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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER II
SESSION 2015/2016**

COURSE NAME : DESIGN OF EXPERIMENT
COURSE CODE : BWB 31803
PROGRAMME CODE : BWQ
EXAMINATION DATE : JUNE /JULY 2016
DURATION : 3 HOURS
INSTRUCTION : ANSWER ALL QUESTIONS

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THIS QUESTION PAPER CONSISTS OF SIX (6) PAGES

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- Q1** An investigators perform an experiments in virtually all fields of inquiry, usually to discover something about a particular process or system. Literally, an experiment is a test. More formally, an experiment defined as a test or series of test in which purposeful changes are made to the input variables of a process or system so that we may observe and identify the reasons for changes that may be observed in the output response. Experimental design is a planning and conducting experiments and about analysing the resulting data so that valid and objective conclusions are obtained. The focus on experiments is in industrial problem. Thus the researchers need to know new product design and formulation, manufacturing procss development and process improvement. In the various design, the researcher should be understand the design purpose.
- (a) Describe the advantages and disadvantages of completely randomized design. (4 marks)
- (b) Differentiate the fixed effect model and random effect model. (4 marks)
- (c) State the different between Completely Randomized Design and Completely Randomized Block Design. Why is the blocking important in Completely Randomized Block Design ? (3 marks)
- (d) What will be happened if we not consider the blocking in the our research design ? (2 marks)
- (e) What is the homogeneous and nuisance factors term in the research design and why should consider the homogeneous in our experiment ? (3 marks)
- (f) Why some of researcher used the Latin Square Design and why they use the Two Factorial Design ? (4 marks)

- Q2** A researcher is interested in comparing the effects of three machines on the employee productivity. He wants to show that the three machines have an effect on the productivity. He believed that the employees. An effect on the productivity. To conduct this experiment, a random sample of four employees was selected and assigned all three machines at random to each employee. The result of the experiments such in **Table Q2**.

Table Q2: The effects of three machines on the employee productivity

Employee	Machines		
	1	2	3
1	56	84	80
2	49	78	72
3	65	94	83
4	60	93	85

- (a) What is the most appropriate design for the above problem ? State the model with the necessary assumptions. (4 marks)
- (b) Test the researcher hypothesis. State H_0 and H_1 . Analyze the data by using $\alpha = 0.05$ and state the conclusion? (6 marks)
- (c) List the experimental units and the treatments in this design. (2 marks)
- (d) Use Duncan's multiple range test to make comparisons between treatment means. Interpret the answer (Use $\alpha = 0.05$). (8 marks)

- Q3** A researcher wish to compare four manufacturing methods on the breaking strength of plastic. Four types of machines are used in this experiment. He believed that machines have an effect on the plastics breaking strength. However, each machine can operate only three methods during the experiments on a given day. **Table Q3** shows the data of the experiment.

Table Q3: Four manufacturing methods on the breaking strength of plastic

Machine	Manufacturing Methods		
	1	2	3
1	A=73	C=73	D=75
2	A=74	B=75	C=75
3	B=67	C=68	D=72
4	A=71	B=72	D=75

- (a) What is the name of the design? Write an appropriate statistical model then list the assumptions and identify the terms. (4 marks)
- (b) Is this design symmetric ? Justify your answer. (3 mark)
- (c) State if the design balance or not. Discuss how to achieve balance in this design ? Justify your answer. (3 marks)
- (d) Test the hypothesis at $\alpha = 0.05$ whether there is an effect of the four manufacturing methods on the breaking strength of plastics. (10 marks)

Q4 An engineer designs a battery for use in a device that will be subjected to some extreme variations in temperature. He is interested in the effects of three types of plate materials and three temperature levels on the life of a particular battery. Four batteries are tested at each combination of plate material and temperature with all 36 test are run in the random order. The data such in **Table Q4**.

Table Q4: Effects plate materials on the life of a particular battery

Material types	Temperature						Total
	15F		70F		125F		
1	130	155	34	40	20	70	196
	74	180	80	75	82	58	116
2	150	188	136	122	25	70	180
	159	126	106	115	58	45	132
3	138	110	174	120	96	104	155
	168	160	150	139	82	60	127

- (a) How to differentiate the different types of design ? Discuss the differences between two factorial design and Randomized Complete Block Design. (4 marks)
- (b) State the simple rules to construct the test statistics for any hypothesis testing. (2 marks)
- (c) Based on the data given, would he manage to conduct the design ? (14 marks)

Q5 The effect of percent Carbonation (10% or 12%) and operating pressure (25 psi or 30 psi) on the fill height of a carbonated beverage (Pepsi). Let percent carbonation be a factor A , and operating pressure be factor B . The experiment replicated three times.

Table Q5: The effect of percent Carbonation (10% or 12%) and operating pressure (25 psi or 30 psi) on the fill height of a carbonated beverage (Pepsi)

Treatment Combination	Replication		
	I	II	III
A Low; B Low	28	25	27
A High, B Low	36	32	32
A Low; B High	18	19	23
A High;B High	31	30	29

- (a) What is the most appropriate design for the problem given ? (1 marks)
- (b) State the appropriate properties on the design. (2 marks)
- (c) Write down the model and the assumptions of the design given. (3 marks)
- (d) Based on the data, would he manage to conduct the design. Justify your answer. (14 marks)

-END OF QUESTION-