UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESI 2012/2013

COURSE NAME	:	INDUSTRIAL ENGINEERING
COURSE CODE	:	BDA 40102 / BDA 4012
PROGRAMME	:	BACHELOR DEGREE (HONS) IN MECHANICAL ENGINEERING
EXAMINATION DATE	:	JUNE 2013
DURATION	:	2 HOURS 30 MINUTES
INSTRUCTION	:	**SECTION A:** PLEASE ANSWER **ALL QUESTIONS** IN THIS SECTION. **SECTION B:** PLEASE ANSWER **THREE (3) QUESTIONS** FROM **FOUR (4) QUESTIONS** PROVIDED IN THIS SECTION.

THIS PAPER CONSISTS OF **THIRTEEN (13)** PAGES

SECTION A

Please answer <u>all questions</u> in this section.

Q1 (a) Nowadays, more companies are hiring industrial engineers and then promoting them into management positions for improving product quality, planning manufacturing resources or designing logistics distribution channels. What are their common objectives when hiring industrial engineers?

(3 marks)

(b) The domain knowledge of Industrial Engineering (IE) is derived from combinations of engineering, mathematics, statistics, computing and social sciences. The IE discipline calls for the adoption of a holistic view in resolving problems encountered and developing opportunities, coupled with a strong emphasis on efficiency and productivity improvement. To summarize, industrial engineering consists of **three (3)** main domains and subdomains either intercept between **two (2)** main domains or as independent subdomains.

Complete the Venn diagram in Figure Q1(b) to represent the inter-relationship between many disciplines in industrial engineering.

(4 marks)

(c) Level of awareness on importance of ergonomics increases as result from effective education process. Ergonomics can make simple designs (such as toothbrushes and light switch) and can render complex systems (for example train services), safe, friendly and easy to use. Briefly discuss at least **five (5)** advantages of ergonomics concepts application in industries.

(5 marks)

(d) Ministry of Education planned to build more primary schools in line with population growth of Malaysian. These schools will be equipped with science laboratories. Basic furniture in the labs are workbenches but there were lot of complaints from the teachers about the height from the previous projects as shown in Figure Q1(d)(i) and Q1(d)(ii).

(i) Comment on problems occurred for both design as shown in Figure Q1(d)(i) and Q1(d)(ii).

(5 marks)

(ii) Based on anthropometric data, suggest appropriate design to overcome the problems stated in question Q1(d)(i).

(8 marks)

SECTION B

Please answer three (3) questions from four (4) questions provided in this section.

Q2 (a) Explain why facilities planning are very important. Give **four (4)** reasons.

(4 marks)

(b) Distinguish between product and process layout. Use proper layout illustrations to support your answers.

(5 marks)

(c) UTHM is considering to build a new biggest cafeteria to service six faculty buildings. The locations of the buildings and the fraction of the faculty's employees working at these locations are shown in Table 1.

Table 1: Building locations

Building	a_i	b_i	**Fraction of Workforce**
FKMP	2	6	1/12
FKAAS	1	0	1/12
FKEE	3	3	1/6
FSTPI	5	9	1/4
FPTP	4	2	1/4
FSKTM	10	7	1/6

(i) Find the optimal location of the cafeteria to minimise the weighted rectilinear distance to all buildings.

(6 marks)

(ii) Compute the total optimal distance.

(2 marks)

(d) A manager at company X wants to assign tasks to workstations as efficiently as possible and achieve an hourly output of 4 units. The department uses a working time of 56 minutes per hour. The accompanying precedence diagram is shown in Figure Q2 (d). The times of all tasks are in minutes.

(i) Determine the appropriate cycle time.

(2 marks)

(ii) What is the minimum number of workstations possible?

(2 marks)

(iii) Assign the tasks as shown in the Figure Q2 (d) to your recommended workstations. Compute the line efficiency. (*Hint*: Combine Assignment A, F and G to achieve optimum solution)

(4 marks)

Q3 Mr. Ahmad is an engineer at a small company that manufactures an exclusive handmade wooden door. Recently, he is implementing a new process layout to improve the existing process. He carried out stop watch time study to determine the standard time of the new process layout. Table 2 shows observation data of stop watch time study on a new process layout.

