

**Department of Mathematics and Statistics,  
Indian Institute of Technology Kanpur  
MTH 111M, 2024-2025, I Semester**

Instructors: Sections A and C: Nandini Nilakantan (instructor in-charge), Tel., 7066, nandini@iitk.ac.in  
Sections B and D: P. Shunmugaraj Tel. 7297, psraj@iitk.ac.in.

Tutors: Section A1:  
Section A2:  
Section A3:  
Section B1:  
Section B2:  
Section B3:  
Section C1:  
Section C2:  
Section C3:  
Section D1:  
Section D2:  
Section D3:

**Text :** Thomas' Calculus.

**Course web site :** <http://home.iitk.ac.in/~psraj/mth112>

**Course materials:** Lecture-wise notes of all the lectures, assignments, practice problems with hints/solutions, course plan and necessary information will be available on this course web site.

*Some proofs/remarks/examples in the lecture notes and some problems in the practice problems are marked (\*). These have been provided to increase your understanding of the subject. However, these will not be asked in the exam and quiz.*

**Tutorial and discussion hours:** Each student will be allotted a tutorial section. Each tutorial section will be assigned a tutor. There will be a tutorial hour and a discussion hour in each week. The tutor will conduct the tutorial and the discussion hour. The problems listed in the assignment sheets will be discussed during tutorial hours. The practice problems available on the course web site are usually not discussed in the tutorial classes; however, the students can discuss these problems with the tutors during discussion hours if they need help. The students can also discuss with the tutors during the discussion hours if they have any questions/doubts in the materials covered in the lectures.

**Weightage for the exams and the quizzes :** There will be one quiz of 40 minutes duration with a maximum score of 30. The date for this quiz will be announced in class. The final examination for this course will be of 2 hours duration and have a maximum score of 90.

### **Course Plan**

**Lecture 1:** (5.6,10.5,10.6<sup>1</sup>) Applications of definite integral: Area between two curves, Polar coordinates, Graphs of polar coordinates.

**Lecture 2:** (10.7,6.1) Area between two curves when their equations are given in polar coordi-

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<sup>1</sup>Section from 13th edition of the text book.

nates, Volumes by slicing.

**Lecture 3:** (6.2,6.3) Volumes by Shell and Washer methods, Length of a curve.

**Lecture 4:** (6.5) Area of surface of revolution, Pappus's Theorem(\*).

**Lecture 5:** Review of vector algebra, Equations of lines and planes.

**Lecture 6:** (13.1,13.3) Continuity and Differentiability of vector functions, Arc length for space curves, Unit tangent vector.

**Lecture 7:** (13.4) Unit normal, Curvature to plane and space curves(\*), Binormal(\*).

**Lecture 8:** (14.1-14.3) Functions of several variables, Continuity, Partial derivatives, differentiability.

**Lecture 9:** (14.4) Differentiability  $\Rightarrow$  Continuity, Increment theorem, Chain rule.

**Lecture 10:** (14.5,14.6) Gradient, Directional derivatives, Tangent plane and Normal line.

**Lecture 11:** (14.10) Mixed derivative theorem, Mean value theorem (MVT)(\*), Extended MVT(\*), Hessian(\*).

**Lecture 12:** (14.7) Necessary and sufficient conditions for Maxima, Minima and Saddle point.

**Lecture 13:** (14.8) The method of Lagrange multipliers(\*).

**Lecture 14:** (15.1,15.2) Double integral, Fubini's theorem, Volumes and Areas.

**Lecture 15:** (15.3,15.4) Change of variable in a double integral, special case: Polar coordinates, Triple integral, Applications.

**Lecture 16:** (15.6,15.7,16.5) Change of variables in a triple integral, Special cases : Cylindrical and Spherical coordinates, Surface area.

**Lecture 17:** (16.5,16.1) Surface area (contd.), Surface integrals, Line integrals.

**Lecture 18:** (16.4) Green's Theorem.

**Lecture 19:** (16.2) Vector fields, Divergence and Curl of a vector field.

**Lecture 20:** (16.7) Stokes' Theorem.

**Lecture 21:** (16.8) The divergence theorem.

(\*) These topics may or may not be covered.