NEW YORK CITY COLLEGE OF TECHNOLOGY
The City University of New York

DEPARTMENT: Electrical and Telecommunications Engineering Technology

SUBJECT CODE TCET 3222   Satellite Transmission
AND TITLE:
REQUIRED COURSE

COURSE DESCRIPTION:

The basic concepts and techniques used in satellite communications are introduced.
The three major segments of a satellite system: the space segment, the earth
segment and the link between these segments are explained in details. An introduction
to satellite launching is followed by a detailed discussion of different orbits and methods of
allocating geostationary orbit to communication satellites are addressed. Three main frequency
bands allocated to communication satellites are discussed in details. The atmospheric and free
space loss, the effects of rain attenuation, elevation angle, antenna's figure of merit and other
factors affecting signal propagation are explained. Uplink and downlink transmissions and the
link budgets are examined and the carrier to noise ratio, bit energy to noise density ratio and gain
to noise temperature ratio are explained. Different modulation and multiple access methods are
covered. The laboratory part of this course utilizes several software simulation tools to analyze
the different segments of a satellite communication network. The link budget analysis,
launching phase maneuvers and impacts of different parameters affecting signal transmission and
reception are performed to improve understanding of the theoretical concepts learned in the
lecture part of the course. The impacts of other Earth and Atmospheric parameters such as sand
storm, rain attenuation, Van Allen Belts and Tropospheric Scintillation on signal propagation are
examined to enhance learning.

PRE-REQUISITES: TCET 2220, TCET 3102

TEXTBOOK: Information, Communication, and Space Technology
By Mohammad Razani
CRC Press, February 2012

REFERENCE BOOKS: 1. Satellite Communications
By Dennis Roddy
McGrawHill
Fourth Edition, 2006.
2. Satellite Communication Systems
By B.G. Evans
IEE Telecommunications Series
3rd Edition, 2000
SUPPLEMENTARY   Handout problems and project assignments
MATERIAL: Prepared by Dr. M. Razani

**COURSE OBJECTIVES/
COURSE OUTCOMES**:
(ETAC/ABET Criteria 3,
Program Criteria)

1. Analyze the earth segment as well as the space segment (3a, 3b, 3c, 3f, PCa).

2. Analyze the link budget for a complete satellite system (3a, 3b, 3c, 3d, 3f, PCa, PCd)

3. Analyze the different modes of interference due to other satellite systems or neighboring terrestrial microwave stations. (3a, 3b, 3f, 3k)

4. Carry out several satellite simulation software that Includes visualization of the concepts leaned in the lecture part and methods of Link Budget calculations and Interference Analysis between satellite systems and their corresponding earth stations (3a, 3b, 3c, 3d, 3f, 3g, 3i).

TOPICS: Topics include space segment, earth segment, link budget calculations, antennas and wave propagations, multiple access techniques, multimedia by satellite, and domestic, regional and international communication satellite organizations. Also familiarity with different software tools used in visualizing the concepts learned in the lectures.

CLASS HOURS: 2
LAB HOURS: 3
CREDITS: 3

PREPARED BY: Professor M. Razani
Spring 2014
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Contribution of course to meeting the requirements of ETAC/ABETCriterion 5:
TCET3222 meets Criterion 5 by providing students with a strong foundation of the theoretical principles and practical laboratory skills needed to understand, measure, and analyze concepts and techniques used in satellite communications of varying applications and complexity. Academic benchmarks, course outcomes, and assessment requirements have been established to ascertain student comprehension of concepts and proper usage of software tools. Through critical thinking, communications and teamwork, students develop skills needed to solve problems in a classroom and laboratory environment, which later serve them in the workplace.

GRADING POLICY: TCET 3222

Homework and class participation   10%
Midterm Exam: 20%
Final Exam;   20%
Project: 20%
Lab: 30%

Letter Grade	Numerical Grade Ranges	Quality
A	93-100	4.0
A-	90-92.9	3.7
B+	87-89.9	3.3
B	83-86.9	3.0
B-	80.82.9	2.7
C+	77-79.9	2.3
C	70-76.9	2.0
D	60-69.9	1.0
F	59.9 and below	0.0

Assessment	Assessment
The following assessment techniques are correlated to the course objectives as follows: In addition, each assessment technique incorporates one or more of the following ETAC/ABET Criterion 3 Student Outcomes and Program Criteria (3a, 3b, 3c, 3d, 3f, 3g, 3i, 3k, PC a, PC d).	Using software tools introduced in the class, the students will be able to:
1. Analyze the Earth Segment as well as the space segment	1.1 Identify each of the earth and space segments' subsystems. 1.2 Work through the chain of the subsystems. 1.3 1.3 Analyze each of the elements independently and in connection with the remaining subsystems.
2. Analyze the link budget for a complete satellite system.	2.1 Calculate the carrier to noise ratio for the uplink , downlink, and the total C/N. 2.2 Calculate the figure of merit for the earth station antenna as well as the satellite antenna. 2.3 Calculate the total loss of signal due to free space, receiving system, atmospheric losses, etc.
3. Analyze the different modes of interference due to other satellite systems or neighboring terrestrial microwave stations.	3.1 Create a model with all of the elements contributing to the interference. 3.2 Treat each of the interfering element one at the time. 3.3 Calculate the amount of interference for each element. 3.4 Add all these effects to get the total interference effect due to all interfering elements.
4. Carry out several satellite simulation software that includes visualization of the concepts learned in the lecture part and methods of Link Budget calculations and interference analysis between satellite systems and their corresponding earth stations.	4.1 Students run satellite software that simulate the discussions in class and will explain their observations in the lab reports.

WEEK	TOPIC	READIG ASSIGNMENTS	HANDOUT HOMEWORK PROBLEMS	LABORATORY EXPERIEMENTS
1	Overview of transmission systems and their applications.			Introduction & overview of all labs for the semester
2	Communication satellites; history and types of services.	Pages 144-168	**1.1-1.8**	**Lab 1** SMW Link Analysis
3	Overview of satellite systems and their developments. Types of satellites, orbits, and launching methods.	pages 97-107	**2.1-2.11**	**Lab 2** Satellite Tracking
4	Application satellites; remote sensing, meteorological, GPS and scientific satellites.	Pages 107-144		**Lab 3** SATSOFT
5	**Exam 1**			**Exam 1**
6	Earth station design; Link Budget parameters and LB calculation.	Pages 169-203	**7.1-7.9**	**Lab 4** SATMASTER
7	Earth station design, continued.	Pages 169-203	**8.1-8.10**	**Lab 5** Satellite Earth Station Maintenance tools.
8	Satellite communication coverage areas, frequency band allocations, interference, & Multiple access methods.	Handouts	**12.1-12.7**	**Lab 6** Software from Internet
9	Space technology and its challenges. Domestic and international space activities.	pages 49-93		**Lab 7** Visualize Tools software
10	International and regional satellite communications organizations.	Handout	**15.8**	**Lab 8** Link Budget Calculation.
11	International and regional satellite communications organizations, continued. **Exam 2**	Handout	**17.1-17.3**	**Exam 2**
12	Students' presentations of their research work.			No Labs, The entire period is

				allocated to the students' presentations.
13	Future space technologies	Pages 207-219		**Lab 9** International Space Station
14	Future directions in satellite communications, review for final exam	Handout		Completion of any labs missed.
15	**Final Exam**			**Final Exam**