | **POs** | **PSOs** |
|---|---|---|---|
| CO1 | Identify suitable methods to solve the differential equations analytically. | PO1 | - |
| CO2 | Solve first order first degree D E, integration problems and simple PDE problems using numerical methods. | PO1 | - |
| CO3 | Solve problems on Gradient, Divergence, and Curl of a vector valued function. | PO1 | - |

**CO-PO Mapping:**

| | **PO1** |
|---|---|
| **CO1** | **1** |
| **CO2** | **1** |
| **CO3** | **1** |

**Course Contents:**

| | | |
|---|---|---|
| Module - 1 | Differential Equations: Solution of first order first degree differential equations- Variable separable methods, Homogeneous Equations, Exact differential equations, illustrative examples from engineering field. Linear& Bernoulli's differential equations, Illustrative examples from engineering field. | **10 hours** |
| Module - 2 | Differential Equations: Solution of second and higher order equations with constant coefficient by inverse differential operator method$f(D)y =$ | **10 hours** |

| | | |
|---|---|---|
| | $e^{ax}$,f(D)y = cos(ax + b)/sin (ax + b), $f(D) = ax^2 + bx + cf(D)y = e^{ax}cos(bx + c)/e^{ax}$sin $(bx + c$,$f(D)y = xcos(ax + b)/x$sin $(ax + b)$(Simple problems). Illustrative examples from engineering field.<br>**Numerical solution of first order first degree ordinary differential equations**: Taylor series method, Runge-Kutta method of fourth order, Milne's Predictor corrector methods. | |
| Module – 3 | **Solution of Partial Differential Equations**: Solving PDE by variable separable method, to find all possible solutions of one-dimensional wave equation, one dimensional Heat flow equation and two-dimensional Laplace's equation by the method of separation of variables, numerical solution of Laplace equation by finite difference approximation method using standard five point formula and diagonal five point formula. Numerical solution of poison equation by finite difference approximation method using standard five-point formula and iterative formulas. | **10 hours** |
| Module - 4 | **Numerical Integration**: Computation of line integral by trapezoidal rule, Simpsons 1/3rd rule, Weddle's rule, Simpsons 3/8th rule, Illustrative examples from engineering field.<br>Vector Algebra: vector addition, Multiplication (Dot and Cross product), Triple products, vector differentiation, velocity, acceleration of a vector point function, Gradient, divergence, curl. | **12 hours** |

**Note - Theorems and properties without proof. Applicable to all the units.**

**Text Books:**


1. Dr. B. S. Grewal, Higher Engineering Mathematics, Khanna Publications, 40th edition (2007).
2. Erwin Kreyszig, Advanced Engineering Mathematics, Tata McGraw Hill Publications, 8th edition (2007).


**Reference Books:**

1. Calculus by Thomas Finney, 9th edition, Pearson education, 2002.

N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010. **Web links**

- http://nptel.ac.in/courses.phd?disciplineID=111
- http://www.class-central.com/subject/math(MOOCs)
- http://academicerath.org/

# MALNAD COLLEGE OF ENGINEERING, HASSAN

**(An Autonomous Institution Affiliated to VTU, Belgaum)**

**Autonomous Programmes**

**Bachelor of Engineering**

## DEPARTMENT OF MATHEMATICS

**Open Electives**

SYLLABUS

**Academic Year 2023-24**

## Scheme of evaluation (Theory courses)

| Assessment | Marks |
|---|---|
| Three CIE's | 40 |
| Activity | 10 |
| SEE | 50 |
| Total | 100 |

| Examination | Maximum marks | Minimum marks to qualify |
|---|---|---|
| CIE | 50 | 20 |
| SEE | 50 | 20 |

| Course Title | Open Elective for B.E. Students<br>Linear Algebra & Numerical Methods | | |
|---|---|---|---|
| **Course Code** | **20OEMA61** | **Course Type** | OE |
| **SEE duration** | 3hours | **(L-T-P-C)** | **(3-0-0-3)** |
| **CIE(Theory) marks** | 40 | **Hours / Week** | 03 |
| **CIE (Activity) marks** | 10 | **SEE marks** | 50 |

