FIRST SEMESTER 2016-2017
Course Handout (Part II)

Date: 02/08/2016

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 : SANGITA YADAV

Team of Instructors : Amit Kumar, Bhavya Tripathi, Devendra Kumar, Jitender Kumar, Krishnendra Shekhawat, Pradeep Kr H Keskar, Priyanka Kumari, Rakhee, Sachin Kumar, Srijata Dey, Shrikant Varsney, Sumanta Pasari, Suresh Kumar, Swati Sharma.

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. Their derivatives are more interesting because of the several degrees of freedom available. Their integrals occur in several places as probability, fluid dynamics, electricity, 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, 12th Edition, Pearson Educations, 2014.

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:**

Lec. No.	Learning Objectives	Topics to be Covered	Ref. to text Book: chap/Sec.
Self Study	Review of real valued functions of one real variable	Properties of limits, infinity as a limit, continuity.	2.3 to 2.6
1-5	Differentiate clearly between three types of series convergence with examples and counter examples, Approximating functions with polynomials	Convergence of sequences and series of real numbers, different tests of convergence, series of non negative terms, absolute and conditional convergence, alternating series, Power series, Maclaurin series, Taylor series of functions.	10.1 - 10.8 10.1 is for self study
6-10	The curvilinear coordinate systems like polar coordinates can be more natural than Cartesian coordinates many a times	Polar coordinates, graphing, polar equations of conic sections, Integration using polar coordinates.	11.3 -11.5, 11.7

11,12	Study of vector valued functions of one variable, motion and its path in space.	Limit, continuity and differentiability of vector function, arc length, velocity unit tangent vector.	13.1-13.3 (projectile motion excluded)
13,14	The relation between the dynamics and geometry of motion.	Curvature, normal vector, torsion and TNB frame tangential and normal components of velocity and acceleration.	13.4, 13.5
15	Motions in other coordinate systems.	Polar and cylindrical coordinates.	Additional and advanced exercises, p. 745 (Ex. 8 and 9)
16,17	Limits and continuity of functions of several variables is more intricate.	Functions of several variables, level curves, limits, continuity.	14.1, 14.2
18-20	Difference between derivative and partial derivative.	Partial derivatives, differentiability, chain rule.	14.3,14.4
21,22	Generalizations of partial derivatives and their applications.	Directional derivatives, gradient vectors, tangent planes and normal lines, linearization.	14.5, 14.6
23,24	How to optimize (maximize or minimize) functions of several variables locally as well as globally.	Maximum, minimum and saddle points of functions of two or three variables, Lagrange multipliers.	14.7, 14.8
25-27	Evaluation of area of planar regions and volumes using iterated integrals.	Double integrals, area, change of integrals to polar coordinates.	15.1-15.4
28-30	Volumes of solids in space using suitable curvilinear coordinate system.	Triple integrals in rectangular, cylindrical and spherical coordinates, substitution in integrals.	15.5, 15.7, 15.8
31-34	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.	Line integrals, work, circulation, flux, path independence, potential function, conservative field, Green's theorem in plane.	16.1-16.4
35-40	Divergence theorem and Stokes' theorem further generalize Green's theorem.	Surface area and surface integral (for implicitly defined surfaces only, without proof), Gauss' divergence theorem, Stokes' theorem.	16.5-16.8 (from sec 16.8 laws of electromagnetic theory and hydrodynamics excluded)

6. **Evaluation Scheme:**

EC No.	Evaluation Component	Duration	Marks	Date, Time	Nature of Component
1.	Mid-semester Test	90 minutes	90	6/10 8:00 - 9:30 AM	CB
2.	Tutorial Tests	25 minutes	90	Unannounced	CB
3.	Comprehensive Exam.	3 hours	120	8/12 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