



Centre for  
Broadcast Skills  
Training

IESS 308

R+D

89/4+5

9/1/4

**SATELLITES IN BROADCASTING**

2 October - 6 October 1995

RA 172

Course Manager - Richard Penman

IEE Rk ~ Sab Cam

ISSN

0 86341 229 7

Monday 2.10.95	a.m.	Travel and Preparation	
	p.m.	Introduction to the Course Principles of Satellite Communications 1	Richard Penman Richard Penman
Tuesday	a.m.	Principles of Satellite Communications 2 Antennas and Propagation	Richard Penman Richard Penman
	p.m.	Transponders	Richard Penman
Wednesday	a.m.	Modulation and Access Techniques (Analogue and Digital)	Richard Penman
	p.m.	Link Budgets	Richard Penman
Thursday	a.m.	Uplink Operation (Theory) Uplink Practicals	Richard Penman/ Guest
	p.m.	Uplink Practicals	Richard Penman
Friday	a.m.	TVRO and SCPC Practicals	Richard Penman
	p.m.	Large Earth Station Engineering Antenna Tracking	Richard Penman/ Salim Sidat (Guest)

Please bring your own Scientific Calculator if possible.

# SATELLITES IN BROADCASTING

(E053)

## SYLLABUS

### 1. PRINCIPLES OF SATELLITE COMMUNICATION SYSTEMS

#### 1.1 The Geo-stationary Orbit

Forces, velocities, orbital period, radius of orbit

#### 1.2 Uses of Satellites

General uses. Specific uses to provide TV and Radio contribution and distribution circuits including the advantages and disadvantages compared to other systems. DBS

#### 1.3 Other Types of Orbit

Molniya, Tundra, LEO

#### 1.4 Satellite Operators

Intelsat, Eutelsat, Pan-am sat, Arabsat, etc.

#### 1.5 Satellite Frequency Bands

#### 1.6 Geo stationary Orbit Occupancy

Identifying satellites by longitude.

#### 1.7 Geo-stationary Arc

as viewed from different Earth Station sites

#### 1.8 Basic Satellite Link System

Up and down links. Earth stations (fixed and portable). Satellite transponders

#### 1.9 Earth Station Antenna Pointing

Calculation of Azimuth and Elevation

Earth Station antenna Mounting Systems (Az-El and Polar)

1.10 Orbit Disturbances

N/S and E/W drift.

Inclined orbits

1.11 Solar Eclipses

1.12 Sun Outages

1.13 Modulation Systems

Analogue FM and digital systems

1.14 Satellite Access Techniques

FDMA, TDMA, SCPC

2. THE EBU AND THE EUROVISION/EURORADIO NETWORK

The terrestrial and satellite link circuits available. Satellite transponders and channel frequencies, polarizations and modulation types.

3. SATELLITE LINK PROPAGATION

2.1 Isotropic Radiators

3.2 Power Density

3.3 Aperture, gain, and eirp

3.4 Free Space Attenuation (FSA) or Path Loss

3.5 Other Factors which affect propagation

4. INTRODUCTION TO EARTH STATION AND SATELLITE ANTENNAS

4.1 Parabolic Dish Antennas

4.2 Dish Geometry

4.3 Feed Systems

4.4 Cassegrain and Gregorian Feeds

4.5 Radiation Patterns

4.6 Beamwidth and Relation to Gain

4.7 Sidelobe Levels

4.8 Footprints

4.9 Polarization

5. EARTH STATIONS

Typical equipment at fixed and portable Earth Stations

Antennas, LNA's, LNB's, coaxial cables, waveguides, SHF receivers, demodulators, rf multiplexers, exciters, HPA's (solid state and TWT).

6. SATELLITE TRANSPONDERS

6.1 Performance Requirements

6.2 Typical Design

7. LINK BUDGETS

7.1 Factors affecting overall link performance (up and down links)

7.2 Downlinks

received carrier power

noise figure, noise temperature

noise performance of cascaded networks

system input noise temperature

receiving system figure of merit (G/T)

received carrier to noise ratio

7.3 Uplinks

Spreading Loss

Incident Power flux Density (IPFD) at the satellite

Transponder saturation

Transponder input and output back off

Transponder G/T

Received C/N ratio

7.4 Link Budget Example (TV contribution circuit)

Up and downlink calculations

7.5 Analogue FM Demodulator Performance

FM advantage

Calculation of video S/N ratio from C/N ratio

Threshold effect and threshold noise

Threshold margin

Threshold extension demodulators

8. DIGITAL MODULATION TECHNIQUES

8.1 Digital Coding and Modems

8.2 Digital Modulation (PSK, QPSK, etc.)

8.3 Obtaining Bit Error Ratio from Carrier to Noise Ratio

8.4 Bit Rate Reduction Techniques for TV signals

8.5 Link Budget Example

Reception of digitally modulated SCPC signal for high quality audio feeds.

9. RADIO AND TV CONTRIBUTION CIRCUITS

9.1 Obtaining Frequency Clearance

9.2 Setting up a Typical OB up and down link station

9.3 Review of currently available commercial Portable Systems for SNG and OB's

10. PRACTICALS (A)

10.1 Demonstration of an SNG Uplink Earth Station

Setting up a typical SNG terminal and accessing a satellite.  
Reception of the down link signal.

10.2 Use of Spectrum Analyzer in aligning antennas and identifying satellites

10.3 Measurement of LNB and Satellite Receiver Noise Figure

11. DOMESTIC SYSTEMS FOR DBS TVRO

11.1 Examples of Satellites for European DBS

orbital positions

radio and tv services

eirp and footprints

polarizations

coding (PAL, MAC, D2-MAC, SECAM, NTSC)

encryption/scrambling

11.2 Typical TVRO System Block Diagram

types of antenna, typical sizes, different antenna mounts

typical LNB noise figures

11.3 Link Budget Calculation

calculation of minimum dish size for a given satellite service and E/S location

12. PRACTICAL (B)

12.1 Setting to Work a Receive Only System

(a) domestic TVRO system

Assembling the separate components in the system, aligning the receiving dish on either a polar or Az-El mount, and adjusting the polarization skew. Operation of the receiver. Assessment of the results.

(b) reception of SCPC signals for high quality audio distribution feeds.

13. LARGE EARTH STATIONS

13.1 Tracking Techniques

Use of Satellite Beacons. Step track, monopulse, beam squinting.

13.2 Commissioning New Earth Stations

E/S antenna required radiation pattern

Measurement of antenna Radiation pattern

Measurement of Receiving System Noise Temperature

Obtaining Operating Licences

14. RELIABILITY OF SATELLITE PROPAGATION PATHS

14.1 Effect of Rain and Atmospheric Attenuation

14.2 Statistical Analysis of Rainfall Patterns, CCIR Calculations

14.3 Calculation of required satellite link fade margin for a given reliability in different parts of the World

14.4 Faraday Rotation

15. SPACECRAFT ENGINEERING

Payload and other sub systems

16. SPACECRAFT LAUNCH VEHICLES

review of current launch vehicles

*Topics 14, 15, 16 = only if time permits.*