# COURSEPACK

## SCHEME

The scheme is an overview of work-integrated learning opportunities and gets students out into the real world. This will give what a course entails.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Course Title** | Engineering Mathematics-II | | | **Course Type** | | | **Integrated** | | |
| **Course Code** | | | | **Class** | | | B. Tech 2nd Sem | | |
| **Instruction delivery** | **Activity** | **Credits** | **Credit Hours** | **Total Number of Classes per Semester** | | | | **Assessment in Weightage** | |
| | **Lecture** | 3 | 3 | **Theory** | **Tutorial** | **Practical Practical** | **Self-study** | **CIE** | **SEE** |
| | **Tutorial** | 0 | 0 | | | | | | |
| | **Practical** | 1 | 2 | | | | | | |
| | **Self-study** | 0 | 0 | | | | | | |
| | **Total** | 4 | 5 | 45 | 0 | 15 | 0 | 50% | 50% |
| **Course Lead** | | | **Course Coordinator** | | | | | | |
| **Names Course Instructors** | **Theory** | | | | | **Practical** | | | |

**COURSE OVERVIEW:** This course is familiarizing the prospective engineers with techniques in Engineering Mathematics-I. It aims to equip the students with standard concepts and tools at an intermediate to advance level that will serve them well towards tackling more advanced level of Mathematics and application that they would find useful in their discipline.

## PREREQUISITE COURSE

| PREREQUISITE COURSE REQUIRED | YES /NO | |
|---|---|---|
| If, yes please fill in the Details | Prerequisite course code | Prerequisite course name |
| | C1UC122B | Engineering Mathematics-I |

## COURSE OBJECTIVE:

The students will be able:
1. to visualize and conceptualize the engineering problems.
2. to model the engineering problem mathematically using theory of calculus and matrices.
3. to determine the solution of the studied engineering problems from application point of view.
4. to validate the solution.
5. to implement the solution for engineering problem

COURSE OUTCOMES (COs)

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

| CO No. | Course Outcomes |
|---|---|
| CO1 | Summarize the concepts of vector space, Inner product spaces, differential equations, and vector calculus. |
| CO2 | Explain Gradient, divergence, curl, line integrals, surface integrals, linear transformation and its matrix representation, rank, nullity, Orthogonality of a set in an IPS. |
| CO3 | Apply the concept of rank-nullity theorem to find dimension of spaces, Gram-Schmidt orthogonalization to evaluate Orthogonal and Orthonormal Basis and appropriate methods to solve ordinary and partial differential equations. |
| CO4 | Analyze the concepts of Curl, Divergence, Gradient and theorems of Green's, Stoke's and Gauss-divergence to solve various problems in the vector field. Examine the solution of Wave equation (one dimension), heat equation (one dimension) and Laplace equation (two-dimension steady state only). |

BLOOM'S LEVEL OF THE COURSE OUTCOMES

Bloom's taxonomy is a set of hierarchical models used for the classification of educational learning objectives into levels of complexity and specificity. The learning domains are cognitive, affective, and psychomotor.

## THEORY

| CO No. | Remember **BTL1** | Understand **BTL2** | Apply **BTL3** | Analyse **BTL4** | Evaluate **BTL2** | Create **BTL6** |
|---|---|---|---|---|---|---|
| 1 | · | | | | | |
| 2 | | · | | | | |
| 3 | | | · | | | |
| 4 | | | · | | | |

PROGRAM OUTCOMES (POs): AS DEFINED BY CONCERNED THE APEX BODIES

| | |
|---|---|
| **PO1** | **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems. |
| **PO2** | **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences. |
| **PO3** | **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. |
| **PO4** | **Conduct investigations of complex problems:** 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. |
| **PO5** | **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. |
| **PO6** | **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues, and the consequent responsibilities relevant to the professional engineering practice. |
| **PO7** | **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, demonstrate the knowledge of, and need for sustainable development. |
| **PO8** | **Ethics:** Apply ethical principles and commit to professional ethics, responsibilities, and norms of the engineering practice. |
| **PO9** | **Individual and Teamwork:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. |
| **PO10** | **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions. |
| **PO11** | **Project management and finance:** Demonstrate knowledge and |

| | |
|---|---|
| | understanding of the engineering 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. |
| **PO12** | **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. |

**PSO1:** Ability to work with emerging technologies in computing requisite to Industry 4.0
**PSO2:** Demonstrate Engineering Practice learned through industry internship to solve live problems in various domains.

