



विश्वजीवनमृतं ज्ञानम्

# Atal Bihari Vajpayee Indian Institute of Information Technology & Management, Gwalior

## IT007: Advanced Machine Learning

Major Examination (Session 2024–25)

Maximum Time: 3 Hours

Max Marks: 45

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*Note: All questions are compulsory. Diagrams and derivations must be neat for full credit.*

1. (a) Explain bias–variance tradeoff with mathematical formulation. (b) How do random forests address the bias–variance dilemma? (7 Marks)
2. (a) Derive the backpropagation algorithm for a simple 2-layer neural network. (b) Illustrate with a worked-out example. (8 Marks)
3. (a) What is dimensionality reduction? Derive PCA with eigen decomposition. (b) Apply PCA to reduce a 3D dataset to 2D. (8 Marks)
4. (a) Explain gradient descent and its variants (SGD, Adam, RMSProp). (b) Discuss situations where Adam is preferred over SGD. (7 Marks)
5. (a) Define reinforcement learning. Derive the Bellman equation for Q-learning. (b) Explain one real-world application of Q-learning. (8 Marks)
6. Write short notes on any two: (i) Generative Adversarial Networks (GANs) (ii) Bayesian optimization in hyperparameter tuning (iii) Online learning methods (7 Marks)