University of Kerala

| | | | | | |
|---|---|---|---|---|---|
| Discipline | Mathematics | | | | |
| Course Code | UK4DSCMAT200 | | | | |
| Course Title | Introduction to Real Analysis and Multiple Integrals | | | | |
| Type of Course | DSC | | | | |
| Semester | IV | | | | |
| Academic Level | 200-299 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical | Total Hours per week |
| | 4 | 4 | | | 4 |
| Pre-requisites | 1. Knowledge of number systems | | | | |
| | 2. Awareness of Calculus | | | | |
| Course Summary | This course includes introductary Real Analysis and Multiple Integrals | | | | |

# Detailed Syllabus

| Module | Unit | Contents | Hrs |
|---|---|---|---|
| **I** | | **Real Numbers** | **15** |
| | 1 | The Algebraic and Order Properties of $\mathbb{R}$, Absolute Value and the Real Line, The Completeness Property of $\mathbb{R}$, Applications of the Supremum Property Intervals (Chapter 2: Sections 2.1, 2.2, 2.3, 2.4, 2.5 (subsections 2.5.1 to 2.5.4) of Text [1]) | |
| **II** | | **Sequences** | **15** |
| | 2 | Sequences and their Limits, Limit Theorems, Monotone Sequences (Chapter 3: Sections 3.1, 3.2, 3.3 (subsections 3.3.1 to 3.3.4) of Text [1]) Subsequences and the Bolzano-Weierstrass Theorem (Chapter 3: Section 3.4 (subsections 3.4.1 to 3.4.9), The Cauchy Criterion (Chapter 3: Section 3.5 (subsections 3.5.1 to 3.5.6) of Text [1]) | |

| Module | Unit | Contents | Hrs |
|---|---|---|---|
| **III** | | **Multiple Integral I** | **15** |
| | 3 | Double Integrals, Double Integrals over Non-rectangular Regions, Double Integrals In Polar Coordinates, Surface Area, Parametric Surfaces. (Chapter 14: Sections 14.1 to 14.4 of Text [2]) | |
| **IV** | | **Multiple Integral II** | **15** |
| | 4 | Triple Integrals, Triple Integrals In Cylindrical And Spherical Coordinates, Change Of Variables In Multiple Integrals, Jacobians, Centers of Gravity using Multiple Integrals. (Chapter 14: Sections 14.5 to 14.8 of text [2]) | |

# Textbook


1. R. G. Bartle, Donald R. Sherbert, Introduction to Real Analysis, Fourth Edition, John Wiley & Sons, Inc., 2010.
2. Howard Anton, I Bivens, S Davis. Calculus, 10th Edition, John Wiley & Sons, 2012.


# References


1. Joel Hass, Maurice D. Weir, Thomas' Calculus Early Transcendentals, 12th Edition, Addison-Weseley Publishing Company, 2004.
2. W. Rudin, Principles of Mathematical Analysis, Second Edition, McGraw-Hill, 1964.
3. Stephen Abbot, Understanding Analysis, 2nd Edition, Springer, 2015.
4. J Stewart, Calculus with Early Transcendental Functions, 7th Edition, Cengage India Private Limited, 2008.
5. Terrence Tao, Analysis I, Hindustan Book Agency, 2022.
6. G B Thomas, R L Finney, Calculus, 9th Edition, Addison-Weseley Publishing Company, 2004.

## 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 | Understanding fundamental properties of real numbers that contributes to formal development of Real Analysis | PSO1, PO1, 2, 3, 4, 5, 6, 7 | R, U | F,C | L | |
| CO 2 | Demonstrates and understand the concept of sequence of real numbers and categorize them into convergent and divergent sequence | PSO1, PO1, 2, 3, 4, 5, 6, 7 | U,An | F,C | L | |
| CO 3 | Describe the concepts of multiple integration | PSO2, PO1, 2, 3, 4, 5, 6, 7 | U, E | C, P | L | |
| CO 4 | Apply double and triple integrals to solve real life problems | PSO3, PO1, 2, 3, 4, 5, 6, 7 | Ap | P | 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 | 2 | 1 | 2 | 2 | 1 | 1 | 2 | 1 | 3 | 1 | 2 | 1 | |
| CO2 | 3 | 2 | 1 | 2 | 2 | 1 | 2 | 2 | 2 | 3 | 1 | 2 | 1 | |
| CO3 | 2 | 3 | 1 | 2 | 1 | 1 | 2 | 2 | 2 | 3 | 1 | 2 | 2 | |
| CO4 | 2 | 2 | 3 | 2 | 1 | 1 | 2 | 3 | 2 | 2 | 1 | 2 | 2 | |

**( - -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 | ✓ | ✓ | | ✓ |