## COURSE ARTICULATION MATRIX

The Course articulation matrix indicates the correlation between Course Outcomes and Program Outcomes and their expected strength of mapping in three levels (low, medium, and high).

| COs#/ POs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO10 | PO11 | PO12 | PSO 1 | PSO 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO204T1 | 3 | 3 | 1 | 1 | | | | | | | | | 2 | 2 |
| CO204T2 | 3 | 3 | 1 | 1 | | | | | | | | | 2 | 1 |
| CO204T3 | 3 | 2 | 1 | 1 | | | | | | | | | 1 | 1 |
| CO204T4 | 3 | 2 | 1 | 1 | | | | | | | | | 2 | 2 |

**Note:** 1-Low, 2-Medium, 3-High

# COURSE ASSESSMENT

**Assessment pattern for Blended/ Integrated course**

| Type of Course | CIE Weightage | | | End Term Exam (ETE) Weightage |
|---|---|---|---|---|
| | LAB (Daily Work/ Record) | LAB EXAM | Mid Term Exam | |
| Integrated (B) | **25** | **25** | 50 | 50 |
| Final Weightage | **25** | | 25 | 50 |
| **Total** | 100 | | | |

## COURSE

| Content |
|---|
| Scalar and vector fields, Differentiation of Vector functions, Gradient, divergence, curl, line integrals, path independence, potential functions and conservative fields, surface integrals, Green's theorem, Stokes's theorem and Gauss's divergence theorems (without proof & simple problems).<br><br>Vector Space, Linear Independence of vectors, basis, dimension; Linear transformations (maps), range and kernel of a linear map, rank, nullity, rank-nullity theorem, Inverse of a linear transformation, composition of linear maps, Matrix associated with a linear map.<br><br>Inner product spaces, Norms, Orthogonality, Orthogonal and Orthonormal Basis, Orthogonal Projections, Gram-Schmidt orthogonalization.<br><br>Basic concepts, Exact differential equations, Linear differential equations of second and higher order with constant coefficients, Method of variation of parameters, Cauchy-Euler equation, System of linear differential equations with constant coefficients, applications of linear differential equations.<br><br>Basic concepts, Classification of second order linear PDE, Method of separation of variables and its application in solving Wave equation (one dimension), heat equation (one dimension) and Laplace equation (two-dimension steady state only). |

## BIBLIOGRAPHY

**Text Books:**

1. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
2. *Erwin Kreyszig*, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons.
3. *R. K. Jain and S. R. K. Iyengar,* Advanced Engineering Mathematics, 4th Edition, Narosa Publishers.
4. *Robert T. Smith and Roland B. Minton,* Calculus, 4thEdition, McGraw Hill Education.
5. *George B. Thomas and Ross L. Finney*, Calculus, 9th Edition, Pearson Education.

**Reference Books:**

1. *Robert T. Smith and Roland B. Minton,* Calculus, 4thEdition, McGraw Hill Education.
2. *David C Lay,* Linear Algebra and its application, 3rd Edition, Pearson Education.
3. *Michael D. Greenberg*, Advanced Engineering Mathematics, 2nd Edition, Pearson Education.

## Course Name: Exploration with CAS-II

**Objective:** *The objective of this course is to enhance the problem-solving skills of prospective engineers using open-source software/ computer algebra system and to perform tedious and difficult algebraic manipulations/tasks as well as plotting of graphs for complicated functions to understand their behavior.*

**Lab-1:**
Revision of the Scilab: Overview, Basic syntax, Mathematical Operators, Predefined constants, Built in functions. Conditional Statements, Loops, Matrix, and Its applications.
**Lab-2:**
Basic Vector Calculations, Finding Norm, Angle between two Vectors, Unit Vector.
**Lab 3:**
Finding Divergence using Scilab and verifying Divergence Theorem, Finding Curl using Scilab and Verifying Stokes Theorem.
**Lab-4:**
Checking LI and LD of Vectors.
**Lab-5:**
Verifying Rank-Nullity Theorem.
**Lab-6:**
Orthogonal and Orthonormal Vectors, Gramm Schmidt Orthogonalization process.
**Lab-7:**
Matrix associated with linear Transformations and their corresponding operations.
**Lab-8:**
Plotting Direction fields of first order differential equations.
**Lab-9:**
Solving Linear ODE with different initial conditions using Scilab.
**Lab-10**:
Solving PDE with boundary conditions using scilab.

