FIRST SEMESTER 2017-2018
Course Handout (Part II)

Date: 02/08/2017

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 : **SURESH KUMAR**

Team of Instructors : Amit Kumar, Ashish Tiwari , Bhavya Tripathi, Devendra Kumar, K Satya Pritam, Krishnendra Shekhawat, Parvin Kumari, Pradeep Kr H Keskar, Priyanka Kumari, Satyendra Singh, Srijata Dey, Srikanth, Sumanta Pasari, Swati, Trilok Mathur

1. **Course Description:** The course is intended as a basic course in calculus of several variables and vector analysis. The geometry of objects in two or three dimensional spaces is studied : near a point on them (locally) using differentiation and on the whole (globally) using integration. It includes polar coordinates, convergence of sequences and series, Maclaurin and Taylor series, partial derivatives, vector calculus leading to theorems of Green, Stokes and Gauss.

2. **Scope and Objective of the Course:**
   - Calculus is fundamental to every branch of science and engineering, as all dynamics is modeled through differential and integral equations.
   - Functions of several variables appear frequently in science.
   - The derivatives of the functions of several variables are more interesting because of the several degrees of freedom available.
   - The integrals of the functions of several variables occur in several places such as probability, fluid dynamics, electrical sciences, just to name a few. All lead in a natural way to functions of several variables.
   - The objective of the course is to lay the foundations for these topics.

3. **Text Book:**
   G. B. Thomas Jr., M. D. Weir and J. R. Hass: Thomas' Calculus, 13th Edition, Pearson Educations, 2017.

4. **Reference Books:**
   (i) E. Kreyszig : Advanced Engineering Mathematics, 10th Edition John Wiley and sons 2011.
   (ii) T. M. Apostol : Calculus Vols I and II, 2nd Edition, John Wiley and sons, 1967 and 1969.

5. **Course Plan:**

Module Number	Lecture session/Tutorial Session.	Ref. to text Book: chap/Sec.	Learning Outcome
1. Limits and continuity of real valued function of one real variable	Self Study: Properties of limits, infinity as a limit, continuity	2.3 to 2.6	Understanding of real valued functions of one real variable
2. Infinite sequences and series	L1: Convergence of sequences and series of real numbers L2-L3: Different tests of convergence for the series of non negative terms L4: Absolute and conditional convergence, alternating series	10.1 - 10.8 10.1 is for self study	Differentiate clearly between three types of series convergence with examples and counter examples, Approximating functions with

	L5: Power series, Maclaurin series, Taylor series of functions		polynomials
3. Polar coordinates	L6: Polar coordinates L7-L8: Graphing in polar coordinates L9: Integration using polar coordinates. L10: Polar equations of conic sections	11.3 -11.5, 11.7	The curvilinear coordinate systems like polar coordinates can be more natural than Cartesian coordinates many a times

4. Vector-valued functions	L11: Limit, continuity and differentiability of vector function L12: Arc length, velocity unit tangent vector.	13.1-13.3 (projectile motion excluded)	Understanding of vector valued functions of one variable, motion and its path in space.
5. Motion in space	L13: Curvature, normal vector, torsion L14: TNB frame, tangential and normal components of velocity and acceleration	13.4, 13.5	The relation between the dynamics and geometry of motion.
6. Cylindrical coordinates	L15: Cylindrical coordinates	Additional and advanced exercises, p. 779 (Ex. 8 and 9)	Motions in other coordinate systems.
7. Functions of several variables	L16: Functions of several variables, level curves L17: Limits, continuity	14.1, 14.2	Limits and continuity of functions of several variables is more intricate.
8. Partial differentiation	L18: Partial derivatives L19: Differentiability L20: Chain rule	14.3, 14.4	Difference between ordinary and partial derivatives
9. Directional derivatives, gradient vectors, tangent planes and normal Lines and linearization	L21: Directional derivatives, gradient vectors L22: Tangent planes and normal lines and linearization	14.5, 14.6	Generalizations of partial derivatives and their applications.
10. Extreme values and saddle point of a function of several real varaibles	L23: Maximum, minimum and saddle points of functions of several real variables L24: Lagrange multipliers	14.7, 14.8	Optimization (maximize or minimize) functions of several variables locally as well as globally.
11. Double integrals	L25: Double integrals L26: Areas and volumes L27: Change of integrals from rectangular to polar coordinates	15.1-15.4	Evaluation of area of planar regions and volumes using iterated integrals.

12. Triple integrals	L28-L29: Triple integrals in rectangular, cylindrical and spherical coordinates L30: Substitution in integrals	15.5, 15.7, 15.8	Volumes of solids in space using suitable curvilinear coordinate system.
13. Line integrals of vector fields and Green's theorem in plane	L31: Line integrals L32-L33: Work, circulation, flux, path independence, Potential function, conservative field L34: Green's theorem in plane	16.1-16.4	Different integrals of vector fields on objects in space; applications to flow, flux, work etc.; their mutual relationship via Green's theorem generalizing the fundamental theorem of integral calculus.
14. Surface integrals, Gauss' divergence theorem and Stokes' theorem.	L35-L37: Surface area and surface integral L38-L40: Gauss' divergence theorem, Stokes' theorem.	16.5-16.8 (from sec 16.8 laws of electromagnetic theory and hydrodynamics excluded)	Divergence theorem and Stokes' theorem further generalize Green's theorem.

Note: In tutorials, problems based on the lectures will be practiced, and tutorial tests will be conducted.

6. **Evaluation Scheme:**

EC No.	Evaluation Component	Duration	Marks	Date, Time	Nature of Component
1.	Mid-semester Test	90 minutes	105	12/10 4:00 - 5:30 PM	CB
2.	Tutorial Tests	----------	60	Unannounced	CB
3.	Comprehensive Exam.	3 hours	135	9/12 AN	CB and OB

7. **Make-up Policy**: Make-up for test will be given only for very genuine cases and prior permission has to be obtained from I/C. There is no provision of make ups for tutorial tests.

8. **Chamber consultation hour:** To be announced by the respective Instructor. The chamber consultation hour of all the instructors will be uploaded on Nalanda website.

9. **Notices:** The notices concerning this course will be displayed on Mathematics department notice board and on Nalanda website.

Instructor-in-charge
MATH F111