**PW–Digital Communications, propagation and antennas**

**(90 hours**)

***General Objectives:***

At the end of these practical sessions, the student will be able to:

- Realize and test the pulse analog modulation and demodulation circuits to find the waveform at the output of each circuit.

- Identify the block diagrams of pulse analog modulation systems and find the

waveforms at the output of each block

-Realize and test the PCM and Delta modulation and demodulation circuits to find the output

waveforms of these circuits

- Identify the block the diagram of digital transmission system PCM and Delta

modulation, and find the waveforms at the output of each block by using

oscilloscope

-Identify the block the diagram of time division multiplexing and demultiplexing

systems and observe by oscilloscope the TDM and demultiplexing of different

sampled signals

- Realize and test the different types of discrete analog modulations ASK, FSK, PSK,

DPSK and QPSK to find the waveforms at the output of each circuit by using

oscilloscope

- Identify the block the diagram of different types of dicrete analog modulations

(ASK, FSK, PSK and QPSK) and observe by oscilloscope the waveforms at the

output of each block

- Identify the block the diagram of frequency division multiplexing and test by

oscilloscope the waveforms at the output of each block

- Observe the spectrum of the multiplexed signals using the spectrum analyzer

- Describe the different blocks of TV satellite receiver, install the system and verify

its good operation

- Identify the different blocks of radar station.

- Determine the parameters of transmission line and wave guides

- Determine the parameters of antennas

-Represent an optical fiber transmission system by its block diagram and determine

its application domain

-The realization of the below circuits may be through assembly, didactic benches and software.

***Content:***

**Digital communications :**

***Chapter 1: Pulse analog modulations* (22 h)**

**Prerequisite:**

-Block diagram of a pulse analog modulation system: PAM, PPM and PWM

-Principle of operation of PAM, PPM and PWM modulation

-Spectrum of pulse analog modulation systems

**Practical works:**

-Realization of PAM, PPM and PWM modulation and demodulation circuits by using transistor or integrated circuits

-Identification of the different blocks of pulse analog modulation transmitter and receiver

-Observation of the input and output signals of each stage and comparison with the theory for different types of pulse modulation PAM, PPM and PWM

***Chapter 2: Pulse code modulation, delta modulation and time division multiplexing*** (**16 h)**

**Prerequisite:**

-Block diagram and principle of operation of each block of PCM and delta system

-Analog to digital conversion and digital to analog conversion

-Principle of the time division multiplexing

**Practical works:**

-Realization of the sampling circuits: Ideal, Natural, Flat-top, sample and hold and so on.

-Realization of PCM and delta modulation and demodulation circuits in addition to the time division multiplexing circuit

-Observation of the input and output signals by oscilloscope for different circuits (PCM, delta modulation and TDM)

-Observation of the input and output signals by oscilloscope at different stages of the system (analog signal, sampled signal, timing signal, digital signal and vice-versa)

-Verification of the effect of changing the sampling frequency due to shannon’s theorem

-Comparison of the output and input signals of the system

-Observation by oscilloscope the:

Samples signals

Multiplexed signals

Timing signals

The signals at the output of the demultiplexer

***Chapter 3: Discrete analog modulation (ASK, FSK, PSK DPSK, QPSK)* (22h)**

**Prerequisite:**

-Block diagram and principle of operation of discrete analog modulation

-Identification of different types of discrete analog modulations (ASK, FSK, PSK DPSK, QPSK)

-Utilization

**Practical works:**

-Realization of FSK, ASK, PSK, DPSK, QPSK modulation and demodulation circuits

-Observation of the waveforms at the input and output of each circuit by oscilloscope

-Identification of the different blocks of FSK, ASK, PSK, DPSK and QPSK systems

-Observation of the waveforms at different stages and comparison with the theoretical forms

***Chapter 4: Frequency division multiplexing*** **(6 h)**

**Prerequisite:**

-Definition of frequency division multiplexing

-Identification of different types of grouping

**Practical works:**

-Test and verify the good operation of a simple FDM system

-Measure the frequency of different carries

-Observe the form of modulated signal for each carrier

-Observe by the spectrum analyzer the signal at the output of the multiplexer for the modulated signals

-Observe the signals at the output of each band pass filter and at the output of each demodulator and compare them with theoretical signals

***Chapter 5: TV satellite receiver* (4 h)**

**Prerequisite:**

-Principle of communication satellite system

-TV satellite receiver

-Parameter of parabolic antenna

**Practical works:**

-Installation and positioning of a parabolic antenna

-Installation of LNB

-Installation of receiver

-Verification of good operation

***Chapter 6: Radar station (4h)***

**Prerequisite:**

Principle of operation of radar and analysis of the block diagram.

**Practical works:**

-Visit of radar station and identification of different parts of each system

-Write the technical reports after each visit

**Propagation and antennas:**

***Chapter 7: Transmission lines, wave guides and antennas*** **(10 h)**

**Prerequisite:**

-Bands of frequencies

-Parameters of transmission lines and wave guides

-Properties of electromagnetic waves

-Role of an antenna in a transmission system and its characteristics

**Practical works:**

-Measure the attenuation per unit-length of coaxial line and metallic rectangular wave guide

-Study the different types of polarization of an antenna (parabolic or horn)

-Measure the received power of an antenna using a radiofrequency powermeter

-Find experimentally the radiation pattern of a parabolic antenna of horn

-Measure the gain of the antenna

***Chapter 8: Optical fibers*** **(6h)**

**Prerequisite:**

-Band of frequencies

-Block diagram and principle of operation of each block

-Types of cables (step index and graded index)

-Parameters of an optical fiber transmission

**Practical works:**

-Connect the different blocks of an optical fiber transmission system

-Observe the waveforms at different stages and compare with the theoretical waveforms

-Measure the different parameters which affect to the optimal transmission properties (distance between the transmitter and the receiver, misalignment and the deviation angle)

-Measure the attenuation per unit length of the optical cables