**Textbooks (For Tutorial sessions):**

1. *Robert T. Smith and Roland B. Minton*, **Calculus**, 4th Edition, McGraw Hill Education.
2. *George B. Thomas and Ross L. Finney*, **Calculus**, 9th Edition, Pearson Education

**References for Lab sessions (On scilab):**

a. Urroz, G E., **Numerical and Statistical Methods with SCILAB for Science and Engineering**, Vol 1 BookSurge Publishing, 2001, ISBN-13: 978-1588983046

a. **Software site:** **http://www.scilab.org, official scilab website**

**Wikipedia article: http://en.wikipedia.org/wiki/Scilab**

## LESSON PLAN FOR Integrated COURSES

**FOR THEORY 15 weeks * 3 Hours = 45 Classes) (1credit = 1Lecture Hour)**
**FOR PRACTICAL 15 weeks * 2Hours = 30 Hours lab sessions (1 credit = 2 lab hours)**

| L-No | Topic for Delivery | Tutorial/Practical Plan | Skills | Competency |
|---|---|---|---|---|
| 1 | Scalar and vector fields, Differentiation of Vector functions | Theory | Ability to utilize the concepts of vector and scalar fields | Understanding of fundamental vector calculus concepts and applications. |
| 2 | Formula for finding gradient, Geometrical meaning as normal vector, Formulas to find divergence and curl of vector fields, Illustrative examples | Theory | | |
| 3 | Defining Line integrals as the limit of a finite sum and work done by a force field, Methods to evaluate Line integrals, Illustrative examples | Theory | | |

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| 4 | Revision of the Scilab: Overview, Basic syntax, Mathematical Operators, Predefined constants, Built in functions. Conditional Statements, Loops, Matrix, and Its applications. | Practical | | |
| 5 | | Practical | | |
| 6 | Statement of Green's Theorem, Application to evaluate Line integrals, Evaluating plane area, Illustrative examples | Theory | | |
| 7 | Statement of Stokes's theorem, Based numericals | Theory | | |
| 8 | Statement of Gauss's theorem, Application to find surface integral over Cubical and spherical surfaces only, Jacobian with simple problems | Theory | | |
| 9 | Basic Vector Calculations, Finding Norm, Angle between two Vectors, Unit Vector. | Practical | | |
| 10 | | Practical | | |
| 11 | Statement of Gauss's theorem, Application to find surface integral over Cubical and spherical surfaces only, Jacobian with simple problems. | Theory | | |
| 12 | Definition of vector space,Linear independence and dependence of vectors, basis and dimension | Theory | Ability to use the concept of vector space , linear transformation and Inner product space | demonstrating a deep understanding of linear algebra and its applications. |
| 13 | Linear transformations, Range and Kernel | Theory | | |
| 14 | Finding Divergence using Scilab and verifying Divergence Theorem, Finding Curl using Scilab and Verifying Stokes Theorem. | Practical | | |
| 15 | | Practical | | |
| 16 | Rank and nullity of Linear transformation | Theory | | |
| 17 | rank- nullity theorem (only statement) and its applications | Theory | | |
| 18 | Composition of Linear map, Inverse of Linear Transformation | Theory | | |
| 19 | Checking LI and LD of Vectors. | Practical | | |
| 20 | | Practical | | |
| 21 | Matrix associated with linear map | Theory | | |
| 22 | Revision of definition of field, and define inner product space (for complex and real field both) with examples | Theory | | |
| 23 | Revision of definition of field, and define inner product space (for complex and real field both) with examples. | Theory | | |
| 24 | Verifying Rank-Nullity Theorem. | Practical | | |
| 25 | | Practical | | |
| 26 | Define orthogonal sets and orthonormal sets with examples. | Theory | | |
| 27 | Define Gram-Schmidt orthogonalizations process and Solve problems related to its application. | Theory | | |
| 28 | Define Gram-Schmidt orthogonalizations process and Solve problems related to its application. | Theory | | |
| 29 | Matrix associated with linear Transformations and | Practical | | |

