Reg. No.															

B.Tech. DEGREE EXAMINATION, MAY 2024

Sixth Semester

18CSE426J – QUANTUM MACHINE LEARNING

(For the candidates admitted during the academic year 2018-2019 to 2021-2022)

Note:

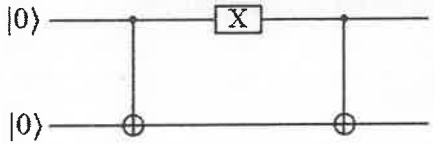
(i) **Part - A** should be answered in OMR sheet within first 40 minutes and OMR sheet should be handed over to hall invigilator at the end of 40th minute.

(ii) **Part - B & Part - C** should be answered in answer booklet.

Time: 3 hours | Max. Marks: 100

PART – A (20 × 1 = 20 Marks)

Answer **ALL** Questions

	Marks	BL	CO	PO
1. Quantum computers are very good at dealing with (A) Clarity (B) Certainty (C) Uncertainty (D) Reliability	1	1	1	1
2. Determine the result of the given circuit.  (A) $\|1\rangle \|0\rangle$ (B) $\|+\rangle \|0\rangle$ (C) $\|1\rangle \|1\rangle$ (D) $\|0\rangle \|1\rangle$	1	2	1	1
3. Entanglement means _____. (A) Two particles are different (B) Two particles are separated (C) Two particles are independent (D) Two particles are connected	1	1	1	1
4. Which simulator is ideal to display the Bloch sphere? (A) State phase simulator (B) State vector simulator (C) State analyzer (D) Feynman diagram	1	2	1	1
5. Which of the following is not a supervised machine learning algorithm? (A) k-means (B) Decision tree (C) Logistic regression (D) Support vector machine	1	1	2	2
6. _____ identifies unusual patterns or outliners in data (A) Anomaly detection (B) Clustering (C) Regression (D) Image segmentation	1	1	2	2
7. Consider rolling a six-face fair dice. Let A denotes an event of getting prime number and B denotes an event of getting an even number. Then the probability of getting either a prime number or an even number is? (A) $\frac{3}{6}$ (B) $\frac{1}{6}$ (C) $\frac{5}{6}$ (D) $\frac{2}{6}$	1	2	2	2

8. If a machine learning model's output involves the target variable, then that model is called as 1 1 2 2

(A) Descriptive model (B) Predictive model
(C) Reinforcement learning (D) Data model

9. Which of the following is NOT a common approach in quantum machine learning? 1 2 3 2

(A) Classical-quantum approach (B) Quantum-quantum approach
(C) Quantum-classical approach (D) Classical-classical approach

10. Which of the following algorithms generate hyperplane as a model at the end of training phase? 1 1 3 2

(A) Support vector machine (B) Decision tree
(C) Naive Bayes (D) K-nearest neighbour

11. The sigmoid activation function f(t) is defined as 1 2 3 2

(A) $\frac{1}{\exp(t)+\exp(-t)}$ (B) $t.\exp(-t)$
(C) $\frac{1}{1+\exp(t)}$ (D) $\frac{1}{1+\exp(-t)}$

12. Which of the following formula represents the quantum kernel estimation for two quantum states $|\Psi\rangle$ and $|\phi\rangle$? 1 2 3 2

(A) $K(\Psi,\phi)=|\langle\Psi|\phi\rangle|^2$ (B) $K(\Psi,\phi)=\langle\Psi|\phi\rangle$
(C) $K(\Psi,\phi)=\langle\Psi|\phi\rangle^2$ (D) $K(\Psi,\phi)=|\langle\Psi|\phi\rangle|$

13. Which of the following is NOT an assumption of principal component analysis? 1 1 4 2

(A) Principal components are orthogonal (B) Principal component analysis provides linear transformation
(C) Principal components with larger variances have important dynamics (D) Mean and variance are not important statistics

