COURSE CODE:	*ELE 203*
COURSE TITLE:	*Fundamentals of Information and Communication Technology*
NUMBER OF UNITS:	*3 Units*
COURSE DURATION:	*Three hours per week*

COURSE DETAILS:

Course Coordinator: **O. A. Akinola**
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Other Lecturers: **None**

COURSE CONTENT:

COURSE REQUIREMENTS:

This is a compulsory course for all 200 level students in the College of Engineering. In view of this, students are expected to participate in all the course activities and have minimum of 75% attendance to be able to write the final examination.

READING LIST:

KHANNA V. K. Digital signal Processing Telecommunications and Multimedia Technology. New-Delhi S.Chand and Company LTD. 2003

LECTURE NOTES

Module 1: Information and Communication

Information is a measureable quantity and a complete information theory exists, which enables the engineer to determine the rate of information transmission. Communication is concerned with the sending or conveying of information from one place to another; the transferred information is called a message.

Fundamentally, any form of electronic communication entails some or all of the following succession of steps:

i. Generation of a thought pattern or image in the persons' mind.
ii. Symbolic Description of the image in terms of visual or aural symbols.
iii. Conversion into electrical form and Encoding for propagation over a physical medium. This medium, called a Communication Channel, may be free space or an engineering structure like a cable, waveguide or any other transmission
iv. Modulation of the carrier which may be defined as the adaptation of the low-frequency or baseband electric oscillations to the characteristics of a channel. Due to their low frequency, these oscillations cannot be used directly to excite electromagnetic waves. Hence, they are utilized to vary the parameters of a strong carrier radio-frequency wave.
v. Radiation of the modulated wave y the antenna of the transmitter.
vi. Excitation of feeble electric oscillations in the antenna at the receiver.
vii. Demodulation of detection which is the inverse of modulation.
viii. Decoding and reproduction of original symbols.
ix. Recreation of the incipient mentally conceived thought pattern or image, producing a faithful replica of the message sent at the user destination, i.e., the receiving end.

Communication between two points situated far apart, is known as Telecommunication which may be defined as long-distance communication through metallic cables, optical fibres, or air and space with the help of microwave and satellite links.

Communication has three major subdivisions:

i. Audio communication
ii. Video communication
iii. Data communication

The allied discipline of Information Technology deals with the study of various processed for acquiring storing, retrieving and transmitting information through the combined use of computers, telecommunications and ancillary facilities.

Module 2: Telecommunication Media Survey

We shall now list the various telecommunication media commencing from the telegraph to the 21st century sophisticated equipment.

i. Telegraph
ii. Telephony
iii. Telex
iv. Facsimile (FAX) System
v. Radio Broadcasting
vi. Television
vii. High-Definition Television (HDTV)
viii. Videoconferencing
ix. Teletext
x. Videotext
xi. Electronic Mail (E-Mail)
xii. Multimedia
xiii. Internet and Other Computer Networks

- Telecommunication modalities

The wide-ranging media of telecommunication as outlined above, can be placed under tow distinct heads, viz., cable communication and radio communication.

1. Cable or line communication

Here electric current is passed through copper wires laid between the transmitting and receiving ends. Amplifiers called Repeaters in analogue systems or Pulse Regenerators in digital systems, placed at a distance several kilometres apart on the way, help in strengthening the signal.

2. Radio of wireless Communication

This method utilizes electromagnetic waves as carriers of information without any connecting wires between the transmitter and the receiver. Two important techniques are (i) Microwave Communication (ii) Satellite Communication.

- Fibre Optic Communication

Construction: An optical fibre consists of a central cylindrical core, made of fused silica, quarts or plastic (through which the light wave travels by multiple total internal reflections) surrounded by an Si or Teflon layer having lower refractive index than the core (to confine the light beam within the core), known as cladding, and finally a polyurethane jacket (to protect from environmental effects and abrasion).

Types of Optical Fibres:

- Single mode fibres
- Multimode fibres

Advantages of Fibre Optic Communication

i. High bandwidth Capability
ii. Electromagnetic Interference Immunity
iii. Low Signal Attenuation
iv. Security from Tapping
v. Size and Weight Reduction Benefits
vi. Human Safety Factor
vii. Superior Corrosion Resistance
viii. Economic Viability

Module 3: Microwave Links

Microwaves are very high energy, high frequency, 1GHz<f<100GHz, short wavelength, 30cm<λ<3mm, electromagnetic waves which propagate rectilinear along line-of-sight paths, offering a highly directional beam with a wide passband and having a capacity to transmit large quantities of signal or data from one point to another.

