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Question Paper Code : 40387

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2024.

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Fifth/Sixth Semester

Biomedical Engineering

CBM 342 — BRAIN COMPUTER INTERFACE AND APPLICATIONS

(Common to : Computer Science and Engineering/Electronics and Communication Engineering/Electronics and Instrumentation Engineering/Electronics and Telecommunication Engineering/Instrumentation and Control Engineering/Medical Electronics)

(Regulations 2021)

Time : Three hours

Maximum : 100 marks

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Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What does BCI stand for and what are its fundamental principles?
2. Mention about EEG signal acquisition and why is it important in BCI.
3. Define sensorimotor activity and name a prominent neural rhythm associated with it.
4. How can be the P300 wave used in cognitive neuroscience?
5. Define Fourier Transform and give its role in feature extraction.
6. Signify PSD in the context of feature extraction methods.
7. Specify Vector Quantization (VQ) and how is it applied in feature reduction.
8. How regression methods can be utilized for feature translation?
9. List the key role of Functional Electrical Stimulation (FES) in BCI applications?
10. Justify the role of external devices controlled using Brain-Computer Interfaces (BCIs).

PART B — (5 × 13 = 65 marks)

11. (a) Discuss the components and functions of a typical BCI system architecture with neat sketches.

Or

- (b) Compare and contrast invasive, non-invasive, and partially invasive BCIs.

12. (a) Explore Movement Related Potentials (MRPs) in detail.

Or

- (b) Mention significant role of Visual Evoked Potentials (VEPs) and explain their use.

13. (a) Comprehend the importance of Principal Component Analysis (PCA) in dimensionality reduction and feature extraction.

Or

- (b) Demonstrate the concept of parametric feature extraction using Autoregressive (AR), Moving Average (MA) and Autoregressive Moving Average (ARMA) models.

14. (a) Enumerate the working principles of Support Vector Machines (SVMs) for feature translation.

Or

- (b) Analyze the concept of Vector Quantization (VQ) in feature translation.

15. (a) Converse and contrast the importance of visual feedback in BCI systems, explaining how it enhances user interaction and control.

Or

- (b) Exhibit the concept of functional restoration using Neuroprosthesis in BCI applications.

PART C — (1 × 15 = 15 marks)

16. (a) Discuss the following
- (i) Artifact removal in EEG signals. (5)
 - (ii) Slow Cortical Potentials (SCPs) (5)
 - (iii) Wavelets. (5)

Or

- (b) Write Short notes on the following
- (i) Wavelet-based feature extraction techniques (5)
 - (ii) Gaussian Mixture Modeling (GMM) (5)
 - (iii) Brain-controlled mobile robot navigation. (5)