**Course Objective:** Is to train students in linear algebra, numerical methods and its applications.

**Course outcomes:** Having studied this course, students will be able to**:**

| COs | Outcomes | PO's | PSO's |
|---|---|---|---|
| **CO1** | Apply suitable solution procedure to solve the linear models of business, engineering, economics and examine for various methods to solve differential equations, interpolation examples, system of equations. | PO1,PO2,PO3 | - |
| **CO2** | To compute suitable matrices arising in magnification, rotation of images using the knowledge of vector space, matrix of linear transformations. | PO1,PO2,PO3 | - |
| **CO3** | Analyze the application-oriented problems connected with difference equations, Markov chain, discrete dynamical systems by using the concept of Eigen values, Eigen vectors. | PO1,<br>PO2,PO3 | - |
| **CO4** | Apply the techniques of singular value decomposition, PCA, to analyze the process of data compression/image processing. | PO1,PO2,PO3 | - |

**CO-PO Mapping:**

| | PO1 | PO2 | PO3 |
|---|---|---|---|
| **CO1** | 3 | 2 | 1 |
| **CO2** | 3 | 2 | 1 |
| **CO3** | 3 | 2 | 1 |
| **CO4** | 3 | 2 | 1 |
| **CO5** | 3 | 2 | 1 |

**Course Content:**

| Modules | Contents | No. of hours |
|---|---|---|
| Module 1 | Applications of system of equations to business and economics introduction to linear transformation, rank, nullity of linear transformations, matrix of a linear transformation. | 10 hours |
| Module 2 | Eigen value, Eigen vectors, diagonalization, application to discrete dynamical systems and difference equations. Applications to web page ranking, applications of diagonalization, Jordan Canonical Form. | 10 hours |
| Module 3 | Orthogonal sets, orthogonal projections, Gram Schmidt process, QR-factorization, multiple regressions through matrix approach, singular value decomposition theorem, examples. Principal component analysis- applications of PCA to data compression, image processing. | 10 hours |
| Module 4 | **Numerical Methods**- to find the solution of system of non linear equations, to compute eigen value, eigen vectors by rutishar method, cubic spline interpolation, numerical double integration by simpson's rule. To solve linear second order and non linear second order differential equation by Finite difference methods. Solution of system of linear equations by SOR method, ill conditioned system, condition number, discussion on the convergence of iterative methods. | 12 hours |

**Text Books:**


1. David C. Lay, Steven R. Lay and J.J. Mc Donald: Linear Algebra and its Applications, 5th Edition, Pearson Education Ltd., 2015.
2. Narasingh Deo, Graph theory, PHI publications, 1st Edition

3. R. K. Jain and S. R. K. Jain & S. R. K. Iyengar, Numerical methods, New age International pvt. Publishers, 6th edition, 2014.

**Reference Books:**

1. E. Kreyszig, "Advanced Engineering Mathematics", 10th edition, Wiley, 2015.
2. Gilbert Strang: Linear Algebra and its Applications, 4th Edition, Cenage publications, 2014.

**Web links**

- http://nptel.ac.in/courses.phd?disciplineID=111
- http://www.class-central.com/subject/math(MOOCs)
- http://academicerath.org/

| Course Title | Open Elective for B.E. Students<br>Operation Research | | |
|---|---|---|---|
| **Course Code** | **20OEMA62** | **Course Type** | OE |
| **SEE duration** | 3hours | **(L-T-P-C)** | **(3-0-0-3)** |
| **CIE(Theory) marks** | 40 | **Hours / Week** | 03 |
| **CIE (Activity) marks** | 10 | **SEE marks** | 50 |

**Course Objective**: Is to train the students with mathematical models and various Operational Research techniques.

**Course outcomes:** Having studied this course, students will be able to**:**

| COs | Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | Analyze and **apply** various Operational Research techniques constructively to make effective business decisions | PO1,PO2,PO3 | - |
| CO2 | To **analyze** the mathematical models used in Operational Research | PO1,PO2,PO3 | - |
| CO3 | Use **modern tool** to **solve/visualize** mathematical problems arising in Operational Research. | PO1,PO2,PO5 | - |

**CO PO Mapping:**

| | PO1 | PO2 | PO3 | PO5 |
|---|---|---|---|---|
| **CO1** | 3 | 2 | 1 | - |
| **CO2** | 3 | 2 | 1 | - |
| **CO3** | 3 | 2 | - | 1 |

