Fiber Optics Communications

Week 15 **Exams, Project, Assignments**

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Final Exam: Instruction

Before starting the final exam, please review the following important instructions:

- Carefully read each question before responding.
- The exam consists of multiple-choice, short-answer, true or false questions and, project assignment.
- Complete the exam independently.
- Use your time effectively.

Evaluation modalities and Exam Structure

- 30 Multiple choice questions
- 5 True or False questions
- 5 Short answer questions
- 1 Project assignment

Time allotted: 90 minutes
Total point: 100%

Questions

Part I: Multiple Choice

- **Instruction:** Choose the correct answer from the given alternatives (2 pts each)

Questions (1/30)

1. Which phenomenon enables light to be guided through an optical fiber core?

   A) Diffraction

   B) Total internal reflection

   C) Scattering

   D) Refraction

Questions (2/30)

2. Which phenomenon enables light to be guided through an optical fiber core?

A) Diffraction

B) Total internal reflection

C) Scattering

D) Refraction

Questions (3/30)

3. The unit of fiber attenuation is:

   A) dB/m

   B) dB/km

   C) W/m

   D) dBm

Questions (4/30)

4. Material dispersion arises due to:

   A) Variation of refractive index with wavelength

   B) Variation of fiber diameter

   C) Fiber bending

   D) Nonlinear effects

Questions (5/30)

5. Modal dispersion occurs in:

   A) Single-mode fiber

   B) Multimode fiber

   C) Both

   D) None

Questions (6/30)

6. Nonlinear effects become significant when:

A) Input power is low

B) Input power is high

C) Dispersion is large

D) Fiber is short

Questions (7/30)

7. The Kerr effect refers to:

A) Change in absorption with light intensity

B) Change in refractive index with optical intensity

C) Stimulated emission

D) Spontaneous emission

Questions (8/30)

8. Four-wave mixing (FWM) is most significant when:

A) Dispersion is large

B) Dispersion is low

C) Power is low

D) Fiber is short

Questions (9/30)

9. Stimulated Raman scattering (SRS) transfers energy:

   A) From higher to lower frequency light

   B) From lower to higher frequency light

   C) Between orthogonal polarizations

   D) To the fiber cladding

Questions (10/30)

10. The most common light sources for optical communication are:

A) LEDs and Laser diodes

B) Incandescent lamps

C) Fluorescent tubes

D) Lasers only

Questions (11/30)

11. LEDs are mainly used in:

A) Long-haul systems

B) High-speed systems

C) Short-distance systems

D) DWDM systems

Questions (12/30)

12. The threshold current in a laser diode is:

A) The current above which lasing begins

B) The minimum current for spontaneous emission

C) The saturation current

D) The recombination current

Questions (13/30)

13. The most common intensity modulation scheme is:

A) OOK (On-Off Keying)

B) PSK

C) QAM

D) ASK

Questions (14/30)

14. Phase modulation varies:

A) Optical power

B) Optical wavelength

C) Optical polarization

D) Optical phase

Questions (15/30)

15. Direct modulation refers to:

A) Using an external device

B) Modulating fiber losses

C) Modulating laser current directly

D) Adjusting the detector bias

Questions (16/30)

16. Mach–Zehnder Modulator (MZM) works on:

A) Electro-optic effect

B) Magneto-optic effect

C) Photoelectric effect

D) Acousto-optic effect

Questions (17/30)

17. Electro-absorption modulators operate based on:

A) Bandgap shift with electric field

B) Magnetic field variation

C) Thermal expansion

D) Piezoelectric effect

Questions (18/30)

18. PIN photodiodes convert:

A) Current into light

B) Voltage into current

C) Frequency into phase

D) Light into current

Questions (19/30)

19. The avalanche photodiode (APD) provides:

A) Lower gain

B) Lower noise

C) Higher responsivity

D) Linear response only

Questions (20/30)

20. Dark current refers to:

A) Current due to light

B) Current without light

C) Leakage current of laser

D) Modulation current

Questions (21/30)

21. The most widely used amplifier in Optical fiber communication systems is:

A) SOA

B) EDFA

C) Raman amplifier

D) Electrical Amplifier

Questions (22/30)

22. Gain flatness is important in:

A) Single-channel systems

B) LED systems

C) Direct modulation

D) WDM systems

Questions (23/30)

23. The most widely used amplifier in Optical fiber communication systems is:

A) SOA

B) EDFA

C) Raman amplifier

D) Electrical Amplifier

Questions (24/30)

24. Gain flatness is important in:

A) Single-channel systems

B) WDM systems

C) LED systems

D) Direct modulation

Questions (25/ 30)

25. Bit error rate (BER) defines:

A) Data rate

B) Fiber loss

C) Error probability per bit

D) System gain

Questions (26/ 30)

26. SONET/SDH is an example of a:

A) Optical packet network

B) Synchronous optical network

C) Asynchronous optical network

D) Optical mesh system

Questions (27/30)

27. WDM stands for:

A) Wideband Data Multiplexing

B) Wave Delay Multiplexing

C) Wavelength Delay Modulation

D) Wavelength Division Multiplexing

Questions (28/ 30)

28. A Passive Optical Network (PON) is termed “passive” because:

A) It uses electronic amplifiers in the distribution network

B) It does not use any active components between OLT and ONT

C) It operates without optical fiber

D) It uses passive lasers only

Questions (29/30)

29. The main components of a PON system are:

A) Optical Line Terminal (OLT), Optical Splitter, and Optical Network Terminal (ONT)

B) Router, Switch, and Transceiver

C) Amplifier, Multiplexer, and Modulator

D) LED, Detector, and Filter

Questions (30/30)

30. Optical Wireless Communication (OWC) uses:

A) Guided light

B) Radio waves

C) Unguided light propagation

D) Sound waves

Questions

Part II: True or False Questions

- **Instruction:** Say true if the statement is correct and say false if the presented statement wrong (2 pts each).

Questions (1-5/5)

1. A LiFi system operates using infrared light
2. Light propagation in an optical fiber occurs due to refraction at the core-cladding boundary.
3. In optical communications, laser diodes have narrower spectral widths than LED sources
4. Direct optical modulation is simpler and low cost than external optical modulation
5. An EDFA amplifies optical signals by converting them to electrical form and then back to optical.

Questions

Part III: Short Answer Questions

- **Instruction:** Give short answer for the following questions (2 pts each).

Questions (1-5/5)

1. What phenomenon allows light to be confined within the fiber core?
2. Which dopant is used in EDFAs?
3. What device converts optical signals into electrical signals?
4. Which optical modulation format represents data as ON and OFF light states?
5. Which element of a PON connects the OLT to multiple ONUs/ONTs?

Questions

Part IV: Project Assignment (20 pts)

Questions (1/1)

1. Design a single-channel optical fiber communication system with the following specifications and analyze the system performance using OptiSystem.

Specifications:

- **Transmission distance:** 50 km, **Bit rate:** 10 Gbps, **Wavelength:** 1550 nm, **Transmitter optical power (Tx Power):** 10 dBm, **Fiber type:** Single-mode fiber (SMF), **Modulation type:** On-Off Keying

Note: Include the following components in your OptiSystem design:

- ✓ Continuous-wave (CW) Laser or Optical Source, Modulator (Mach-Zehnder), Single-mode fiber with proper length and parameters, Optical receiver with photodetector and BER analyzer
- ✓ Run simulations to measure the following parameters: Optical signal power at the receiver, Signal-to-noise ratio (SNR), Bit error rate (BER)
- ✓ Prepare and submit the performance analysis report

Thank You!