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| 30 | their corresponding operations. | Practical | | |
| 31 | Defining first order exact differential equation, necessary and sufficient condition, General solution. | Theory | ability to analyze solution of differential equation and their integral curves | understanding of foundational concepts in differential equation |
| 32 | nth order homogeneous linear equation f(D)y=0, linear independence of solutions, | Theory | | |
| 33 | auxiliary equation, solution: when roots of auxiliary equation are a) distinct, b) equal, c) complex. | Theory | | |
| 34 | Orthogonal and Orthonormal Vectors, Gramm Schmidt Orthogonalization process. | Practical | | |
| 35 | | Practical | | |
| 36 | nth order non-homogeneous linear equation f(D)y=r(x), | Theory | | |
| 37 | general solution =Complimentary function+ particular integral, method to find PI when r(x)=e^(ax). | Theory | | |
| 38 | Method to find PI when r(x)= sin(ax), cos(ax). And r(x)=x^n, | Theory | | |
| 39 | Plotting Direction fields of first order differential equations. | Practical | | |
| 40 | | Practical | | |
| 41 | Method to find PI when r(x)= sin(ax), cos(ax). And r(x)=x^n, | Theory | | |
| 42 | method to find PI when r(x)=exp(ax)V(x), x^n sin(ax), x^n cos(ax) | Theory | | |
| 43 | method to find PI when r(x)=exp(ax)V(x), x^n sin(ax), x^n cos(ax) | Theory | | |
| 44 | Solving Linear ODE with different initial conditions using Scilab. | Practical | | |
| 45 | | Practical | | |
| 46 | Variation of parameter method to find PI of a second order linear differential equation. | Theory | | |
| 47 | Variation of parameter method to find PI of a second order linear differential equation. | Theory | | |
| 48 | Cauchy-Euler equation and its solution. | Theory | | |
| 49 | Solving Linear ODE with different initial conditions using Scilab. | Practical | | |
| 50 | | Practical | | |
| 51 | Cauchy-Euler equation and its solution. | Theory | | |
| 52 | Finding solution of a system of linear equations. | Theory | | |
| 53 | Finding solution of a system of linear equations. | Theory | | |
| 54 | Solving Linear ODE with different initial conditions using Scilab. | Practical | | |
| 55 | | Practical | | |
| 56 | Mathematical modeling. Basic elements of an electric circuit, Kirchhoff's law. | Theory | | |
| 57 | Solution of simple LR and CR circuits. | Theory | | |
| 58 | Basic concept and classification of second order PDE | Theory | Ability to solving the | utilizing Heat, Wave and Laplace equation to solve |

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| 59 | Solving PDE with boundary conditions using scilab. | Practical | mathematical problems involving differential equations, and numerous applications in physics, engineering, economics, and other fields. | various real-world problems, |
| 60 | | Practical | | |
| 61 | Separation of variable method to solve second orders linear homogeneous PDEs with constant coefficients | Theory | | |
| 62 | One dimensional wave equation as mathematical model of vibrations of a stretched string. Solution of 1-dim wave equation by SOV method. | Theory | | |
| 63 | Solution of 1-dim wave equation with different initial conditions. | Theory | | |
| 64 | Solving PDE with boundary conditions using scilab | Practical | | |
| 65 | | Practical | | |
| 66 | One dimensional heat equation as mathematical model for the temperature distribution in a thin heated rod. | Theory | | |
| 67 | Solution of 1-dim heat equation with both ends of the rod at infinity. | Theory | | |
| 68 | Solution of 1-dim heat equation when the rod has insulated ends. | Theory | | |
| 69 | Revision of finding Curl using Scilab and Verifying Stokes Theorem. | Practical | | |
| 70 | | Practical | | |
| 71 | Two-dimensional Laplace equation. | Theory | | |
| 72 | Two-dimensional Laplace equation as a mathematical model for the steady state temperature distribution in a thin rectangular plate, solution of the equation. | Theory | | |
| 73 | Solution of Laplace equation with different boundary conditions. | Theory | | |
| 74 | Revision of finding Divergence using Scilab and verifying Divergence Theorem, Finding Curl using Scilab and Verifying Stokes Theorem. | Practical | | |
| 75 | | Practical | | |

## PROBLEM-BASED LEARNING

Exercises in Problem-based Learning (Assignments)