**Course Content:**

| Modules | Contents | No. of hours |
|---|---|---|
| Module 1 | **Transportation Problem (I-C)**<br><br>Finding initial basic feasible solution by Least cost method, Vogel's approximation method. Optimization using – Modified Distribution (MODI) Method testing for optimality of balanced transportation problems. Assignment (Hungarian method: balanced and unbalanced) and travelling salesman problems (No degeneracy problems) | 10 hours |
| Module 2 | **Network Analysis**<br><br>Project Scheduling and PERT-CPM: Introduction, Basic Difference between PERT and CPM, PERT/CPM Network Components and Precedence Relationship, Project Management – PERT<br>Sequencing: Introduction, processing N jobs through two machines: processing N jobs through two machines (Johnson's method). | 10 hours |
| Module 3 | **Dynamic Programming**<br><br>Dynamic programming multistage decision processes – types – concept of sub optimization and the principle of optimality – computational procedure in dynamic programming – examples illustrating the calculus method of solution - examples illustrating the tabular method of solution(Product Allocation Problem, Airline Problem and Dynamic programming problem leading to linear programming problem(only 2 constraints)). | 10 hours |
| Module 4 | **Game Theory (I-C)**<br><br>Decision Analysis and Games Decision under uncertainty, Game theory, Some basic terminologies, Optimal solution of two-person zero sum game, Solution of mixed strategy games, graphical solution of games, linear programming solution of games. | 12 hours |
| | | |

**Text Books:**

1. Optimization Methods in Operations Research and systems Analysis" – by K.V. Mittal and C.Mohan, New Age, International (P) Limited, Publishers

**Reference Books:**

1.Operations Research – by S.D. Sharma, Kedarnath Ramanath& Co

2.Linear programming, G. Hadley, Narosa Publishing House, New Delhi.

**Web links**

- http://nptel.ac.in/courses.phd?disciplineID=111
- http://www.class-central.com/subject/math(MOOCs)
- http://academicerath.org/

| Course Title | Open Elective for B.E. Students<br>Numerical Methods | | |
|---|---|---|---|
| **Course Code** | **20OEMA63** | **Course Type** | OE |
| **SEE duration** | 3hours | **(L-T-P-C)** | **(3-0-0-3)** |
| **CIE(Theory) marks** | 40 | **Hours / Week** | 03 |
| **CIE (Activity) marks** | 10 | **SEE marks** | 50 |

**Course Objective**: is to train students to acquire knowledge in numerical methods and its applications.

**Course outcomes:** Having studied this course, students will be able to**:**

| COs | Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | Compute, input corresponding to the output of the experimental data, Root of equations and solve nonlinear/linear system of equations using suitable methods. | PO1,PO2, PO3 | - |
| CO2 | Analyze the behavior of the experimental data, fit a suitable piece wise polynomials/spline, approximate by chebschev polynomial and carryout the double interpolation, numerical double integration. | PO1,PO2,PO3 | - |
| CO3 | Examine the system, compute the eigen value /eigen vectors using suitable methods, and obtain the solution of difference equations, initial value and boundary value problems. | PO1,PO2,PO3 | - |
| CO4 | Solve second order linear differential equations by Ritz finite element method with linear piecewise polynomials for two and three elements of equal length. | PO1,PO2,PO3 | - |

**CO-PO Mapping:**

| | PO1 | PO2 | PO3 |
|---|---|---|---|
| **CO1** | 3 | 2 | 1 |
| **CO2** | 3 | 2 | 1 |
| **CO3** | 3 | 2 | 1 |
| **CO4** | 3 | 2 | 1 |

**Course Content:**

| **Modules** | **Contents** | **No. of hours** |
|---|---|---|
| Module 1 | **TRANSCENDENTAL AND POLYNOMIAL EQUATIONS:** Newton Raphson Method, Rate of Convergence of Newton Raphson Method, System of Nonlinear Equations-Newton's method, Methods for Complex Roots- Newton's method, Choice of an Iterative Method and Implementation. **SYSTEM OF LINEAR ALGEBRAIC EQUATIONS AND EIGEN VALUE PROBLEMS:** Linear system of equations, Solution of Linear system of equations by Gauss elimination method and LU decomposition method, ill conditioned system, Eigen values and Eigen vectors, Rayleigh power method, Gerschgorin theorem-to find the interval which contains the eigen value of a matrix ,to find bounds of the eigen values , Rutishauser method to find the eigen values of an Arbitrary Matrices-to find the eigen values and eigen vectors based on the concepts of rank. | 10 hours |
| Module 2 | **INTERPOLATION AND APPROXIMATION:** Lagrange's interpolation, Piecewise interpolation- piecewise linear, quadratic, cubic interpolation, Spline Interpolation – quadratic and cubic | 10 hours |