14. Identify the odd one out from the below given use cases 1 2 4 2

(A) Cyber-profiling criminals (B) Call record detail analysis
(C) Insurance fraud detection (D) Find the amount of rainfall in the next month

15. Which of the following machine learning algorithm requires normalization? 1 1 4 2

(A) K-means clustering (B) Naive Bayes
(C) Decision tree (D) Random forest

16. Which of the following is an example of continuous data? 1 1 4 2

(A) Ratings from 1 to 5 (B) Height
(C) Colors (D) Types of fruit

17. Which quantum algorithm is commonly used to train quantum neural networks? 1 2 5 3

(A) Grover's algorithm (B) Shor's algorithm
(C) Quantum Appropriate Optimization Algorithm (QAOA) (D) Variational Quantum Eigen solver (VQE)

18. What is hybrid Quantum Neural Network (QNN)? 1 2 5 3

(A) A neural network that operates entirely on quantum data
(B) A neural network that uses both classical and quantum elements
(C) A quantum circuit designed to mimic the behavior of a classical neural network
(D) A classical neural network trained using quantum algorithms

19. How does a quantum convolutional neural network (QCNN) differ from a classical convolutional neural network? 1 2 5 3

(A) Quantum convolutional neural network uses classical gates instead of quantum gates
(B) Quantum convolutional neural network operates on classical data
(C) Quantum convolutional neural network applies convolution operations using quantum gates
(D) Quantum convolutional neural network has fewer layers than a classical convolutional network

20. Quantum generative adversarial network means 1 1 5 3

(A) A quantum circuit that generates classical data
(B) A quantum algorithm for generated quantum data
(C) A neural network that generates quantum gates
(D) A quantum circuit that generates quantum data

PART – B (5 × 4 = 20 Marks) Marks BL CO PO

Answer **ANY FIVE** Questions

21. Using XYZ gates, show that XYZ = Y. 4 3 1 1

22. Analyze the difference between classical and quantum machine learning. 4 3 2 2

23. Write the four approaches which are used in the quantum machine learning. 4 3 3 2

24. Show unsupervised learning is functionally different from supervised learning with examples. 4 3 4 2

25. Compare biological neuron and artificial neuron. 4 3 5 3

26. For a given univariant dataset S = {5, 10, 15, 20, 25, 30} of marks. Compute mean, median, mode standard deviation and variance. 4 4 2 2

27. Manipulate the quantum feature map and kernels with an example. 4 3 3 2

PART – C (5 × 12 = 60 Marks) Marks BL CO PO

Answer **ALL** Questions

28. a. Define Qubit. Show Bloch sphere representation of single qubit gates and one multi-qubit gates with truth table. 12 3 1 1

(OR)

b. Consider a qubit system. Let 12 4 1 1

$E_1 = |0\rangle\langle 0|$

$E_2 = |1\rangle\langle 1|$

$|\psi\rangle = \frac{1}{\sqrt{2}}(|0\rangle + |1\rangle)$

Compute P(1) and P(2).

29. a.	Compare and contrast classical and quantum machine learning and also interpret the three ingredients of a learning problem.	12	3	2	2
	(OR)				
b.	Write in detail about the linear models in machine learning.	12	3	2	2
30. a.	Interpret the quantum information encoding with their types.	12	3	3	2
	(OR)				
b.	Illustrate the quantum support vector machine using Qiskit.	12	3	3	2
31. a.	Apply principal component analysis (PCA) for the following matrix and prove that it works $\begin{pmatrix} 4 & 3 \\ 1 & 2 \end{pmatrix}$.	12	4	3	2
	(OR)				
b.	Illustrate the types of different classifiers used in quantum machine learning.	12	3	4	2
32. a.	Show that how hybrid quantum neural network is different from quantum convolutional neural network.	12	3	5	3
	(OR)				
b.	Illustrate the workings of a Quantum Generative Adversarial Network (QGAN).	12	3	5	3

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