| Sr. No. | Problem | KL |
|---|---|---|
| 1 | Define gradient of the scalar field with example. | K2 |
| 2 | Find the gradient of the scalar field $f(x, y, z) = x^2y^2 + xy^2 - z^2$. | |
| 3 | If $r = x\,i + y\,j + z\,k$, $\lvert r\rvert = r$ and $\hat{r} = \frac{r}{r}$ , then show that $grad\left(\frac{1}{r}\right) = -\frac{\hat{r}}{r^2}$ where $\hat{r}$ is unit vector. | K3 |
| 4 | Let $v = a(x, y, z)\, i + b(x, y, z)\, j - c(x, y, z)\, k$ be a differentiable vector field. Show that $div(curl\, v) = 0$. | K3 |
| 5 | Let $f(x, y, z) = 16xy^3z^2$ be a differentiable scalar field. Show that $curl(grad\, f) = 0$. | K2, K3 |
| 6 | Evaluate $\int_C (x^2 + yz)\, ds$, where $C$ is the curve defined by $x = 4y,\ z = 3$ from $(2, \frac{1}{2}, 3)$ to $(4, 1, 3)$. | K3, K4 |
| 7 | Evaluate $\oint_C \left(x^2 + y^2\right)dx + (y + 2x)dy$, where $C$ is the boundary of the region in the first quadrant that is bounded by the curves $y^2 = x, x^2 = y$ by Green's theorem. | K4, K5 |
| 8 | Evaluate the surface integral $\iint_S F.n\, dA$ where $F = z^2\, i + xy\, j - y^2\, k$ and $S$ is the portion of the surface of the cylinder $x^2 + y^2 = 36,\ 0 \le z \le 4$ included in the first octant. | K4, K5 |
| 9 | Use the Gauss theorem to evaluate $\iint_S (v.n)dA$, where $v = x\, i + y\, j + z\, k$ and $S$ is the boundary of sphere $x^2 + y^2 + z^2 = 4$. | K5 |
| 10 | Evaluate $\oint_C v.dr$ using the Stokes's theorem where $v = 3y\, i + 4z\, j + 2x\, k$ and $C$ is the intersection of the surface of the sphere $x^2 + y^2 + z^2 = 16,\ x \ge 0$ and the cylinder $y^2 + z^2 = 4$. | K5 |
| 11 | Discuss whether or not $R^2$ is a subspace of $R^4$ | K4 |
| 12 | Discuss that set of all square matrices of order n form a vector space with respect to matrix addition and scalar multiplication. | K3 |
| 13 | Determine whether, the set $\{x , x , \cos cos\, 2x \}$ is linearly dependent. | K3 |
| 14 | Find the coordinate vector $[p(x)]$ of $p(x) = 1 - 4x + 6x^2$ with respect to the basis $\{1 + x,\ x + x^2, 1 + x^2\}$. | K3 |
| 15 | If $A = [1\ 1\ 1\ 2\ 2\ 3\ x\ y\ z\ ]$ and $V = \{(x, y, z) \in R^3; det(A) = 0\}$ then find dimension of $V$? | K2 |

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| 16 | Let the linear transformation $T: R^3 \rightarrow R^3$ be defined by $T(x, y, z) = (2x + z, 3x - z, x + y + z)$. Then find range space and null space of $T$. | K3 |
| 17 | Let the linear transformation $T: R^3 \rightarrow R^3$ be defined by $T(x, y, z) = (x + z, 2x + y + 3z, 2y + 2z)$. Then find matrix of linear transformation $T$ with respect to the ordered basis $B = \{(1, 1, 0), (-1, 0, 1), (1, -2, 3)\}$. | K3 |
| 18 | Let $T_1, T_2: R^5 \rightarrow R^3$ be the linear transformation such that $rank(T_1) = 3$ and $nullity(T_2) = 3$. Let $T_3: R^3 \rightarrow R^3$ be the linear transformation such that $T_3 o T_1 = T_2$. Then find rank of $T_3$ ? | K2 |
| 19 | Let the linear transformation $T: p_3[0, 1] \rightarrow p_2[0, 1]$ be defined by $(Tp)(x) = p''(x) + p'(x)$. Then find the matrix representation of $T$ with respect to the basis $\{1, x, x^2, x^3\}$ and $\{1, x, x^2\}$ of $p_3[0, 1]$ and $p_2[0, 1]$ respectively? | K3 |
| 20 | Prove that the $T: R^3 \rightarrow R^3$ defined by $T(x, y, z) = (x + z, x - z, y)$ is invertible. Find inverse of $T$. | K2 |
| 21 | Let $u = (a, b)$ and $v = (c, d)$ be two vectors in $R^2$. Show that $< u, v > = (ac - bd)$ is not an inner product. | K2 |
| 22 | Find an orthogonal basis for the subspace $W$ of $R^3$ given by $W = \{[x\ y\ z]: x - y + 2z = 0\}$. | K2 |
| 23 | Determine the matrix $[10\ 20\ 6\ 10\ -20\ 6\ -10\ 0\ 12]$ is orthogonal. If it is, find its inverse. | K3 |
| 24 | Find an orthogonal basis for $R^3$ that contains the vector $x_1 = [1\ 2\ 3]$. (by Gram-Schmidt Process) | K2, K3 |
| 25 | Identify order and degree of the following differential equations $\frac{d^2y}{dx^2} - 3x\sqrt{\frac{dy}{dx}}\,\frac{dy}{dx} = x.$ | K2 |
| 26 | Find the solution of differential equation $\left\|\frac{dy}{dx}\right\| + y = 0$. | K2 |
| 27 | For the initial value problem $\frac{dy}{dx} = \sin sin\, x$, $y(0) = 0$. Find the value of $y$ at $x = \pi/3$. | K2 |
| 28 | Find the general solution of second order linear homogeneous differential equation $\frac{d^2y}{dx^2} - 6\frac{dy}{dx} + 25y = 0$. | K2 |
| 29 | Determine whether the differential equation $e^{x^2}(2xy\, dx + dy) = 0$ is exact. If exact, solve it. | K2 |
| 30 | Find the particular solution of the differential equation $\frac{d^2y}{dx^2} - 4\frac{dy}{dx} + 3y = 2x - 3x^2$. | K2, K3 |
| 31 | Solve $\frac{d^2y}{dx^2} + 5\frac{dy}{dx} + 4y = 10\, e^{-3x}$. | K3 |
| 32 | Solve | K3 |