| | | |
|---|---|---|
| | spline interpolation, Lagrange Bivariate Interpolation polynomial, Least Squares Approximation—to obtain a least square polynomial of degree one and two for the given function, using Chebyshev polynomial approximation -to obtain second degree polynomial approximation.<br>**Numerical Integration:**<br>Numerical Integration- line integral-Simpson's 1/3rd rule<br>Numerical Double Integration- Trapezoidal and Simpson's 3/8th rule. | |
| Module 3 | **Ordinary differential equations and Difference Equations:**<br>To obtain general solution of system of differential equation using eigen value and eigen vectors, General solution of Difference Equations, to solve second ordered differential equation - initial value problems by Nemerov method. | 10 hours |
| Module 4 | **Ordinary differential equations: Boundary value problems**<br>To solve linear and non-linear second ordered differential equation – boundary value problem using Finite difference method.<br>Finite element method- To solve second order linear differential equation-boundary value problem by Ritz method, to solve second order linear differential equation by Ritz finite element method with linear piecewise polynomials for two and three elements of equal length. | 12 hours |

**Text Books:**


1. Frank R Giordano, William P Fox, Steven B Horton: A first course in mathematical modelling, 5th edition, Cengage Learning India Pvt Ltd., 2015
2. R. K. Jain and S. R. K. Jain & S. R. K. Iyengar, Numerical methods, New age International pvt. Publishers, 6thedition, 2014.
3. William Nivadi, Statistics for engineers & scientists 3rd edition, McGraw Hill education, 2013


**Reference Books:**


1. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley India P.v.t. Ltd. 8th Edition, (Wiley student edition) 2004.
2. S S Sastry, Introductory Methods of Numerical Analysis, PHI publications, 5th Edition 2013.

**Web links**

- http://nptel.ac.in/courses.phd?disciplineID=111
- http://www.class-central.com/subject/math(MOOCs)
- http://academicerath.org

| Course Title | Open Elective for B.E. Students<br>Linear Programming | | |
|---|---|---|---|
| **Course Code** | **20OEMA64** | **Course Type** | OE |
| **SEE duration** | 3hours | **(L-T-P-C)** | **(3-0-0-3)** |
| **CIE(Theory) marks** | 40 | **Hours / Week** | 03 |
| **CIE (Activity) marks** | 10 | **SEE marks** | 50 |

**Course Objective**: Students will be trained to acquire knowledge to do mathematical modelling and their solutions using linear programming methods.

**Course outcomes:** Having studied this course, students will be able to**:**

| COs | Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | To do mathematical modelling in terms of general linear programming problems. | PO1,PO2,PO3 | - |
| CO2 | Analyze and solve linear programming problems by Graphical method, simplex method, | PO1,PO2,PO3 | - |
| CO3 | Examine the degeneracy problems, apply Revised simplex method, and able to do Sensitivity Analysis. | PO1,PO2,PO3 | - |
| CO4 | Examine to test for Duality in linear programming problems, solve by Dual simplex method, Primal-dual method and provide solutions to Transportation problems. | PO1,PO2,PO3 | - |

**CO-PO Mapping:**

| | PO1 | PO2 | PO3 |
|---|---|---|---|
| **CO1** | 3 | 2 | 1 |
| **CO2** | 3 | 2 | 1 |
| **CO3** | 3 | 2 | 1 |
| **CO4** | 3 | 2 | 1 |

