Satellite Communications B

EEM.scmB

Organiser: Dr Zhili Sun (ZS)
Lecturers: Professor Barry Evans (BGE)
            Professor Rahim Tafazolli (RT)
            Mr. Tony Jeans (TGJ)
            Dr. Peter Sweeney (PS)
            Dr Haitham Cruickshank (HC)
            Professor Gerald Maral (external lecturer) (GM)

Credits: 15 Level M
Semester: Spring
Day: Friday
Time: am
Linked UG: None

Prerequisite: EEM.scmA - Satellite Communications A.
(It is also advisable to take the Modulation & Coding module).

Aims: The aim of this module is to build onto the knowledge gained in EEM.scmA and to provide
the student with a detailed understanding of the techniques used and applications in modern
Satellite Communications. In addition, to provide the student with familiarity of simulation
techniques used in the design of Satellite Communications links.

Objectives: Students taking this module will have a detailed knowledge of modern satellite
communication techniques and systems as well as an appreciation of all the current
application areas. In particular the students will have obtained the skill of simulating a
satellite communication link using a commonly available and industry standard software
package.

Assessment: Written, closed-book, examination paper 70%
Assignment 30%

Assignments: Satellite System Simulation Assignment using the Systemview package (or alternative) -
assignment tutor Mr T Jeans (issued week 1, due in week 12). (Compulsory, minimum mark
30%)

Labs: None.

Part time students: Assignment: same rules apply as for full-time students.

Schedule:

10 - 11 am
11 - 12 pm
12 - 1 pm
Week 1

15

exams

ZS
BGE
HC
GM
RT
TGJ
PS

Revision

Syllabus

Lecturers BGE/GM/ZS/HC/RT/TGJ/PS

Hours 30 Lecture hours/problem classes + 2 day short course*

*Note that students are expected to attend part of a short course which is run out of normal semester-
time and for two complete days (TBA).
1. Digital modulation for satellite communication systems (TGJ)
   Digital modulation MPSK for Satellites Communications, details of Eb/No, CR/BTR and practical Satcom modems. OK-QPSK, P/4 QPSK, MSK, QAM. Effects of non-linearities, interference etc.

Satellite Systems Simulation (TGJ)
An introduction to simulation and the Systemview package (or alternative) for communication systems design. Review of assignment.

2. Channel coding and decoding applications to satellite communications (PS)
   Block coding, maximum likelihood decoding, effects of FEC, bandwidth & performance, binary cyclic codes (BCC), Reed-Soloman codes, convolutional codes, Viterbi decoding, concatenated codes, turbo codes, etc.

3. Digital Broadcasting (BGE)
   Review of analogue FM transmission of FDM-TV. Infrastructure of broadcasting - evolution of MAC systems to HDTV standards. Digital TV - source encoding and MPEG ideas - DVB channel coding and modulation. Link budgets and the use of coding - conditional access and commercial application VOD etc. DAB, COFDM techniques, satellites for DAB/DARS and examples Xm/Sirius/worldspace

4-5. Satellite Networking (ZS)

6-7. DVB and security (HC)


10. Advanced Satellite Systems (BGE)
   OBP - satellite on-board MCDs and switches; advantages of OBP and examples of current R & D in mobile, broadband systems. ISLs - microwave/millimetre wave and optical - components and link design. Tracking and control antennas/telescopes. MBAs - review of types of antenna, BFNs and DSP elements - scanning beams etc. Advantages of ISL-OBP-MBAs examples & R and D update.

S1. Multiple Access (GM)
   Road map of MA and applications. Review of FDMA and TDMA, SCP, MCPC, INTELSAT, IDR etc. TDMA frame details, synchronisation, open-closed loops, efficiency and frame design. SS-TDMA - frame design and synchronisation aspects. CDMA details; spreading codes, synchronisation, power control, voice activation, receiver tracking and acquisition. Capacity calculations - importance of interference - example link budgets. Synchronisation and asynchronous CDMA. Random access, Aloha, S-Aloha, S Rej Aloha - details and calculations. RA-TDMA, Traffic implications and effects on Access design - comparisons of throughput, delay performance and applications.

S2. VSAT/Business Systems (GM)
## Recommended Texts

<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Title</th>
<th>Publisher</th>
<th>ISBN</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>B Maral, G</td>
<td>VSAT Networks</td>
<td>J. Wiley &amp; Sons</td>
<td>0471-953024</td>
<td>£50.00</td>
</tr>
<tr>
<td>Lutz, E, Werner, M &amp; Jahn, A</td>
<td>Satellite Systems for Personal &amp; Broadband Communications</td>
<td>Springer</td>
<td>3540668403</td>
<td></td>
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<tr>
<td>Benoit H,</td>
<td>Satellite television: techniques of analogue and digital television</td>
<td>Arnold</td>
<td>0471238104</td>
<td></td>
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<tr>
<td>Benoit H,</td>
<td>Digital television</td>
<td>Arnold</td>
<td>04713584x</td>
<td></td>
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<tr>
<td>Sheriff R &amp; Fun Yu</td>
<td>Mobile satellite communication networks</td>
<td>J Wiley &amp; Son</td>
<td>047172047x</td>
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