Mission Design for Satellite-Launch Vehicle (SLV)

Instructor: Professor Dr. Syed Arif Kamal
August 25-29, 2008

Course Description:

Space exploration is not possible without the availability of spacecrafts, which are able to accomplish their pre-assigned mission. A fire- cracker is unguided and uncontrolled, whereas a satellite-launch vehicle (SLV) is guided and controlled. The course would cover mathematical tools involved in determining which path the spacecraft is following (navigation), which path should it follow (guidance) and how to bring it to the desired path (control). Guidance schemes and control laws are mathematical formulations of the dynamical problem. However, the problem as presented in textbooks is not sufficient to design missions. The instructor, himself involved in the practical design of the space systems, shall take the participants from mathematics to technology, the bridge passing through physics and engineering.

Aims and Objectives:

After attending this course the participants are expected to:

- learn the basic concepts of mission design of SLV
- visualize the type of mathematics needed in this discipline
- acquire skills to formulate a problem
- get hands-on experience to analyze orbit problems

About the Instructor:

Professor Dr Syed Arif Kamal completed his PhD in Mathematical Neuroscience in 1993. He holds masters degrees from the Johns Hopkins University (USA) and Indiana University, Bloomington (USA). He has a throughout first-class-first academic career with 4 gold medals to his credit. He is a recipient of Quaid-é-Azam Scholarship for overseas graduate studies.

Dr Kamal joined Department of Mathematics, University of Karachi as Associate Professor in 1995, assuming the rank of Professor in 2001. He served as Chairman of his department during 2003-6. He is a member of AIAA; Convener of National-Curriculum-Revision Committee (Mathematics), Higher Education Commission; Member, Expert Panel, National Curriculum Council, Ministry of Education, HEC-Approved-PhD Supervisor; Member of Karachi University Senate, Academic Council, Board of Faculty and Board of Studies. Apart from teaching, he has, actively, participated in funded as well as non-funded research projects.

His areas of research include Guidance and Control, Space-Flight Dynamics, Security Technologies, Mathematical Modeling, Mathematical Physics, 3-D Optical Imaging and Image Processing, with applications in the fields of biomathematics, bioinformatics and astrodynamics. He has 95 papers to his credit. *Homepage:* http://ngds-ku.org/kamal
e-mail: kamal(at the rate of)ngds-ku.org

Pre-requisites:

A strong mathematical background is a must in order to understand the subject material. Attendees should posses any of the following degrees:

- Bachelors in Engineering (any field)
- Masters in Mathematics or Statistics
- Masters in Computer Science

Outline:

Day 1

- Projectile Dynamics, Orbital and Escape Velocities Geostationary and Polar Satellites, SLV Orbits
- Techniques of Problem Formulation and Solution

Day 2

- Down-Range and Cross-Range Error for Short-Range Projectiles
- Mathematics of Inertial-Navigation and Telemetry Systems
- Review of Lagrangian and Hamiltonian Dynamics

Day 3

- Two-Body problem in Plane-Polar-Coördinate Mesh
- Two-Body problem in Elliptic-Astrodynamical -Coördinate Mesh
- Hohmann-Transfer Orbit

Day 4

- Control Laws: Extended-Cross-Product, Dot-Product , Ellipse-Orientation Steering
- Explicit-Guidance Schemes: Delta, Lambert Scheme, Q System
- Three-Body Problem and Stability of Satellites

Day 5

- Problem Discussion/Software Demonstration
- Course Summary

Institute of Space Technology

Professional Development Short Course
MISSION DESIGN FOR SATELLITE-LAUNCH VEHICLE

Fee: Rs. 5,000/-

R E G I S T R A T I O N F O R M

I, hereby, apply for admission to the above course. Course fee payable through crossed cheque to Institute of Space Technology is enclosed.

Name: _____

Organization: _____

Position: _____

Qualification: _____

Address: _____

_____

Tel. No.: _____

e-mail: _____

Signatures: _____ Date: _____

Completed form should be returned to:

Academic Coördinator
Institute of Space Technology
PO Box 2750
Islamabad 44000.
Telephone: (051) 927 3316
e-mail: info(at the rate of)ist.edu.pk
Website: http://www.ist.edu.pk

Timings:
3:00 pm - 5:30 pm (Monday-Friday)

Venue:
Institute of Space Technology
Islamabad Highway, Near Rawat Toll Plaza
Islamabad.

Registration:
Requests for participation on the prescribed form (or photocopy) should reach the course coördinator a week prior to the commencement of course, *i. e.*, Monday, August 18, 2008. The short listed candidates will be informed through post. Also, a list of these candidates shall be uploaded on the IST website. The final selection, however, is subject to the receipt of formal application. Forms can be downloaded from:
<http://www.ist.edu.pk>

Instructor with participants of course "GNC of Spacecraft" conducted at IST during August 15-19, 2006

Instructor with participants of course "Astrodynamics and Flight Dynamics" conducted at SUPARCO during May 7-11, 2007

For further information, please contact:
Academic Coördinator
Voice: (051) 907 5486
e-mail: muhammad.ismail(at the rate of)ist.edu.pk

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Organized by
Institute of Space Technology
Islamabad Highway, Islamabad 44000

Web address of this document
http://www.ngds-ku.org/Astrodynamics/IST3.pdf