**Course Content:**

| Modules | Contents | No. of hours |
|---|---|---|
| Module 1 | Linear programming problems, Statement and formation of general linear programming problems, Graphical method, Slack and surplus variables, Standard and matrix forms of linear programming problem, Basic feasible solution. | 10 hours |
| Module 2 | Linear programming, Simplex method, Artificial variables, Big-M method, two phase method. | 10 hours |
| Module 3 | Examine the Resolution of degeneracy, apply Revised simplex method, Sensitivity Analysis. | 10 hours |
| Module 4 | Duality in linear programming problems, Dual simplex method, Primal-dual method Integer programming, Transportation problems, Assignment problems. | 12 hours |

**Text Books:**


1. Optimization Methods in Operations Research and systems Analysis" – by K.V. Mittal and C.Mohan, New Age, International (P) Limited, Publishers
2. Operations Research – by S.D. Sharma, Kedarnath Ramanath& Co
3. Linear programming, G. Hadley, Narosa Publishing House, New Delhi.
4. Linear programming, Guptha, Krishna mandir prakashan meerut publication.


**Web links**

- http://nptel.ac.in/courses.phd?disciplineID=111
- http://www.class-central.com/subject/math(MOOCs)
- http://academicerath.org/

| Course Title | Open Elective for B.E. Students<br>Graph Theory and Combinatorics | | |
|---|---|---|---|
| **Course Code** | **20OEMA65** | **Course Type** | OE |
| **SEE duration** | 3hours | **(L-T-P-C)** | **(3-0-0-3)** |
| **CIE(Theory) marks** | 40 | **Hours / Week** | 03 |
| **CIE (Activity) marks** | 10 | **SEE marks** | 50 |

**Course Objective:**
Prepare students to use Graph Theory and Combinatorics as a tool in developing a consistent mathematical model in engineering and technology.

**Course Outcomes:** Having studied this course, students will be able to

| COs | Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | Apply and analyze the concepts of graph theory in switching network and related Engineering problems. | PO1,PO2 | - |
| CO2 | Identify and apply concept of trees in determination of shortest path of transportation network. | PO1,PO2 | - |
| CO3 | Use and analyze counting principles related to enumeration problems of engineering and technology | PO1,PO2 | - |
| CO4 | Use generating functions, rook polynomials, derangements in problems to analyze solution to engineering problems | PO1,PO2 | - |
| CO5 | Make use of graph theory and counting principles to Derive mathematical model for real life problems in Engineering. | PO1,PO2 | - |

**CO-PO Mapping:**

| | PO1 | PO2 |
|---|---|---|
| **CO1** | 3 | 2 |
| **CO2** | 3 | 2 |
| **CO3** | 3 | 3 |
| **CO4** | 3 | 2 |
| **CO5** | 3 | 2 |

**Course Content:**

| Modules | Contents | No. of hours |
|---|---|---|
| Module 1 | **Graph theory:** Definitions and examples, Types of graph- subgraphs, complements, and planar graphs. Matrix representation of a graph, Incidence matrix, sub matrix, circuit matrix.<br>**Application:** an application to switching net work<br>**Self-study:** Euler- graphs, Hamiltonian graphs, Graph coloring. | 11 Hours |
| Module 2 | **Trees:** Definitions, properties and examples, Rooted trees, Sorting, Weighted trees, and Prefix codes.<br>**Applications:**<br>**Optimization and Matching:** Dijkstra's shortest path algorithm.<br>**Minimal spanning tree:** the Algorithm of Kruskal and Prim.<br>**Self-study:** Biconnected components and articulation points. | 10Hours |

| | | |
|---|---|---|
| Module 3 | **Fundamental Principles of Counting:** The rule of sum and product, permutation principle, combination principle, rule of generalized Permutations and Combinations. Binomial theorem, Inclusion, and exclusion principle.<br>**Self-study:** Pigeonhole principle, Ramsey number, Catalan number | 11Hours |
| Module 4 | **Derangements:** nothing is in its right place, The rook polynomial.<br>**Generating Functions:** Introductory examples, calculation techniques. Partition of integers. Exponential generating functions. The summation operator.<br>**Self-study:** Arrangements forbidden position. | 10Hours |

**Textbooks:**

Discrete and Combinatorial Mathematics, R C Grimaldi, Pearson's publications, 5th edition, 2007.

**Reference Books:**

**1** Graph Theory by Narsingh Deo.

**2.** Discrete and Combinatorial Mathematics, By Colman.

3.Discrete Mathematical Structures, by D. S. Malik & M. K. Sen, Thomson's Publications, First edition, 2006.

