University of Kerala

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|---|---|---|---|---|---|
| Discipline | Mathematics | | | | |
| Course Code | UK3DSCMAT210 | | | | |
| Course Title | Integral Transform | | | | |
| Type of Course | DSC | | | | |
| Semester | III | | | | |
| Academic Level | 200-299 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours per week |
| | 4 | 3 | - | 2 | 5 |
| Pre-requisites | 1. Differentiation 2. Integration | | | | |
| Course Summary | This course enable the students to gain applications in modelling and solving differential equations | | | | |

# Detailed Syllabus

| Module | Unit | Contents | Hrs |
|---|---|---|---|
| **I** | | **Laplace Transform** | **9** |
| | 1 | Laplace Transform, Linearity, First Shifting Theorem (s-Shifting), Existence and Uniqueness of Laplace Transforms[6.1 of Text 1] | |
| | 2 | Transforms of Derivatives and Integrals, Excluding Differential Equations and Initial Value Problems [6.2 of Text 1] | |
| **II** | | **Applications of Laplace Transform** | **9** |
| | 3 | Unit Step Function, Second Shifting Theorem, Excluding *Example 3* & *Example 4* [6.3 of Text 1] | |
| | 4 | Short Impulses, Dirac's Delta Function, Excluding *Example 3* & *Example 4* [6.4 of Text 1] | |
| **III** | | **Fourier Series- Period** $2\pi$ | **9** |
| | 5 | Fourier Series, A Basic Example, Euler Formulas without derivation. | |

| Module | Unit | Contents | Hrs |
|---|---|---|---|
| | 6 | Convergence and Sum of a Fourier Series | |
| **IV** | **Fourier Series-Arbitrary Period** | | **9** |
| | 7 | Arbitrary Period, Even and Odd Functions | |
| | 8 | Half-Range Expansions | |
| **V** | **Teacher designed module - suggested topics** | | **9** |
| | 9 | Differential Equations, Initial Value Problems[Section 6.2 of Text 1] | |
| | 10 | *Example 3* & *Example 4* [Section 6.3 of Text 1] | |
| | 11 | *Example 3* & *Example 4* [Section 6.4 of Text 1] | |

# Practical sessions and examinations – 30 hours

All the topics mentioned above can be used for practical sessions using SageMath software. Some useful resources for solving these problems using the SageMath software are also given below.

1. Defining symbolic functions
2. Differentiating functions and forming differential equations eliminating constants
3. Computing Laplace transforms of functions
4. Computing inverse transforms
5. Computing Fourier series of functions
6. Solving differential equations using desolve

A record should be maintained with atleast 7 problems from the main topics/teacher designed topics. Each problem in the record must have a description of the problem, algorithm (step by step procedure), commands used, input given and output obtained accordingly. For the ESE, from the list of above 10 problems, the student should be able to answer two selected (from the 7 available in the record) by the examiner.

# Resources for practical sessions

1. SageMath Documentation - Solving ordinary differential equations https://doc.sagemath.org/html/en/reference/calculus/sage/calculus/desolvers.html
2. Sage Quickstart for Differential Equations https://doc.sagemath.org/html/en/prep/Quickstarts/Differential-Equations.html
3. Saskia Roos, Michael Jung, *An Introductory Course on Sage, Lecture Notes* https://www.math.uni-potsdam.de/fileadmin/user_upload/An_Introductory_Course_on_Sage.pdf
4. Sagemath documentation – Symbolic variableshttps://doc.sagemath.org/html/en/reference/calculus/sage/calculus/var.html

5. SageMath documentatin – Solving equations, Laplace transforms etc https://doc.sagemath.org/html/en/tutorial/tour_algebra.html
6. SageMath Documentation – Fourier series https://doc.sagemath.org/html/en/constructions/calculus.html
7. Tuan A. Le, Hieu D. Nguyen, SageMath Advice for calculus https://users.rowan.edu/~nguyen/sage/SageMathAdviceforCalculus.pdf
8. Sagemath documentation – Sage Quickstart for Multivariable Calculus https://doc.sagemath.org/html/en/prep/Quickstarts/Multivariable-Calculus.html
9. Sagemath documentation – Parametric plots https://doc.sagemath.org/html/en/reference/plot3d/sage/plot/plot3d/parametric_plot3d.html#sage.plot.plot3d.parametric_plot3d.parametric_plot3d
10. SageMath documentation – 3D Graphics https://doc.sagemath.org/html/en/reference/plot3d/index.html

## Textbook


1. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, Wiley Publishers, 2018.


## References


1. G B Thomas, R L Finney, Calculus, 9th Edition, Addison-Weseley Publishing Company, 2004.
2. Peter V. O. Neil, Advanced Engineering Mathematics, Thompson Publications, 2007.

# Course Outcomes

| CO No. | Upon completion of the course the graduate will be able to | PO/PSO | Cognitive Level | Knowledge Category | Lecture(L) Tutorial (T) | Practical (P) |
|---|---|---|---|---|---|---|
| CO 1 | Calculate the solution of algebraic and transcendental equation using numerical methods | PO 2, PSO1, 2,3 | U, Ap | F,C | L | |
| CO 2 | Apply numerical techniques to interpolate data points effectively | PO1, PSO1, 2,3 | U, Ap | F,C | L | |
| CO 3 | Apply numerical techniques for differentiation and integration | PO2, PSO1, 2,3 | U, Ap | F,C | L | |
| CO 4 | Calculate the solution of ordinary differential equations using numerical methods | PO2, PSO1, 2,3 | U, Ap | F,C | L | |

**(R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create)**
**(F-Factual, C-Conceptual, P-Procedural, M-Metacognitive)**

# Mapping of CO with PSOs and POs

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | - | - | - | - | 3 | - | - | - | - | - | - |
| CO2 | 3 | 3 | 2 | - | - | - | 3 | - | - | - | - | - | - | - |
| CO3 | 3 | 3 | 2 | - | - | - | - | 3 | - | - | - | - | - | - |
| CO4 | 3 | 3 | 2 | - | - | - | - | 3 | - | - | - | - | - | - |

**( - -Nill, 1-Slightly/Low, 2-Moderate/Medium, 3-Substantial/High)**

# Assessment Rubrics

- Quiz/Assignment/Discussion/Seminar
- Midterm Exam

- Programming Assignments
- Final Exam

## Mapping of COs to Assessment Rubrics

| | Internal Examination | Assignment | Project Evaluation | End Semester Exam |
|---|---|---|---|---|
| CO1 | ✓ | ✓ | | ✓ |
| CO2 | ✓ | ✓ | | ✓ |
| CO3 | ✓ | ✓ | | ✓ |
| CO4 | ✓ | ✓ | | ✓ |