

**III B.Tech II Semester Supplementary Examinations,
November/December 2005
OPTO ELECTRONIC & LASER INSTRUMENTATION
(Electronics & Instrumentation Engineering)**

Time: 3 hours

Max Marks: 80

**Answer any FIVE Questions
All Questions carry equal marks**

1. (a) Briefly explain about the optical fibre construction details and show a figure for transmission of light rays and discuss about the refractive index distribution with a graph.
(b) Write the equations for the total internal reflection of the light rays in a optical fibre cable and derive the expression for the Numerical Aperture of the fibre. [8+8]
2. (a) Give any three applications of optical fibers for instrumentation and explain them with the necessary figures.
(b) Draw the block diagram of a typical fiber optic communication system and explain the function of each block in detail. [8+8]
3. (a) Estimate the number of photons emitted per second from a laser that puts out one watt of power. State clearly the assumptions made.
(b) Describe the degradation mechanism in injection lasers. [8+8]
4. (a) Explain how the Moire-Fringe modulation fiber optic sensor helps in eliminating the instability encountered with fiber optic intensity modulated sensor.
(b) With a neat diagram explain the interferometric method of measurement of length. [8+8]
5. (a) Differentiate between a transducer and a sensor
(b) Describe the arrangement and working of an optical fiber liquid level detector. [8+8]
6. With neat diagrams explain the following applications of lasers in detail :
(a) Lasers in material processing.
(b) Laser fusion in power plants. [8+8]
7. Write short notes on :
(a) Holograms on magnetic tape
(b) Holograms on the thermoplastic films. [8+8]
8. (a) Compare the performance characteristic of a p.i.n photodiode and p.n photodiode.

- (b) Distinguish between internal and external quantum efficiency. [8+8]

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(b) Write the equations for the total internal reflection of the light rays in a optical fibre cable and derive the expression for the Numerical Aperture of the fibre. [8+8]
2. Explain about the following with the necessary figures.
(a) Optical fibers for communication.
(b) Optical fibers for Instrumentation. [8+8]
3. (a) Derive the optimum coupling condition in laser oscillation
(b) Calculate critical fluorescence power P_s of He-Ne laser operating at 6328 Å. assume $V=2 \text{ cm}^3$, $L = 1 \%$ loss, $l= 30 \text{ cm}$, $\Delta\nu = 1.5 * 10^9 \text{ Hz}$. Also find out critical inversion frequency. [8+8]
4. (a) Explain how the Moire-Fringe modulation fiber optic sensor helps in eliminating the instability encountered with fiber optic intensity modulated sensor.
(b) With a neat diagram explain the interferometric method of measurement of length. [8+8]
5. (a) Differentiate between an extrinsic and intrinsic fiber optic sensor.
(b) Describe the arrangement and working of an optical fiber liquid level detector.
(c) Explain how the above sensor is superior over the other liquid level sensors. [5+5+6]
6. With neat diagrams explain the following applications of lasers in detail :
(a) Lasers in material processing.
(b) Laser fusion in power plants. [8+8]
7. (a) Explain with relevant diagrams the basic principle of confinement of carriers optical power in the active region of a double heterojunction LED.
(b) Discuss different modulation drive circuits for LEDs and explain their operations. Explain the operations of analog drive circuits designed with Darlington pairs. [8+8]

8. (a) Define and explain the meaning of responsivity and quantum efficiency of photodiode and derive expressions for the same.
- (b) Discuss the advantages of p.i.n. photodiode over p.n. structure in a photodiode. [8+8]

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1. (a) Explain the historical development of optical fibers with the help of Electro-magnetic spectrum.
(b) Draw a graph showing the refractive index distribution of central core cladded optical fibre and explain the plot. [8+8]
2. (a) Compare Optical fiber communication system with Microwave communication system.
(b) Discuss about the various applications of optical fibers in detail. [8+8]
3. (a) Obtain rate equation for two level system.
(b) In ruby laser $\lambda_0 = 6943 \text{ \AA}$, $t_{sp} = 3 \times 10^{-3} \text{ sec}$, $n_0 = 1.76$, $d = 5 \text{ cm}$, $r_1 = r_2 = 0.9$, $\alpha_1 = 0$, $g(\omega_0) = 1.1 \times 10^{-12} \text{ sec}$. Find threshold inversion, t_c and $\Delta\gamma$. [6+10]
4. (a) Describe the working of Moire-fringe modulation fiber optic sensor.
(b) Differentiate between an intensity modulated sensor and interferometric fiber optic sensor. [8+8]
5. (a) Differentiate between an extrinsic and intrinsic fiber optic sensor.
(b) Describe the arrangement and working of an optical fiber liquid level detector.
(c) Explain how the above sensor is superior over the other liquid level sensors. [5+5+6]
6. With neat diagrams explain:
(a) Lasers in precision length measurement.
(b) Lasers in velocity measurement. [8+8]
7. (a) Explain the terms coherence requirements, resolution in connection with hologram?
(b) With the help of neat sketches explain the recording mechanism of hologram? [8+8]
8. (a) Differentiate between Magneto - optic and Acusto - optic modulators.
(b) Why acousto - optic modulators have to be used at low acoustic frequencies. [8+8]

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2. (a) Give a point - to - point fiber optic communication link block diagram and explain the use of each block in detail.
(b) Give any three applications of optical fibers for instrumentation and explain them with the necessary figures. [8+8]
3. (a) Bring out the importance of Q Switching. Compare mechanical switching with Electronic switching.
(b) CO₂ laser is more efficient as compared to other gas lasers - Say "True" or "False". Justify your answer comparing the performances. [8+8]
4. (a) With a neat diagram explain the interferometric method of measurement of length.
(b) Write in detail about IR sources. [8+8]
5. (a) What is an Evanescent sensor? Explain.
(b) Explain the principle and working of a fiber Gyroscope. [8+8]
6. With neat diagrams explain the following applications of lasers in detail :
(a) Lasers in material processing.
(b) Laser fusion in power plants. [8+8]
7. (a) With the help of neat sketches explain holographic character recognition?
(b) With the help of neat. sketches explain recording and reconstruction of Fourier Transform hologram? [8+8]
8. (a) What is a Bragg modulator?
(b) Obtain expression for the bandwidth of a Bragg acousto - optic modulator. [8+8]
