**Question Bank: Deep Learning**

**Unit 4**

**Recurrent and Recursive Neural Networks**

**Unfolding Computational Graphs**

1. What does “unfolding” mean in the context of recurrent neural networks?
2. Explain how computational graphs are used to represent RNNs during training.

**Recurrent Neural Networks (RNNs)**

1. Describe the architecture of a simple recurrent neural network.
2. What types of tasks are RNNs best suited for compared to feedforward networks?
3. Explain the vanishing gradient problem in RNNs.

**Bidirectional RNNs**

1. What is a Bidirectional RNN, and how does it differ from a standard RNN?
2. Give one advantage and one limitation of Bidirectional RNNs.

**Encoder-Decoder Sequence-to-Sequence Architectures**

1. Explain the role of the encoder and decoder in sequence-to-sequence models.
2. How are encoder-decoder models applied in machine translation tasks?
3. What is the role of attention in improving encoder-decoder architectures?

**Deep Recurrent Networks**

1. What makes a recurrent network “deep”?
2. Discuss one benefit and one drawback of deep RNN architectures.

**Recursive Neural Networks**

1. How does a recursive neural network differ from a recurrent neural network?
2. Give an example of a real-world application where recursive neural networks are useful.

**The Challenge of Long-Term Dependencies**

1. Why do standard RNNs struggle with long-term dependencies?
2. How does backpropagation through time (BPTT) worsen the vanishing/exploding gradient problem?

**Echo State Networks**

1. What is the key idea behind Echo State Networks (ESNs)?
2. How does the concept of a “reservoir” help in ESNs?

**Leaky Units and Multiple Time Scales**

1. What are leaky units, and how do they help model long-term dependencies?
2. Explain how multiple time scales can be handled in recurrent architectures.

**Long Short-Term Memory (LSTM) and Gated RNNs**

1. What are the main components (gates) of an LSTM unit, and what is their function?
2. How do Gated Recurrent Units (GRUs) differ from LSTMs?
3. Compare the performance of LSTM, GRU, and vanilla RNN in handling long sequences.

**Optimization for Long-Term Dependencies**

1. Describe two optimization strategies to mitigate vanishing gradients in RNNs.

**Explicit Memory**

1. What is meant by explicit memory in neural networks, and how does it differ from implicit memory in RNNs?