CT472 Optical Communication
Technical Elective (3-0-0-3)
B Tech (VII semester) course
Open for MTech students also

Objectives
The main goal of this course is to provide an introduction and understanding of optical fiber communication systems. As any other standard process, optical communication system also consists of an input (optical source/transmitter), an output (optical detector/receiver) and an intermediate channel (optical fiber supported by optical amplifier/repeater). This course will discuss about all these components of systems including fibers, lasers, photodetectors and amplifiers. The focus will be on understanding the concept regarding the attenuation characteristics of light while being transmitted through a fiber, how to create a light signal (a source), how to couple light into a fiber and detect/receive at the end of the transmission link efficiently.

There will be no lab component

Depending upon interest of the class some interesting topics from current research will be introduced to students. It may give them an appreciation of the leading edge technology of optical communication.

Instructor
Dr. Anil K Roy
Office: Room # 2105, Faculty Block – 2
Tel: 30510613
EPABX: 613
email: anil_roy@daiict.ac.in

Recommended books
1. Fiber Optic Communication Systems by G.P. Agrawal (Wiley)
2. Fiber Optic Communications by J.C. Palais (Pearson Education)
3. Introduction to Fiber Optics by A. Ghatak & K. Thyagarajan (Cambridge)
4. Optical Fiber Communications by Gerd Keiser (MGH)
5. Fiber Optic Communications Technology by Mynbaev & Scheiner (Pearson Education)
6. Fiber Optic Cable System Installation by E. R. Pearson (Delmar)
7. Optical Networks by R. Ramaswami & K. N. Sivarajan (Elsevier)
Grading
The overall grade will consist of five elements: two insem exams, four quizzes, and one endsem exam with the following weightage:

- **Insem Exams**: 40%
- **Quizzes**: 20%
- **Endsem Exam**: 40%

**Research Dissertation** [open for MTech students only]
Each student will be required to produce one written report summarizing a specific area of research in optical communication. The report should be approximately 10 pages long, properly referenced, and should summarize knowledge that the student gathers from various sources such as journal articles, research reports, reference books, etc. Marks will be given for the understanding of the subject that the student demonstrates, as well as for the format, structure, and grammar of the report. The reports will be due in the latter part of the term.

**Insem Exams**
Two exams of 25 marks each of duration not more than 60 mins per the examination timetable announced by the institute on scheduled weeks. Syllabus will be whatever taught till that period of the semester.

**Quiz**
Quiz is designed to encourage regular students. There will be at the most four quizzes, 5 marks each during the semester.

**Endsem Exam**
As per institute’s schedule. Time not exceeding 120 min.

**Course Outline**

- **Introduction [5]**
  - Optical communication
  - Basics of Optics, EM Theory and Waveguide
  - Bandwidth and Bit rate
  - dB scale of measurement

- **Optical Fibers [4]**
  - Geometry
  - Step index
  - Graded index
  - Numerical Aperture
  - Modes as solutions of Maxwell’s equations in fiber medium

- **Wave propagation in fiber [2]**
  - Step index
  - Graded index
Loss Mechanism [6]
- Attenuation through absorption
- Dispersion of light in a waveguide
- Material dispersion
- Waveguide dispersion
- Loss due to bend in fibers
- Polarization mode dispersion

Fiber fabrication and cabling [3]

Optical Transmitter [4]
- Basics of laser theory and rate equation
- LEDs
- Semiconductor Lasers
- Transmitter design

Optical Receivers [4]
- Characteristics of receivers
- Responsivity, Rise time and bandwidth
- Common photodetectors
- P–N, P–I–N and Avalanche
- Receiver Noise
- SNR calculation and optimization
- Quantum limit of receivers
- Receiver Performance

Optical Amplifiers [2]
- Types of OAs

Erbium Doped Fiber Amplifier (EDFA) [4]
- Basic concepts of EDFAs
- Physics of signal amplification
- Gain Spectrum & bandwidth
- Gain Saturation
- Amplifier Noise

Design Consideration [4]
- Loss compensating mechanisms
- Dispersion compensating fibers
- System design and performance issues
- Installation issues

The above course may be subject to minor changes and some additional material may be presented in the lectures. Numbers in square brackette indicate no. of lectures.
**Topics for Research Dissertation** [open for MTech students only]
WDM, DWDM, Photonic crystal fibers, Optical sensors, Nanofibers, VCSEL (Vertical Cavity Surface Emitting Laser), Optical Virtual Private Network (OVPN) for Grid Computing

**POLICY FOR IMPLEMENTATION DURING THE COURSE**
Instructor encourages punctuality, sincerity, regularity and proper discipline during the course and interaction. At the same time cheating and plagiarism is highly condemned. Any such act of a student shall be dealt with strictly.

Instructor suggests taking your own hand-notes while attending lectures. Majority of lectures will not be available on powerpoint presentation, for those no slides will be available on instructor’s lecture folder.

There is no direct numeric weightage given to attendance, but attendance is a must, failing which action shall be taken as per Institute’s norm.

Grading shall be done on relative performance of the class. But it does not necessarily mean that the student getting highest marks shall get an AA grade.

Conversion from a score out of 100 to a letter grade will be done using a scale determined after the evaluation of the final examination.