ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination   Summer Semester, A.Y. 2022-2023
Course No: EEE 4871   Time: 90 Minutes
Course Title: Biomedical Signal Processing   Full Marks: 75

There are 2 (**two**) questions. Answer both 2 (**two**) questions. The symbols have their usual meanings.
Programmable calculators are not allowed. Marks of each question and corresponding COs and POs are
written in the brackets.

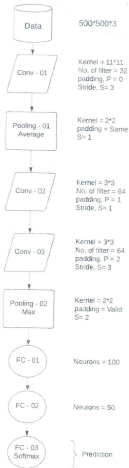|		
1. a)	Explain how x-ray radiation is used in biomedical imaging.	10 (CO1, PO1)
b)	Explain how sound waves propagate through a biological medium and how that concept can be utilized in imaging.	10 (CO1, PO1)
c)	Explain the main differences between a CT scan and an X-ray.	5 (CO1, PO1)
d)	One of your classmates is suffering from vascular occlusion (obstruction of a blood vessel). What approach would you suggest to properly visualize the condition – justify your answer.	5 (CO1, PO1)
2.	A group of students are trying to design a classification system that will take images of chest x-rays as input and predict different complications such as pneumonia, lung cancer, rib fracture, etc. There are in total 15 such categories and the number of images they collected is 1000. However, for some categories of complications, they managed to collect only a handful of images as they are rare (around 20). They designed the CNN architecture provided in Fig. 1. They used the ReLU activation function and GD optimizer. They trained the model for 40 epochs and achieved a training accuracy of 80% and a validation accuracy of 55%. Answer the following questions based on their work -	
a)	Calculate the number of parameters of the given CNN model.	10 (CO2, PO2)
b)	The number of trainable parameters in the model is way too high. Identify the specific reasons behind this and how can you reduce the number of parameters?	5 (CO2, PO2)
c)	Explain how using a tanh activation function instead of ReLU will affect the model.	5 (CO2, PO2)
d)	Explain how you can overcome the problem of limited data, especially for those rare cases.	5 (CO2, PO2)
e)	Explain whether is model is underfitting or overfitting. How the situation can be alleviated – Justify your answer.	10 (CO2, PO2)
f)	Explain how changing the optimizer from GD to mini-batch GD or Adam would affect the training process.	10 (CO2, PO2)

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┌─────────┐
│  Data   │              500*500*3
└─────────┘
     │
     ▼
╱─────────╱            Kernel = 11*11
│ Conv - 01            No. of filter = 32
╱─────────╱            pudding, P = 0
                       Stride, S= 3
     │
     ▼
┌─────────┐            Kernel = 2*2
│Pooling - 01          padding = Same
│ Average  │           S= 1
└─────────┘
     │
     ▼
╱─────────╱            Kernel = 3*3
│ Conv - 02            No. of filter = 64
╱─────────╱            padding, P = 1
                       Stride, S= 1
     │
     ▼
╱─────────╱            Kernel = 3*3
│ Conv - 03            No. of filter = 64
╱─────────╱            padding, P = 2
                       Stride, S= 3
     │
     ▼
┌─────────┐            Kernel = 2*2
│Pooling - 02          padding = Valid
│  Max     │           S= 2
└─────────┘
     │
     ▼
╱─────────╲
│ FC - 01  │           Neurons = 100
╲─────────╱
     │
     ▼
╱─────────╲
│ FC - 02  │           Neurons = 50
╲─────────╱
     │
     ▼
╱─────────╲
│ FC - 03  │  ⎫
│ Softmax  │  ⎬ Prediction
╲─────────╱  ⎭
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Fig. 1