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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
(ONLINE)
SEMESTER II
SESSION 2020/2021**

COURSE NAME : INTELLIGENT CONTROL SYSTEM
COURSE CODE : BEH41803/BEJ44103
PROGRAMME CODE : BEJ
EXAMINATION DATE : JULY 2021
DURATION : 3 HOURS
INSTRUCTION : ANSWERS ALL QUESTIONS
OPEN BOOK EXAMINATION

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THIS QUESTION PAPER CONSISTS OF **FOUR (4)** PAGES

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Part A (Objective)

Q1 This section contains 20 questions and answer all the questions from the following link:

bit.ly/BEH41803_FE

(50 marks)

Part B (Subjective)

Q2 By referring to Convolutional Neural Network (CNN) code in **Figure Q2**.

- (a) Illustrate the model structure with details of layer labelling (3 marks)
- (b) Analyze image output shape and its total trainable parameters for each stack of the CNN layer. (20 marks)
- (c) Illustrate the new model structure if VGG pre-trained model is to be integrated to the existing CNN structure. (2 marks)

Q3 A fuzzy logic based washing machine system has been simplified by using only two inputs and one output. The input variables are Degree-of-Dirt (DD) and Type-of-Dirt (TD); the output variable is Washing-Time (WT). The fuzzy rule-base consist of:

Rule 1 : IF DD is <i>Large</i>	AND TD is <i>Greasy</i>	THEN WT is <i>Long</i>
Rule 2: IF DD is <i>Medium</i>	AND TD is <i>Greasy</i>	THEN WT is <i>Long</i>
Rule 3: IF DD is <i>Small</i>	AND TD is <i>Greasy</i>	THEN WT is <i>Short</i>
Rule 4 : IF DD is <i>Large</i>	AND TD is <i>Medium</i>	THEN WT is <i>Long</i>
Rule 5 : IF DD is <i>Medium</i>	AND TD is <i>Medium</i>	THEN WT is <i>Short</i>
Rule 6 : IF DD is <i>Small</i>	AND TD is <i>Medium</i>	THEN WT is <i>Short</i>
Rule 7 : IF DD is <i>Large</i>	AND TD is <i>Not Greasy</i>	THEN WT is <i>Short</i>
Rule 8 : IF DD is <i>Medium</i>	AND TD is <i>Not Greasy</i>	THEN WT is <i>Very Short</i>
Rule 9 : IF DD is <i>Small</i>	AND TD is <i>Not Greasy</i>	THEN WT is <i>Very Short</i>

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The DD and TD having the same universe of discourse [0 - 100], Meanwhile the WT is represented in the universe [0 - 60]. The membership functions for each variable are as follows:

$$Small = \left\{ \frac{1}{0} + \frac{1}{10} + \frac{0}{40} \right\}$$

$$Long = \left\{ \frac{0}{30} + \frac{1}{50} + \frac{1}{60} \right\}$$

$$Medium = \left\{ \frac{0}{20} + \frac{1}{40} + \frac{1}{70} + \frac{0}{80} \right\}$$

$$Short = \left\{ \frac{0}{20} + \frac{1}{30} + \frac{0}{40} \right\}$$

$$Large = \left\{ \frac{0}{60} + \frac{1}{90} \right\}$$

$$Very Short = \left\{ \frac{0}{0} + \frac{1}{10} + \frac{0}{30} \right\}$$

$$Greasy = \left\{ \frac{0}{60} + \frac{1}{80} + \frac{1}{100} \right\}$$

$$Not Greasy = \left\{ \frac{0}{0} + \frac{1}{30} + \frac{0}{50} \right\}$$

- (a) Sketch the input and output of the fuzzy membership function respectively. (9 marks)
- (b) Investigate the model output before defuzzification using Mamdani implication relation and disjunctive aggregator when DD is 36 and TD is 92. (9 marks)
- (c) Analyze the crisp value of *WT* from the composed model in Q3 (b) using Bisector of Area (BOA) method. (7 marks)

-END OF QUESTIONS -

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```
cnn_model = models.Sequential()  
cnn_model.add(layers.Conv2D(16,(11,11), activation='relu', input_shape=(256,256,3)))  
cnn_model.add(layers.MaxPooling2D((2,2)))  
cnn_model.add(layers.Conv2D(32,(7,7),activation='relu'))  
cnn_model.add(layers.MaxPooling2D((2,2)))  
cnn_model.add(layers.Conv2D(64,(1,1),activation='relu'))  
cnn_model.add(layers.Conv2D(128,(5,5),activation='relu'))  
cnn_model.add(layers.MaxPooling2D((2,2)))  
cnn_model.add(layers.Conv2D(256,(3,3),activation='relu'))  
cnn_model.add(layers.MaxPooling2D((2,2)))  
cnn_model.add(layers.Conv2D(512,(3,3),activation='relu'))  
cnn_model.add(layers.Flatten())  
cnn_model.add(layers.Dense(512, activation='relu'))  
cnn_model.add(layers.Dense(1,activation='sigmoid'))
```

Figure Q2**TERBUKA**