KATHMANDU UNIVERSITY
End Semester Examination
December, 2024

Marks Scored:

Level : B.E.
Year : IV

Course : ETEG 422
Semester : I

Exam Roll No. :

Time: 30 mins.

F. M. : 10

Registration No.:

Date : 26 DEC 2024

SECTION "A"

[20Q. × 0.5 = 10 marks]

Choose the most appropriate answer and **encircle**.

1. Which of the following is the dispersion in optical fiber communication?
   a. Absorption of light pulses
   b. Compression of light pulses
   c. Broadening of transmitted light pulses along the channel
   d. Overlapping of light pulses on compression

2. A multimode step index fiber has a normalized frequency of 72. The number of guided modes is _____
   a. 952 b. 1360 c. 1590 d. 2592

3. The wavelength of radiation emitted by an LED made up of a semiconducting material with band gap energy of 2.8 eV is _____
   a. 1450.1 A^0 b. 3432.9 A^0 c. 55420.7 A^0 d. 4430.8 A^0

4. The laser which produce pulses of coherent visible light at a wavelength of 694.3 nm is _____
   a. DFB laser b. Ruby laser c. He Ne laser d. CO_2 laser

5. For given V- number, the number of modes that can be carried by step-index multimode fiber is given by
   a. $V^2/2$ b. $V^2/4$ c. $V^2/3$ d. $V^2/5$

6. An LED operating at 850 nm has spectral width of 45 nm. What is the pulse spreading due to material dispersion in a Silica fiber?
   a. 6.3 ns/km b. 3.2 ns/km c. 1 ns/km d. 4.5 ns/km

7. In which principle optical fiber cable works?
   a. Total internal reflection b. Tyndall effect
   c. Photo-electric effect d. Diffraction

8. A WDM system uses an optical fiber having a specified attenuation of 0.2 dB/km. If the system is designed to have a power margin of 30dB. The total transmission distance without repeaters is _____
   a. 10 km b. 30 km c. 100 km d. 150 km

9. On-off keying (OOK) in optical fiber communication is also referred as _____
   a. FSK b. DSK c. PSK d. ASK

10. The depletion region must be _____ to allow a large fraction of the incident light to be absorbed in the photodiode.
a. Inactive b. Long c. Thick d. Thin

11. The optical regenerators are used for _____
a. Signal amplification b. Modulation
b. Noise reduction d. Both amplification and noise reduction

12. The transmissive optical sensors come under _____
a. Phase modulated b. Intensity modulated
c. Scattering based d. Wavelength Conversion based

13. The main benefit of light wave communications over microwaves or any other communications media is _____
a. Lower cost b. Better security
c. Free from electromagnetic interference d. Wider bandwidth

14. The greatest wavelength of photons that a photodiode built using a semiconductor with a bandgap of 2eV can detect is around _____
a. 620 nm b. 540 nm c. 430 nm d. 380 nm

15. The basic structure of an Avalanche photodiode is _____
a. $P^+ - i - n^+$ b. $i - P^- - n^+$ c. $P^+ - P^- - n^+$ d. $P^+ - i - P - n^+$

16. In _____ detection, the phase of the local oscillator signal is locked to the incoming signal.
a. Homodyne b. Heterodyne c. Spatial d. Noisy asynchronous

17. The photodiode current under no light is known as _____
a. Forward current b. Reverse current c. Maximum current d. Dark current

18. Optical fiber communication uses _____ dielectric waveguide structures for confining light.
a. Rectangular b. Circular c. Planar d. Triangular

19. The technique that provides the maximum bit rate in an optical link is _____
a. Amplifier budget analysis b. Power budget analysis
c. Rise time budget analysis d. Both b and c

20. The number of channels that are demultiplexed by a demultiplexer if its spectral range is 1600 GHz and Channels are spaced at 50 GHz at central wavelength of 1550 nm is ____
a. 12 b. 21 c. 32 d. 44

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F. M. : 40

SECTION "B"
[4 Q. × 10 = 40 marks]

*Attempt **ANY FOUR** questions.*
Figure in the margin indicates the full mark. Symbols have their usual meaning. Students are required to answer in their own words as far as practicable.

1.

a. Draw the photodiode equivalent circuit and obtain the relation between junction capacitance, time constant and reverse bias voltage. Also relate the transit time with the depletion layer width and drift velocity of a photodiode. [4]

b. How is preform prepared using modified chemical vapor deposition (MCVD) process of optical fiber fabrication technique? Explain with the help of suitable diagram. [4]

c. The relative refractive index difference between the core and cladding of an optical fiber is 0.8% and acceptance angle in air is 0.2 radians. Determine the velocity of light in the fiber core. Make necessary assumptions if required. [2]

2.

a. How does the avalanche process occur in avalanche photodiode? Describe with the help of suitable diagram and find the expression for photocurrent. [3+2]

b. Let us assume that a 5 km fiber optic communication link is to be installed and we have the following data available: [5]

- Twelve sections of fiber optic cable, each of length 600 m with an attenuation of 1db/km
- Connector loss of 1.3 dB/connector
- Receiver sensitivity of -50 dBm
- System margin of 6 dB

Determine the amount of the optical power which should be coupled into the fiber at the transmitter end.

3.

a. Interpret the working of the coherent and non-coherent optical system with examples. [3]

b. Explain the construction, operating principle and applications of VCSEL laser diode. [4]

c. How does double heterojunction laser diode work? Explain the structure and application in detail. [3]

P.T.O.

4.

a. Describe the schematic cross section of slab and strip waveguides. [4]

b. How do you classify the optical fiber cable according to the modes of operation? What are the causes of modal and material dispersion? How does the dispersion limit the bandwidth? Explain with the help of mathematical expression. [6]

5.

a. How does an optical time domain reflectometer (OTDR) work as a distributed optical sensor? Explain with the help of suitable diagram. [5]

b. Write short notes on: [2×2.5]

i. Media Convertor

ii. All Dielectric Self-Supporting (ADSS) Optical Cable