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Question Paper Code : 80401

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2025.

Fifth/Sixth/Eighth Semester

Computer Science and Engineering

CBM 342 – BRAIN COMPUTER INTERFACE AND APPLICATIONS

(Common to Biomedical Engineering/Electronics and Communication Engineering/Electronics and Telecommunication Engineering/Medical Electronics)

(Regulations 2021)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Draw the structure of BCI system and mark the main components.
2. What are the common methods used for classifying signals in Brain-computer interface system?
3. What is movement related potentials in BCI?
4. How is the activity of neural cells measured and characterized in BCI?
5. Define the amplitude, phase and power spectrum of a time-varying signal sampled at discrete time intervals.
6. Mention the significance of FFT.
7. How does the SVM typically outperform the perceptron when it comes to generalization to new data?
8. In what way the ensemble technique of booting differ from bagging?
9. Define Hebbian principle of plasticity.
10. If visual feedback and kinesthetic feedback were congruent, targets were reached faster and cursor paths became straighter, compared to incongruent feedback conditions. Justify this.

PART B — (5 × 13 = 65 marks)

11. (a) Elaborate how does the spatial distribution of ECoG activation during motor imagery compare with ECoG activation during actual movement? Justify, how does this activation change after motor imagery is used for cursor control with feedback?

Or

- (b) List some of the advantages and disadvantages of using fMRI as the source signal for a BCI compared to EEG. Consider the parameters of spatial resolution, temporal resolution, portability and cost.
12. (a) Compare the characteristics of the evoked potentials (EPs) with appropriate sketches
- (i) P300 (3)
 - (ii) SSVEP (3)
 - (iii) N100 (3)
 - (iv) N400 (4)

Or

- (b) Enumerate the activity of Neural cells in BCI with neat diagrams.
13. (a) ARIMA, ARCH and GARCH are time series models used in statistics and econometrics to model and forecast time series data. Elaborately discuss all these models.

Or

- (b) What is PCA? If you are given the choice between using PCA and ICA for analysing brain data, when would you opt for one versus the other? Give appropriate reason for your answer.
14. (a) How LDA works in BCI? List the limitations and considerations for the same.

Or

- (b) Signify the role of Hidden Markov model in BCI. Discuss the applications, advantages and limitations for the same.

15. (a) How does the integration of neuroprosthetic devices within Brain-Computer interfaces facilitate functional restoration in individuals with neurological impairments, and what are the challenges associated with implementing neuroprostheses for restoring motor functions?

Or

- (b) Discuss the key components and methodology involved in implementing a brain actuated control system for a mobile robot using EEG-based BCI. Mention the challenges faced in such systems.

PART C — (1 × 15 = 15 marks)

16. (a) Comprehensively explain the techniques currently available for invasive recording of brain signals. Specify for each technique whether they can record spikes from individual neurons in detail.

Or

- (b) Describe the noninvasive techniques for stimulating neurons in intact brains. Converse the trade-off between specificity in stimulation versus invasiveness.

