



کراچی یونیورسٹی  
*University of Karachi*  
Department of Mathematics

First Semester 2009

Prerequisite: MATH 686

## MATH 717: Astrodynamics I (3+0)

Activity	Dates	Class Schedule
Introduction Day		Room No. 7, Mathematics
Teaching	March 16 – May 9	Friday 0830h – 0949h
Proposal Presentations	February 23 – March 7	Saturday 0935h – 1024h
Semester Examinations	May 11–30	Office Hours
Vacations	June 1 – July 15 (Summer)	Friday 1110h – 1149h

**Course Supervisor:** **Professor Dr. Syed Arif Kamal**  
*Member AIAA (USA), IBRO (France)*  
MS (Indiana, Bloomington, USA); MA (Johns Hopkins, USA); PhD  
**Telephone:** 926 1300-6 ext. 2380 (Tuesday, Thursday 1600h – 1700h)  
**Homepage:** <http://ngds-ku.org/kamal>  
**e-mail:** [kamal\(at the rate of\)ngds-ku.org](mailto:kamal(at the rate of)ngds-ku.org)  
**Office:** Room No. 6, Department of Mathematics, University of Karachi  
**Directions:** <http://www.ngds-ku.org/kamal/contact.htm#Directions>

### Course Objectives

To give the students a professional edge in the techniques and the methods of astrodynamics and space-flight dynamics, so that they can handle complex computational and programming tasks, *e. g.*, orbit computation for satellites and satellite-launch vehicles, stability consideration for launching of satellites, autopilot designing for spacecrafts as well as attitude control of satellites.

### Higher Education and Job Opportunities

PhD from Department of Mathematics, ISPA or IST (Islamabad); jobs in SUPARCO, NDC, PAF & other R&D organizations

### Course Outline

**Section A:** Hypergeometric functions and elliptic

integrals, n-body problem, advanced treatment of two-body problem

**Section B:** Two-body orbits and initial-value problem, solving Kepler's equation, two-body-orbital-boundary-value problem, solving Lambert's problem

**Section C:** Mathematical proofs and applications of control laws (cross-product, extended-cross-product, normal-component-cross-product, dot-product, normal-component-dot-product and ellipse-orientation steering)

**Section D:** Mathematical proofs and applications of guidance schemes (delta, Lambert, inverse-Lambert and multi-stage Lambert scheme, Q, inverse-Q and multi-stage-Q system)

### Recommended Reading

- R. H. Battin, *An Introduction to the Mathematics and the Methods of Astrodynamics*, AIAA Education Series, New York (1987 & 1999)
- R. Deusch, *Orbital Dynamics of Space Vehicles*, Prentice Hall, Englewood Cliffs, New Jersey, USA (1963)

For course announcements, assignments and past papers, go to *Pedagogical Section*, click on "Courses (offered during the current semester)". This handout may be downloaded from:

<[http://www.ngds-ku.org/M779-80/MATH717\\_09.pdf](http://www.ngds-ku.org/M779-80/MATH717_09.pdf)>