Indian Institute of Technology Jammu
Course: GenAI (Cohort 2)
End Semester Examination

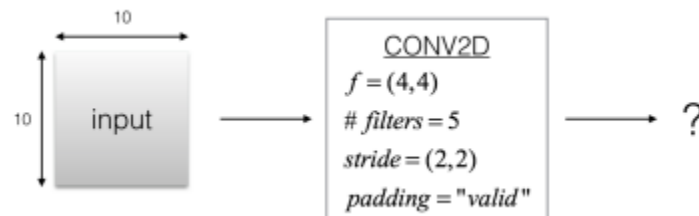**Duration: 120 mins**   **Max. Marks: 50**

Note: *There are 11 questions. All questions are compulsory.*

1. You'd like to train a fully-connected neural network with 5 hidden layers, each with 10 hidden units. The input is 20-dimensional, and the output is a scalar. What is the total number of trainable parameters in your network?

   [2 marks]

2. Consider the figure below:

   There are five 4×4 convolutional filters with 'valid' padding and a stride of $(2, 2)$ What is the output shape after performing the convolution step?

   [3 marks]

3. Compute the total cost, J, of the network averaged across the following dataset of 3 examples using the binary cross entropy loss. $Y^T = (1, 0, 0)$, and $\widehat{Y^T} = (0.1, 0.2, 0.7)$.

   [3 marks]

4. Calculate the gradient of sigmoid and tanh functions. Calculate in terms of $\sigma(z)$ and $tanh(z)$ where $\sigma(z) = \frac{1}{1+e^{-z}}$ and $tanh(z) = \frac{e^z - e^{-z}}{e^z + e^{-z}}$.

   [5 marks]

5. Explain the difference between L1 and L2 regularization.

   [2 marks]

6. You are given the following piece of code for forward propagation through a single hidden layer in a neural network. The layer uses ReLU as the activation function. Identify and correct the error in the code.

```python
class SimpleNN(nn.Module):
    def __init__(self, input_size, hidden_size):
        super(SimpleNN, self).__init__()
```

```
        self.hidden_layer = nn.Linear(input_size, hidden_size)
        self.output_layer = nn.Linear(hidden_size, 1)
        self.relu = nn.ReLU()

   def forward(self, x):
        hidden = self.hidden_layer(x)
        hidden = self.relu
        output = self.output_layer(hidden)
        return output
```
[**2 marks**]

7. You are developing a deep-learning model for a multi-class classification problem with 10 classes. The dataset is highly imbalanced, with some classes having thousands of samples and others having only a few hundred.
   a) Why does class imbalance pose a challenge for training deep learning models in multiclass classification? What problems might arise in the model's predictions if the class imbalance is not addressed?
   [**3 marks**]
   b) Suggest strategies to handle imbalanced datasets in multiclass classification.