

**Lectures**

Wednesday 10:50-11:50, Thursday 15:10-16:10, Friday 10:50-11:50  
Lecture Hall Complex, Room 304

**Instructor:** Chitrabhanu Chaudhuri  
**Office:** Main Building, Room 463  
**Office hours:** Wednesday 4-6 PM or by appointment  
**Email:** chitrabhanu@iiserpune.ac.in

**Texts**

1. Michael Spivak, Calculus on manifolds: A Modern Approach to Classical Theorems of Advanced Calculus, Westview Press: United States of America, 1998.
2. J. R. Munkres, Analysis on manifolds, Westview Press, 1991.

**Assignments and Quizzes**

There will be weekly assignments and 2 in class quizzes.

**Points Distribution**

Final grades will be determined as follows.

1. Assignments 20
2. Quizzes 20
3. Midterm 30
4. Final 30

**Topics**

1. Directional derivatives
2. Derivative as a linear map
3. Inverse and Implicit function theorems
4. Immersions
5. Submersions
6. Measure zero sets
7. Statement of Sard's theorem
8. Integrable functions
9. Fubini's theorem
10. Partitions of unity
11. Change of variables
12. Vector fields
13. Differential forms on  $\mathbb{R}^n$
14. Stoke's theorem for  $\mathbb{R}^n$
15. Submanifolds of  $\mathbb{R}^n$
16. Tensorfields and differential forms on submanifolds
17. Stoke's theorem for submanifolds

## Plan of Lectures

Class	Date	Material	Comments
1	9 Jan (Tu)	Euclidean Space	Assignment 1
2	10 Jan (We)	Partial derivatives and Directional derivatives	
3	11 Jan (Th)	Derivative as a Linear map	
4	15 Jan (Mon)	Higher Derivatives and Jacobian	
5	16 Jan (Tu)	<b>Tutorial</b>	Assignment 2
6	17 Jan (We)	Inverse Function theorem	
7	18 Jan (Th)	Inverse Function theorem	
8	23 Jan (Tu)	Implicit Function Theorem	
9	24 Jan (We)	Immersion and Submersions	
10	25 Jan (Th)	<b>Tutorial</b>	
11	30 Jan (Tu)	Integration on rectangles	Assignment 3
12	31 Jan (We)	Measure zero sets and Integrable Functions	
13	1 Feb (Th)	Integrable Functions	
14	6 Feb (Tu)	Fubini's theorem	
15	7 Feb (We)	Examples	
16	8 Feb (Th)	<b>Tutorial</b>	
17	12 Feb (Mon)	<b>Quiz 1</b>	Assignment 4
18	13 Feb (Tu)	Partitions of Unity	
19	15 Feb (Th)	Change of Variables Proof	

19 - 27 Feb Mid-Semester exams.

<b>Class</b>	<b>Date</b>	<b>Material</b>	<b>Comments</b>
20	1 Mar (Th)	<b>Tutorial</b>	
21	6 Mar (Tu)	Change of Variables examples and Sard's theorem	
22	7 Mar (We)	Manifolds in $\mathbb{R}^n$	Assignment 5
23	8 Mar (Th)	Manifolds in $\mathbb{R}^n$	
24	12 Mar (Mon)	Manifolds with Boundary	
25	13 Mar (Tu)	Tangent space and Vector fields	
26	14 Mar (We)	<b>Tutorial</b>	Assignment 6
27	15 Mar (Th)	No class!!!	
28	20 Mar (Tu)	Multilinear Algebra	
29	21 Mar (We)	Multilinear Algebra	
30	22 Mar (Th)	<b>Tutorial</b>	
31	27 Mar (Tu)	Differential forms	Assignment 7
32	28 Mar (We)	Differential forms	
33	29 Mar (Th)	Integration on Manifolds	
34	2 Apr (Mon)	<b>Quiz 2</b>	
35	3 Apr (Tu)	Integration on Manifolds	
36	4 Apr (We)	<b>Tutorial</b>	
37	5 Apr (Th)	Integrating differential forms	Assignment 8
38	10 Apr (Tu)	Stokes' theorem	
39	11 Apr (We)	Stokes' theorem	
40	12 Apr (Th)	Examples using Stoke's theorem	
41	17 Apr (Tu)	<b>Tutorial</b>	