University of Karachi

Department of Mathematics

2014 *Session* *Pre-requisite*: MATH 510

MATH 685: Astronomy I (3+0)

Activity	Dates	Class Schedule
Introduction day	January 16, 2014	Monday-Wednesday
Teaching	January 17 – May 23	0830h–0920h
Semester Examinations	June 03-20	*Venue*: Room No. 009, Mathematics
Summer Holidays	June 23-30	*Office Hours*: Mon-Wed 1530h–1630h

Course Supervisor: **Professor Dr. Syed Arif Kamal**; *Telephone*: + 92 21 9926 1300-6 ext. 2380
PhD; MSc summa cum laude; MA (Johns Hopkins, United States); MS (Indiana, United States)
Special courses in Space Physics, Astrophysics and Cosmology at MSc and MS levels
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Directions: https://www.ngds-ku.org/kamal/contact.htm#Directions
Handout Address: https://ngds-ku.org/M685-6/MATH685_14.pdf
Tutorial: Ms. Sabahat Latif (Room No. 115)

Course Objectives

To give the students a sound background in the techniques and the methods of astrodynamics and space-light dynamics, so that they can see the applications of these ideas in different branches of science and engineering, *e. g*., orbit computation for satellites and satellite-launch vehicles, stability consideration for launching of satellites, autopilot designing for spacecrafts and attitude control of satellites.

Higher Education and Job Opportunities

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

Course Outline

Section A: Orientation of earth, latitude, longitude, meridian, dateline international, poles, Greenwich mean time (GMT), time zones, rotation of earth about its axis, formation of day and night with demonstration, revolution of earth round the sun, tilting of earth axis, seasons, solar calendar, lunar calendar, core, crust and atmosphere of earth, origin of earth magnetism, geographic and magnetic north poles, solar and lunar eclipses, solar system

Section B: Problem-solving techniques (scalar and vector methods: force and energy methods, conservation laws as applied in astronomy, under-determined, critically-determined and over-determined systems: existence of solution of pair of simultaneous equations), mathematics of scientific instruments, errors (systematic and random), spherical-polar and cylindrical coordinates

Section C: Gravitational mass and inertial mass, weak principle of equivalence, mass and weight, factors in modeling of '*g*', expression for '*g*' (inside and outside earth)

Section D: Parts of rocket, rocket and aircraft engines, astrodynamical terminologies and coördinate systems, convention to label axes, combination of rotations, Euler angles, infinitesimal transformations

Recommended Reading

a) R. Deusch, *Orbital Dynamics of Space Vehicles*, Prentice Hall, Englewood Cliffs, New Jersey, United States (1963)
b) M. Zeilik, *Conceptual Astronomy: A Journey of Ideas*, John Wiley, New York, United States (1993)

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Course Plan

Day	*Monday*	*Date*	*Tuesday*	*Date*	*Wednesday*
Date ↓			**FEBRUARY 2014**		
03	Introduction to astronomy	**04**	Astromathematics	**05**	*No Class* (*Kashmir Day*)
10	Astrodynamics	**11**	Space-Flight Dynamics	**12**	Orientation of earth
17	Longitude and latitude[@]	**18**	Rotation of earth about axis[#]	**19**	*Discussion*
24	Revolution of earth[$]	**25**	Solar and lunar calendars	**26**	Earth core and magnetism
			MARCH 2014		
03	North and south poles[%]	**04**	Solar eclipse	**05**	Lunar eclipse
10	*Discussion*	**11**	*Student Presentations*[&]	**12**	*Student Presentations*[&]
17	*Student Presentations*[&]	**18**	*Student Presentations*[&]	**19**	*Student Presentations*[&]
24	Problem-solving techniques	**25**	Astronomical instruments	**26**	Errors
31	*Quiz*				
			APRIL 2014		
		01	Curvilinear coördinates	**02**	Grav. and inertial masses*
07	*Discussion*	**08**	Modeling of '*g*'[¶]	**09**	Expression of '*g*'[§]
14	Parts of rocket	**15**	Rocket and aircraft engines	**16**	Astrodyn. terminologies[μ]
21	Coördinate Systems[©]	**22**	Convention to label axes	**23**	Combination of rotations
28	Euler angles	**29**	Comb. of rot. and transl.[®]	**30**	Inf. Transformations I[∃]
			MAY 2014		
05	Inf. Transformations II[∃]	**06**	*Discussion*	**07**	*Glimpse of the next course*
12	*Revision*	**13**	*Revision*	**14**	*Revision*
19	*Past-Paper Solution I*	**20**	*Past-Paper Solution II*	**21**	*Exam-Taking Strategy*

Additional Details

[@]meridian, dateline international, poles, Greenwich mean time (GMT), time zones
[#]formation of day and night
[$]revolution of earth round the sun, tilting of earth axis, seasons
[%]geographic and magnetic poles
[&]students shall prepare and give presentations on planets (core, crust, atmosphere and dynamics) of the solar system
*gravitational and inertial masses, weak principle of equivalence, mass and weight
[¶]factors in modeling of '*g*'
[§]inside and outside earth
[μ]astrodynamical terminologies
[©]used in astronomy, astromathematics and astrodynamics
[®]combination of rotation and translation
[∃]infinitesimal transformations, as applied to inertial navigation system

Past Papers: https://www.ngds-ku.org/kamal/past.htm#Astronomy