

**BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI**

**K K BIRLA GOA CAMPUS**

**FIRST SEMESTER 2024-2025**

**Course Handout (Part II)**

Date: 26/07/2024

In addition to part-I (General Handout for all courses appended to the timetable) this portion gives further specific details regarding the course.

**Course No.: MATH F111**

**Course Title: Mathematics-I**

**Instructor-In-Charge:** Saranya G. Nair

**Instructors:** Amit Setia, Anushaya Mohapatra, Gunja Sachdeva, Mukesh Kumar Nagar, Prasanna Kumar, Shilpa Gondhali

**Teaching Assistants (TA):** Amit, P Varada, Patil Jatin Suresh, Rakib Mondal, Sarita Sihag, Shravani V Shetgaonkar, Vidhya Venugopal.

**First Degree TA:** Garvit Chittora, Arham Jain, Om Patel, Siddhant Khunteta

1. **Course Description:** The course is intended as a basic course in calculus of several variables and vector analysis. It includes polar coordinates, convergence of sequences and series, partial derivatives, vector calculus with theorems due to Green, Gauss and Stokes.
2. **Scope and Objective of the Course:** A course in Multivariate Calculus encompasses an extensive examination of calculus principles applied to functions of multiple variables, covering topics such as partial derivatives, multiple integrals, vector calculus, and theorems like Stokes' theorem and the divergence theorem. The scope includes understanding functions of several variables, computing partial derivatives, evaluating multiple integrals over regions in two or three dimensions, and applying vector calculus concepts to fields like physics and engineering.

Objectives of the course include mastering techniques for differentiation and integration in multiple dimensions, developing problem-solving skills for real-world applications, understanding fundamental theorems and concepts, and fostering geometric visualization abilities to interpret multivariable functions and their properties effectively. Ultimately, students gain proficiency in using multivariable calculus as a powerful tool for analyzing and solving complex problems across various disciplines.

3. **Text Book:** Thomas' Calculus by George B. Thomas Jr., Joel Hass, Christopher Heil, Maurice D. Weir, *Pearson education 12th edition*, 2015.
4. **Reference Books:**
  - R1: Essential Calculus Early Transcendentals by J. Stewart, *Thomson Learning*, 2014.
  - R2: A First Course in Calculus by Serge Lang, *Springer-Verlag 5<sup>th</sup> edition*, 2009.
  - R3: Advanced Engineering Mathematics by Erwin Kreyszig *Wiley 10<sup>th</sup> edition*, 2015.

R4: Calculus Vol 1 & 2, by T M Apostol, 2<sup>nd</sup> edition, 2007.

5. Lecture-wise plan, objectives and textbook exercise problems for practice:

Lec. No.	Learning Objectives	Topics to be covered	Chap/ Sec.	Selected Exercise Problems for your reference
1-4	To study curves in polar form	Polar coordinates, Graphing in polar coordinates, Areas and lengths in polar coordinates  <b>Self study:</b> polar equations of conic sections	11.3-11.5,  11.7	11.3:1,6,7,15,25,37,38,48,60,62  11.4: 1,6,16,19,21,23,25,26,29,30,31,32,33,34  11.5:1,2,6,9,12,19,20,23,25
5-11	To study the convergence of infinite sequences and series	Sequence of real numbers, frequently occurring limits, monotonic sequence theorem,  Infinite series, different tests of convergence, series of non-negative terms, absolute & conditional convergence alternating series	10.1-10.6	10.1: 1,5,9,12,23,32,38,43,48,49,50,53,58,59,60,63,85,86,89,90,97,99-102,106,128-146  10.2: 1,5,6,12,18,28,32,35,37,41,44,47,49,51,53,59,72,78,81-87  10.3: 6,8,10,26,28,43,47,53-58  10.4: 5,10,15,20,25,30,35,40,45,56,65,68 10.5: 5,6,10,12,20,30,35,40  10.6: 5,10,20,30,35,40
12-13	To study the series representation of differentiable functions	Power series, Maclaurin's series, Taylor series of functions	10.7, 10.8	10.7: 5,10,15,20,25,30,35,40,45  10.8: 5,10,15,16,24
14-16	To study the basic calculus of vector valued functions	Limit, continuity & differentiability of vector function, arc length, unit tangent vector	13.1-13.3	13.1:5,10,15,20,23,27,31 13.2: 5,10,15 13.3: 5,10,15

