KATHMANDU UNIVERSITY
End Semester Examination
February, 2025

Marks Scored:

Level : B.E.
Year : III

Course : ETEG 321
Semester : II

Exam Roll No. :

Time: 30 mins.

F. M. : 10

Registration No.:

Date : 24 FEB 2025
23

SECTION "A"

[20 Q. × 0.5 = 10 marks]

Choose and encircle the most appropriate option from each set of choices

1. What is the principle behind Doppler ultrasound imaging?
   a. Using high-frequency sound waves to detect tissue temperature
   b. Using sound waves to detect movement and blood flow based on frequency shifts
   c. Measuring electrical conductivity in tissues
   d. Using infrared light to visualize internal structures

2. What contrast agent is commonly used in X-ray imaging to visualize the gastrointestinal tract?
   a. Iodine b. Barium sulfate c. Gadolinium d. Saline solution

3. What is the primary principle behind MRI imaging?
   a. X-ray absorption by tissues
   b. Magnetic field and radio waves interacting with hydrogen nuclei
   c. Sound waves bouncing off tissues
   d. Electrical conductivity of tissues

4. What is the primary difference between a CT scan and a standard X-ray?
   a. CT scans use non-ionizing radiation
   b. CT scans produce 3D cross-sectional images
   c. X-rays are better for soft tissue imaging
   d. CT scans use ultrasound instead of radiation

5. Which type of stimulus is commonly used to measure visual evoked potentials (VEP)?
   a. Sound waves b. Light flashes or patterns
   c. Touch or pressure d. Electrical pulses to the skin

6. Which is more associated with telemetry?
   a. Transmission of electrical signals within a closed system
   b. Measurement and wireless transmission of data from a remote source
   c. Remote control of mechanical systems
   d. Real-time processing of data locally

7. Which organization is responsible for the development and publication of electrical safety standard codes in the biomedical field?
   a. ISO b. FDA c. OSHA d. IEC

8. Which type of brainwave is most prominent during deep sleep?
   a. Alpha waves b. Beta waves c. Delta waves d. Theta waves

9. Which condition is commonly diagnosed using EMG?
   a. Parkinson's disease
   b. Myasthenia gravis
   c. Hypertension
   d. Epilepsy

10. Which type of UPS system is most commonly used in ICUs for critical equipment?
   a. Standby UPS
   b. Line-interactive UPS
   c. Online double-conversion UPS
   d. Passive standby UPS

11. Which property of laser light makes it different from regular light?
   a. It is monochromatic and coherent
   b. It is diffused and incoherent
   c. It has a short wavelength
   d. It emits multiple colors simultaneously

12. Which of the following is a common safety standard for electrical medical equipment?
   a. ISO 14001
   b. IEEE 802.11
   c. IEC 60601
   d. ASME B16.5

13. In which application is a calorimetric transducer most commonly used?
   a. Monitoring blood pressure
   b. Measuring metabolic rates in the human body
   c. Detecting changes in brain waves
   d. Measuring voltage levels in circuits

14. What is photocoagulation commonly used for?
   a. Treating fractures
   b. Sealing or repairing tissues using laser light
   c. Measuring blood pressure
   d. Diagnosing neurological disorders

15. Which component of the ECG waveform represents the depolarization of the ventricles?
   a. P wave
   b. QRS complex
   c. T wave
   d. ST segment

16. In which area is a Neural Computer Interface most commonly used?
   a. Enhancing visual perception
   b. Enabling communication for individuals with paralysis
   c. Monitoring blood glucose levels
   d. Increasing memory capacity

17. In which application are piezoelectric transducers commonly used?
   a. ECG signal generation
   b. Ultrasound imaging and medical diagnostics
   c. Measuring temperature in liquids
   d. Electrical power generation in turbines

18. Which ion is responsible for repolarization of the neuron during an action potential?
   a. Sodium (Na^+) moving out
   b. Potassium (K^+) moving out
   c. Calcium (Ca^{2+}) moving in
   d. Chloride (Cl^-) moving in

19. Which of the following is a common feature of wearable health devices?
   a. Blood pressure monitoring
   b. Full-body X-ray imaging
   c. MRI scanning capability
   d. Invasive surgery assistance

20. Which type of radiation is used in X-ray imaging?
   a. Infrared radiation
   b. Ultraviolet radiation
   c. Ionizing radiation
   d. Non-ionizing radiation

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SECTION "B"

Attempt ANY FOUR questions. Each question carries 10 marks. Symbols have their usual meanings. Necessary assumptions are permissible. Marks are indicated inside brackets.

1. a. Explain the working principle of MRI scan. [3]
   b. Discuss the interpretation of an ECG waveform, including the P wave, QRS complex, T wave, and the intervals (PR interval, QRS duration, QT interval). [4]
   c. Elaborate on the usage of piezoelectric transducers in the field of biomedical engineering with practical examples. [3]

2. a. Design a simple wearable device using the concept that you get from your course on Principle of Biomedical Engineering. Also, provide your concern on ISO standards. [4]
   b. How does ultrasound provide diagnostic advantages in comparison to other imaging modalities such as X-rays and CT scans? [3]
   c. What are the key elements of computer assisted bio-feedback signal processing? Give some examples. [3]

3. a. Elaborate on unipolar limb lead placement for ECG readings. [3]
   b. Describe the principles of action potentials in excitable cells. How are ion channels involved in generating action potentials? [4]
   c. How should an ICU's UPS system be tested to assess its capability in handling critical loads during a power outage? [3]

4. a. Discuss the clinical significance of EMG in the diagnosis and management of conditions such as peripheral neuropathies, muscular dystrophies, and myopathies [4]
   b. Discuss the challenges and limitations of using radio telemetry in healthcare. [3]
   c. Explain the role of safety standard codes in ensuring the safety of bioelectronics devices and systems. [3]

5. a. Explain the process of photocoagulation and its mechanism in treating eye conditions. [3]
   b. Elaborate on international 10-20 system of EEG. [3]
   c. Explain neural computer interface with example. [2]
   d. Elaborate on the usage of chemiluminescence based biosensor in the field of biomedical engineering. [2]