| | | |
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| | $\frac{d^2y}{dx^2} + 2\frac{dy}{dx} + y = 2x\, e^{-3x} \cos cos\, x$ . | |
| 33 | Solve the non-homogeneous ODE by method of variation of parameter $\frac{d^2y}{dx^2} + y = \sec sec\, x$ . | K2 |
| 34 | Find the solution of the differential equation $x^2\frac{d^2y}{dx^2} + 5x\frac{dy}{dx} + 4y = 0.$ | K3 |
| 35 | Find the current $I(t)$ in the $LC$ − circuit with the following data assuming initial current and charge: $L = 2$ Henry, $C = 0.005$ Farad and $E = 220\, Sin\, 4t$ volts. | K3 |
| 36 | Solve: $\left(x^2D^2 - xD + 1\right)y = \left(\frac{\log log\, x}{x}\right)^2.$ | K3 |
| 37 | Solve the set of simultaneous differential equations $(3D + 1)x + 3Dy = 3t + 1$ <br> $(D - 3)x + Dy = 2t.$ | K2 |
| 38 | Classify the partial differential equation $\left(x^2 - y^2\right)u_{xx} + 2\left(x^2 + y^2\right)u_{xy} + \left(x^2 - y^2\right)u_{yy} = 0$ , for region $x > 0,\ y > 0.$ | K2 |
| 39 | Find region in which partial differential equation $x^2\, u_{xx} + x\left(y^2 - 1\right)u_{xy} + y\left(x^2 - y^2\right)u_{yy} = 0$ , is hyperbolic? | K2 |
| 40 | Use separation of variables method to solve following PDE: $\frac{\partial u}{\partial t} = \frac{\partial u}{\partial x},\ u(0, x) = 2e^{-3x}.$ | K3 |
| 41 | Find the solution of initial value problem $u_t = u_{xx},\ u(0, t) = 0,\ u(\pi, t) = 0$ and $u(x, 0) = \cos cos\, x\ \sin sin\, 5x$ . | K2, K3 |
| 42 | Find the temperature in a laterally insulated bar of length $L$ whose ends are suddenly cooled at 0 degree Celsius and kept at that temperature, was initially at a uniform temperature $u_0$. | K2, K3 |
| 43 | Let $u(x, t)$ the solution of initial value problem $u_{tt} = u_{xx},\ u(x, 0) = \cos cos\, 5x$ and $u_t(x, 0) = 0$. Then find value of $u(1, 1)$? | K3 |
| 44 | An elastic string of length $l$ which is fastened at the ends $x = 0$ and $x = l$ , is released from its horizontal position (zero initial displacement) with initial velocity $g(x)$ given as: $g(x) = \{x,\ \ 0 \le x \le \frac{l}{3}\ 0,\ \ \frac{l}{3} < x < l$ <br> Find the displacement of the string at any instant of time. | K3 |
| 45 | The boundary value problem governing the steady state temperature distribution in a flat, thin, rectangular plate of width $a$ and insulated surface is given by $u(0, y) = 0,\ u(a, y) = 0,\ u(x, \infty) = 0,\ u(x, 0) = kx.$ <br> Find steady state temperature in plate. | K3 |