17-19	To study the quantities that describe how an object's path can turn and twist in space	Curvature, Normal vector, tangential and normal components of velocity and acceleration.	13.4, 13.5	13.4: 5,7,10,19 13.5: 5,10,15,20,21,26
20,21	To study limits and continuity in higher dimensions	Functions of several variables, level curves, limits, continuity	14.1,1 4.2	14.1: 5,10,15,20,31-37, 49, 52 14.2: 6,12,18,26,32,36,43,44,49- 58
22-24	To study the concept of partial differentiation and its physical / geometrical interpretation	Partial derivatives, chain rule, directional derivative, gradient vectors,	14.3- 14.5	14.3: 5,10,15,25,45,55,61,62,65,66, 71,73,90,91,93 14.4: 5,10,25,30,35,41,45,49,50 14.5:5,10,15,20,25,29-37
25-26	To estimate the value of a function through linearization	Tangent planes & normal line, linearization	14. 6	14.6: 6,12,16,19,25,31,32,35,40,45, 49,50, 63,67
27 -29	To study the concept of extreme values on functions of several variables	Maxima, minima & saddle points of functions of two or three variables, Lagrange multipliers	14.7,1 4.8	14.7:5,10,15,20,32,41-47 14.8: 5,7,10,15,17,29,33,41-44
30-32	To study double integrals in cartesian and polar form	Double Integrals, area, change of integrals to polar coordinates	15.1- 15.4	15.1: 5,10,15,20,25 15.2: 5,13,27,35,48,58,62,69 15.3:5,15,19-22,23 15.4:2,5,15,25,27,37,46
33-35	To study three different	Triple integral, integral in cylindrical and spherical coordinates	15.5, 1 5.7,	15.5: 1-6,10,21,22,23,25,37,41 15.7:,10,13,14,15,18,22,33,63

	types of volume integrals and applications		15.8	
36-39	To study the concept of integration over curves and surfaces in space	Line integral, work, flux, path independence, potential function, conservative field, Green's theorem in the plane	16.1-16.4	16.1: 1,5,9,12,19,24,26,33 16.2: 3,9,14,18,19,23,27,31,38,39-43 16.3: 5,10,15,20,24,27,30,32 16.4: 4,8,11,15,19,21,22,24,25,30,31,37
40-42	To study higher dimensional versions of fundamental theorem of calculus	Surface area & surface integral, Divergence Theorem, Stoke's Theorem	16.5-16.8	16.5: 5,10,15,17,26,28, 37, 45 16.6: 5,10,15,18,25,30,31,35,38 16.7: 5,10,14,19 16.8: 3,5,9,13,17-20,27

#### 6. Evaluation Scheme:

EC No.	Evaluation Component	Date of the Exam	Duration	Marks	Nature of exam
1	Mid-Sem exam	5/10/2024, Saturday 2:00 PM - 3:30 PM	1 hour 30 min	105	Closed Book
2	Comprehensive exam	07/12/24 (AN)	3 hours	120	Closed Book

3	AQ-1	21/09/2024 Saturday 3:00 pm-4:00 pm	1 hour	75	Open Book
	AQ-2  <b>Note:</b> Out of two Announced Quizzes (AQ), best mark will be considered and no makeup exam for it	16/11/2024 Saturday 3:00 pm-4:00 pm	1 hour		
	Total			300	

7. **Cut off** for NC grade: **Minimum( 40% of the Median, 20% of maximum marks)**

**Make-up Policy:** Make-up will be given only for very genuine cases (only in Evaluation Components 1 and 2) and prior permission has to be obtained from Instruction Division and I/C.

8. **Chamber consultation hour:** To be announced by respective faculties in the lecture class.

9. **Notices:** All notices regarding the course **MATH F111** will be displayed on online course platform: <https://quantaaws.bits-go.a.ac.in/>

**Instructor-In-Charge  
MATH F111**