NATIONAL UNIVERSITY OF ENGINEERING
COLLEGE OF ELECTRICAL AND ELECTRONICS ENGINEERING

TELECOMMUNICATIONS ENGINEERING PROGRAM

IT255 – OPTICAL FIBER

I. GENERAL INFORMATION

CODE	**:**	IT255 – Optical Fiber
SEMESTER	**:**	9
CREDITS	**:**	03
HOURS PER WEEK	**:**	04 (Theory – Practice)
PREREQUISITES	**:**	IT213 – Transmission Lines
CONDITION	**:**	Mandatory

II. COURSE DESCRIPTION

The course prepares the student in the application of concepts and fundamentals of signal transmission technology through optical fiber. The operating characteristics of each of the passive and active components that make up an optical communications system are described and analyzed. Methods and practices for the installation, termination, splicing and measurement of fiber optic cables are described and analyzed. The applications of fiber optic systems in telecommunications networks are analyzed. The basic design of an optical communications system is developed.

III. COURSE OUTCOMES

At the end of the course the student will:

- Describe the electromagnetic spectrum and distinguish the optical transmission windows within the spectrum in relation to the frequencies of radio and microwave communications.
- Explain optical propagation and describe the structure and types of optical fibers
- Explain the transmission characteristics (Attenuation and Bandwidth) of multimode and single mode optical fibers. Perform and analyze attenuation and bandwidth calculations.
- List the optical fibers recognized by ITU, IEC and TIA and describe their bandwidth and attenuation characteristics.
- Describe and explain the characteristics and applications of the various types of fiber optic cables.
- Explain the principle of operation and the characteristics of light sources (LED and LASER) and optical amplifiers.
- Explain the principle of operation and the characteristics of passive optical devices: Splices, Connectors, Couplers and Optical Derivators.
- Explain the modulation and multiplexing techniques for optical transmission.

- Explain the fundamental methods and considerations for the installation, splices and measurements of fiber optic cables.

- Perform the basic design of a fiber optic communications system.

IV. LEARNING UNITS

1. **INTRODUCTION**
   Evolution of the Optical Communications Systems / Configuration of the Optical Fiber Communications System / Characteristics and Advantages of the Optical Fiber.

2. **THEORY OF OPTICAL TRANSMISSION**
   Basic Concepts / Theory of Rays (Optical-Geometric) / Propagation Modes / Types of Optical Fibers: Multimode and Single Mode. Step and Gradual Index.

3. **OPTICAL FIBER TRANSMISSION CHARACTERISTICS**
   Optical Attenuation / Bandwidth and Temporary Dispersion / International Standards and Recommendations.

4. **OPTICAL FIBER AND CABLES**
   Coated Fiber Optic Structures / Structures and Types of Fiber Optic Cables.

5. **ACTIVE OPTICAL DEVICES**
   Optical Sources: LASER and LED / Optical Detectors: PIN and APD Photodiode / Optical Amplifiers / Optical Switches.

6. **PASSIVE OPTICAL DEVICES**
   Generalities / Requirements for fiber connections / Loss factors in an interconnection / Fiber optic splices / Fiber optic connectors / Fiber optic couplers and shunts.

7. **OPTICAL TRANSMISSION TECHNIQUES**
   Modulation and optical detection techniques / Multiplexing techniques: FDM, TDM and WDM / Consistent transmission system.

8. **CONSTRUCTION OF OPTICAL NETWORKS**
   Installation of fiber optic cables / Splicing and termination of optical cables / Optical tests and measurements.

9. **APPLICATIONS AND FUTURE DEVELOPMENTS**
   Introduction / PDH, SONET and SDH networks / LAN, MAN AND WAN networks.

10. **BASIC DESIGN CONSIDERATIONS**
    General requirements of the communications system / Optical requirements / Selection of optical components / Attenuation and bandwidth calculations.

V. LABORATORIES AND PRACTICAL EXPERIENCES

- Laboratory 1: Recognition of the optical fiber as a guide of light waves and types of optical fibers.

- Laboratory 2: Measurement of optical power.

- Laboratory 3: Measurement of fiber optic attenuation.

- Laboratory 4: Measurement of retro-dispersions and signal reflections in the optical fiber.

- Laboratory 5: Fiber optic splices.
- Laboratory 6: Troubleshooting in a fiber optic system.

VI. METHODOLOGY

The course takes place in theory, practice and laboratory sessions. In the theory sessions, the teacher presents the concepts and fundamentals. In the practical sessions, various problems are solved and their solution is analyzed. In the laboratory sessions, optical fibers, equipment and devices are used to analyze and check the operating characteristics of the optical fibers, splices and optical connectors. At the end of the course the student must present and present an integrating work or project. In all sessions the active participation of the student is promoted.

VII. EVALUATION FORMULA

The learning will be evaluated through the "G" system.

- Partial Exam (PE): Weight 1
- Final Exam (FE): Weight 1
- Average of 03 Practices (P): Weight 1.

$$\boldsymbol{FA} = \frac{\boldsymbol{PE} + \boldsymbol{FE} + \boldsymbol{P}}{\boldsymbol{3}}$$

VIII. BIBLIOGRAPHY

- John M. Senior. Optical Fiber Communications Principles and Practice. Price Hall.
- John Gowar Optical Communications System. Prentice Hall
- G. Keiser. Optical Fiber Communications Mc Graw Hill
- Dennis Derckson. Fiber Optic Test and Measurement Prentice Hall
- Bod Chomycz. Optical Fiber Facilities Mc Graw Hill.
- Itu-Series G. Recommendations.