



Roll No.

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## ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)

B.E. / B. Tech / B. Arch (Full Time) - END SEMESTER EXAMINATIONS, NOV / DEC 2023

BIOMEDICAL ENGINEERING

VII Semester

BM5012 &amp; MEDICAL OPTICS

(Regulations 2019)

Time: 3hrs

Max.Marks: 100

|      |                                                                                                       |
|------|-------------------------------------------------------------------------------------------------------|
| CO 1 | Comprehend and appreciate the significance and role of this course in the present contemporary world. |
| CO 2 | Demonstrate knowledge of the fundamentals of optical properties of tissues.                           |
| CO 3 | Describe surgical applications of laser.                                                              |
| CO 4 | Describe photonics and its therapeutic applications.                                                  |
| CO 5 | Apply the concepts of laser and light to understand the laser safety procedures.                      |

**BL – Bloom's Taxonomy Levels**

(L1 - Remembering, L2 - Understanding, L3 - Applying, L4 - Analysing, L5 - Evaluating, L6 - Creating)

**PART- A (10 x 2 = 20 Marks)**

(Answer all Questions)

| Q. No | Questions                                                                                                                                                                                                           | Marks | CO | BL |
|-------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|----|----|
| 1     | List the characteristics of LASER light.                                                                                                                                                                            | 2     | 1  | L1 |
| 2     | Define polarizer. State its need.                                                                                                                                                                                   | 2     | 1  | L2 |
| 3     | A fiber has refractive index of 1.4 for the core and 1.2 for the cladding. Calculate the critical angle.                                                                                                            | 2     | 2  | L3 |
| 4     | The aortic wall has an absorption coefficient of $2.3 \text{ cm}^{-1}$ and a scattering coefficient of $340 \text{ cm}^{-1}$ at 612nm. Calculate the optical albedo of the tissue and what does the result signify? | 2     | 2  | L3 |
| 5     | Differentiate LASIK and LASEK procedures.                                                                                                                                                                           | 2     | 3  | L2 |
| 6     | List the characteristics of Nd:YAG Lasers. Mention any two of its biomedical applications.                                                                                                                          | 2     | 3  | L1 |
| 7     | Differentiate time domain and frequency domain OCT methods.                                                                                                                                                         | 2     | 1  | L2 |
| 8     | What is the principle of LIF imaging?                                                                                                                                                                               | 2     | 1  | L1 |
| 9     | List the LASER safety Hazard classifications with an example for each.                                                                                                                                              | 2     | 5  | L2 |
| 10    | Define phototherapy. List its applications in the field of dermatology.                                                                                                                                             | 2     | 4  | L1 |

**PART- B (5 x 13 = 65 Marks)**

| Q. No      | Questions                                                                                      | Marks | CO | BL |
|------------|------------------------------------------------------------------------------------------------|-------|----|----|
| 11 (a) (i) | Explain the construction and the various processes of lasing mechanism with neat illustration. | 13    | 1  | L2 |
| OR         |                                                                                                |       |    |    |
| 11 (b) (i) | Explain fluorescence and phosphorescence phenomena using Jablonski diagrams.                   | 7     | 1  | L2 |
| (ii)       | What are optical tweezers? Explain its principle of operation with neat illustration.          | 6     | 1  | L2 |

|            |                                                                                                                               |    |   |    |
|------------|-------------------------------------------------------------------------------------------------------------------------------|----|---|----|
| 12 (a) (i) | Demonstrate in detail the various thermal interaction mechanisms of laser light with tissue.                                  | 13 | 2 | L3 |
| <b>OR</b>  |                                                                                                                               |    |   |    |
| 12 (b) (i) | Brief how absorption phenomenon influences the interaction of light energy with biological tissues using necessary equations. | 7  | 2 | L3 |
| (ii)       | Compare the three types of source-detector measurement schemes employed in a spectroscopic instrument.                        | 6  | 2 | L3 |
| 13 (a) (i) | Describe laser tissue welding. Explain its mechanism and types in detail with neat illustration.                              | 13 | 3 | L2 |
| <b>OR</b>  |                                                                                                                               |    |   |    |
| 13 (b) (i) | What are the LASERs used for treating dental hard tissue problems. Brief an application using one of them.                    | 7  | 3 | L2 |
| (ii)       | Demonstrate the application of LASER in the treatment of any one retinal disorder.                                            | 6  | 3 | L2 |
| 14 (a) (i) | Explain the principle and working of Optical coherence tomography. Brief any one application.                                 | 13 | 1 | L2 |
| <b>OR</b>  |                                                                                                                               |    |   |    |
| 14 (b) (i) | Explain the set-up of a holographic system with neat illustration.                                                            | 7  | 1 | L2 |
| (ii)       | With necessary equations, describe LASER speckle contrast imaging.                                                            | 6  | 1 | L2 |
| 15 (a) (i) | Explain the principle and mechanism of PDT. Discuss an oncological and non-oncological application.                           | 13 | 4 | L1 |
| <b>OR</b>  |                                                                                                                               |    |   |    |
| 15 (b) (i) | Elucidate the mechanism of Low-Level Laser Therapy. Discuss any two applications.                                             | 13 | 4 | L1 |

**PART- C (1 x 15 = 15 Marks)**  
(Q.No.16 is compulsory)

| Q. No   | Questions                                                                                                                          | Marks | CO | BL |
|---------|------------------------------------------------------------------------------------------------------------------------------------|-------|----|----|
| 16. (i) | Design a photonic instrument for a biomedical application with the detailed explanation of its every single block with an example. | 15    | 1  | L3 |