**Web links**

- http://nptel.ac.in/courses.phd?disciplineID=111
- http://www.class-central.com/subject/math(MOOCs)
- http://academicerath.org/

| Course Title | Open Elective for B.E. Students<br>Linear Algebra and Statistics With python/R Programming | | |
|---|---|---|---|
| **Course Code** | **20OEMA66** | **Course Type** | OE |
| **SEE duration** | 3hours | **(L-T-P-C)** | **(2-0-2-3)** |
| **CIE(Theory) marks** | 40 | **Hours / Week** | 03 |
| **CIE (Activity) marks** | 10 | **SEE marks** | 50 |

**Course Objective**: Students will be trained to acquire knowledge in linear algebra and Statistics With python/R Programming and its applications.

**Course outcomes:** Having studied this course, students will be able to**:**

| COs | Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | Utilize the concept of consistency of system of equations to solve the engineering application problems, and compute the principal components of PCA | PO1,PO2,PO3 | - |
| CO2 | Analyze the problems connected with probability to apply suitable probability distribution and also, predict the probability in the long run for Markov chain-based problems | PO1,PO2,PO3 | - |
| CO3 | Validate an assumption through "hypothesis testing" (that is the assumption is not simply because of chance). | PO1,PO2,PO3 | - |
| CO4 | Carry out the analysis of correlation, regression, multiple regression. | PO1,PO2,PO3 | - |
| CO5 | .write/execute the program for the mathematical procedures connected with probability, correlation, regression | PO1,PO2,PO3 | - |

**CO-PO Mapping:**

| | PO1 | PO2 | PO3 |
|---|---|---|---|
| **CO1** | 3 | 2 | 1 |
| **CO2** | 3 | 2 | 1 |
| **CO3** | 3 | 2 | 1 |
| **CO4** | 3 | 2 | 1 |
| **CO5** | 3 | 2 | 1 |

**Course Content:**

| Modules | Contents | No. of hours |
|---|---|---|
| Module 1 | **Linear Algebra:** Solution of the system of linear equations. Eigen values and Eigen vectors, Rayleigh power method to find the highest Eigen value. Illustrative examples. QR factorization, SVD, principal component analysis. | 9 hours |
| Module 2 | **Statistics:** Correlation., Linear Regression analysis (when the experimental output depends on one input). Illustrative examples from engineering field, Random variable, Binominal pdf- Illustrative examples. Poisson probability distribution function- Illustrative examples. Exponential pdf, Normal/Gaussian pdf. Illustrative examples from engineering field. | 9 hours |
| Module 3 | **Hypothesis analysis:** Introduction, Testing a hypothesis, central limit theorem-statement, Level of significance, Simple sampling of attributes, confidence intervals, Test of significance for large samples, Comparison of large samples, Student's t-distribution, Chi-square distribution.<br>**Markov Chains:** Introduction, stochastic matrices, fixed probability vectors and regular stochastic matrices. Application of Markov chain to determine the voting tendencies. | 9 hours |

| | | |
|---|---|---|
| Module 4 | **Lab programming.**<br>1. Solution of system equations.<br>2. Computation of eigen value and eigen vector using numerical method/analytical method.<br>3. To compute the principal components in principle component analysis.<br>4. To predict the conditional probabilities using Bayes theorem.<br>5. To predict the probability of discrete random variable- Binomial, Poisson.<br>6. To predict the probability of continuous random variable in an interval(Normal random variable, Uniform random variable)<br>7. To predict the probability of application connected with Markov process in long run.<br>8. To compute the confidence interval for mean and standard deviation.<br>9. Hypothesis testing on application problems connected with mean, variance, proportions when sample size is large.<br>10. Hypothesis testing on application problem connected with mean, variance, proportions when sample size is less(student's T distribution, chi square distribution). | 28 hours |

**Text Books:**


1. David C. Lay, Steven R. Lay and J.J. Mc Donald: Linear Algebra and its Applications, 5th Edition, Pearson Education Ltd., 2015.
2. Narasingh Deo, Graph theory, PHI publications, 1st Edition
3. R. K. Jain and S. R. K. Jain & S. R. K. Iyengar, Numerical methods, New age International pvt. Publishers, 6th edition, 2014.


**Reference Books:**


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- http://academicerath.org/