Modes of propagation and Linkages

i. Line-of-Sight Link. Due to the curvature of the earth, high receiver-cum-transmitter towers are erected, approximately 50 km apart. Microwaves are transmitted from one tower to another where they are amplified and sent to the next tower in the series.
ii. Troposcatter Link. These links used as complementary links to line-of-sight transmission, are based on the forward scattering of radio waves from the atmospheric later called Troposhere, the lowest layer of the atmosphere with

thickness varying from 7km at the poles to about29km at the equator, and responsible for weather changes.

iii. Artificial Satellite-based Line-of-Sight Link. This link exploits a satellite placed in a geostationary orbit and containing a repeater along with receiving and transmitting antennae oriented towards the earth.

- Satellite Communication

The satellite channel: a communication Satellite consists of a spacecraft orbiting the earth in a circular or elliptical orbit and carrying on board microwave transmitting or receiving equipment; microwave frequencies are employed to penetrate the ionosphere and to handle the side signal bandwidth.

The satellite channel comprises

i. The Uplink connecting the terrestrial transmitting station to the on-board satellite transponder
ii. The transponder amplifying the signal to overcome noise effects and thus working as a sky-based repeater and
iii. A downlink connecting the transponder to the receiving station on the earth.

GEO Satellite Systems

In this system, the satellite is constrained to a geostationary or a geosynchronous orbit for which the required altitude is 36,000km for an elevation angle of 90 degrees. The orbital period of this satellite is 24hours so that it appears stationary or fixed in the sky to an observer on the earth. Using an earth coverage antenna, the angular range of such a satellite is 17.34degrees which roughly corresponds to $1/3^{rd}$ of the earth so that regions within this area can be connected through the satellite. Three geostationary satellites are necessary to establish around-the world satellite link.

Non-Geo Satellite Systems

In these systems, the satellites are placed in proximity to the earth either in Low-Earth Orbits (LEO) or Medium-Earth Orbits (MEO). Non-GEO systems are superior to Geo systems for interactive voice services. However, for real-time applications, at least one satellite must always be in view between any two links. This increases the number of satellites, system complexity and cost. Non-GEO systems are therefore targeted for global markets with local regulatory approvals in different countries.

Module 4: Transmission Parameters

Parameters for the performance evaluation of a telecommunication medium fall into three main groups:

i. Bandwidth Parameters
ii. Interface Parameters
iii. Facility Parameters

Bandwidth Parameters

Attenuation Distortion, also called Frequency Response or Differential Gain is defined as the difference between the current gain at a particular frequency and the current gain at a reference frequency. For the telephone circuit, the 1004 Hz is used as a standard test tone frequency.

Phase Delay or Propagation Time is the time elapsed as the signal traverses from source to destination.

Interface Parameters

Considering the telephone network, the two primary requirements of these parameters are the electrical protection of the network and the personnel using it, and the design standardization. Station equipment impedance (resistive) should be> 600ohm and the ground isolation impedance of equipment should be > 20Monms DC and 50kohms AC value.

Facility Parameters

Noise is the name given to the undesired energy vitiating the useful passband of a communications channel. Correlated Noise such as non-linear distortion is the noise associated with a signal whereas Uncorrelated Noise, e.g, Thermal noise is present even in absence of the signal

Background Noise, referred to by different names as White, Thermal, Gaussian or C-Message Noise is the noise inherently present in a circuit by virtue of its electrical make-up or constitution. It is an additive parameter and its magnitude increases with the electrical length of the circuit.

Impulse Noise refers to the short-duration high amplitude peaks in the noise spectrum of a signal.

A Gain Hit is a sudden random variation in circuit gain.

A Phase Hit is a sudden irregular phase change in a signal while a Phase Jitter in a signal implies continuous uncontrolled changes in its zero crossings.

Non-linear Distortion is exhibited in the form of additional tones present in the signal due to its non-linear amplification. It manifests itself, for example, as distorted sine waves.

Module 5: Communication Systems Classification

Two-Point and Multipoint Systems

Based on the number of points linked, these systems fall into two major divisions, namely: Two-Point and Multi-Point Systems.

- Two-Point communication System Subclassification

Communication systems connecting and two can be categorized as follows:

i. Simplex in which information can be transmitted in one direction only
ii. Half-Duplex Systems are those allowing transfer of information in both directions although not simultaneously
iii. Full-duplex or Duplex systems are generally four-wire systems permitting simultaneous transmission of information in both direction.

- Multipoint Communication System Configurations

Three sub-classes of these systems exist:

i. Star Network in which each element called the Secondary has direct access to a central computer known as the Primary.
ii. Ring Network in which information traverses around a loop so that if any one component of the loop goes out of order, the loop becomes inoperational.
iii. Multidrop System in which the main computer designated as the Primary, Host or CPU can communicate with other computers known as the Secondaries, Remotes or Tributaries but a secondary can interact with any other secondary and that too only through the primary. In particular, a multidrop system is said to be Full/Full Duplex (F/FDX) if the primary can transmit information to a secondary while simultaneously receiving information from another secondary.