Table 2: Stop watch time study data

Work Elements	Performance Rating (%)	Observation time (Second)			
		Cycle 1	Cycle 2	Cycle 3	Cycle 4
1	110	0.22	0.26	0.25	0.23
2	100	0.15	0.18	0.15	0.16
3	100	0.90	1.10	1.04	1.00

Practice in his company is to allow 5% for fatigue allowance, 5% for delay, and 5% for personal relief. The worker's salary is RM960 per month. On the basis of this situation:

(a) List out **two (2)** purposes of conducting time study.

(2 marks)

(b) List **two (2)** other techniques that can be used for time study other than work sampling and stop watch time study.

(2 marks)

(c) Determine the number of workers required if the demand is 17,280 units per month. Assume the company is operating 24 days per month and a single 8 hour shift per day.

(11 marks)

(d) Based on Q3(c), compute the overtime cost per day for each worker for the production of 25,680 units per month. Assume the overtime pay rate is 1.5 times of the normal wage.

(6 marks)

(e) Explain the situation in which the work sampling is a more appropriate to be used as compared to stop watch time study.

(4 marks)

Q4 (a) Discuss forward and backward scheduling with examples.

(4 marks)

(b) ABC Sdn. Bhd company needs 24,000 units per year of a bought out component which will be used in its main assembly product. Each component is ordered at the rate of RM 75 per piece. The cost of preparing and sending order is RM 75 per order and the carrying cost per unit is 18 % of the purchase price per unit.

Determine the following:

(i) Economic order quantity
(ii) Number of orders to be executed per year
(iii) Time taken between successive orders.

(5 marks)

(c) There are five jobs which must go through the two machines A and B in the order AB. Processing times in hours are given in Table 3.

Table 3: Jobs to be processed by two machines

Machines	Processing time (hour)				
	Job 1	Job 2	Job 3	Job 4	Job 5
A	5	1	9	3	10
B	2	6	7	8	4

Estimate the total elapsed time and delay in each machine.

(8 Marks)

(d) Table 4 shows information concerning four jobs that are waiting processing at a work center. The jobs are supposed to be arranged following the sequencing rules of:

(i) FCFS (First come first served)
(ii) SPT (Shortest processing time)
(iii) EDD (Earliest due date)

Table 4: Information concerning four jobs that are waiting processing at a work center

Job	Job time (days)	Due dates
A	28	38
B	9	15
C	7	17
D	6	18

Determine the average completion time, average number of jobs in the system, average job lateness and percentage of utilization for each rules. What is the best method to adopt and give the reasons for choosing this best method?

(8 Marks)

Q5 (a) Describe the following terminologies in a Quality Hierarchy:

(i) Total Quality Management;
(ii) Quality Assurance;
(iii) Quality Control
(iv) Inspection

(4 marks)

(b) Describe (with example) the following "Quality Control" tools:

(i) Pareto Diagram
(ii) Scatter Diagram

(5 marks)

(c) In a quality control case study, subgroup samples (n = 3) of a critical quality characteristic are summarized in Table 5. Subgroups 1~6 represent the in-control process samples. Design parameters for X-bar control chart are given as A_2= 1.023, D_3 = 1.693 and D_4 = 2.574

Table 5: Process samples for quality characteristic (in mm)

No.	**Subgroup: 1 ~ 6**	No.	**Subgroup: 7 ~ 12**
1	50.430, 50.420, 50.410	7	50.430, 50.420, 50.410
2	50.420, 50.415, 50.430	8	50.450, 50.445, 50.440
3	50.430, 50.440, 50.425	9	50.430, 50.420, 50.440
4	50.415, 50.425, 50.435	10	50.440, 50.450, 50.440
5	50.420, 50.410, 50.425	11	50.450, 50.460, 50.440
6	50.415, 50.410, 50.420	12	50.430, 50.450, 50.440

Note : *Historical standard deviation of X-bar* (σ) = 0.006 mm

(i) Using the X-bar control chart, determine the central line (μ) and control limits (UCL, LCL). Then, plot the chart and indicate the area to be in a statistically "In-Control" and "Out-of-Control" conditions.

(8 marks)

(ii) Revise the central line and control limits by assuming that out-of-control data are subjected to assignable cause (systematic error) and range of sample is remain unchanged. Then, plot the revised X-bar control chart and indicate the "In-Control" or "Out-of-Control" condition.

(8 marks)

- END OF QUESTIONS -

Appendix I

FINAL EXAMINATION

SEMESTER / SESSION : SEMESTER II /2012/2013
COURSE : INDUSTRIAL ENGINEERING

PROGRAM : 4BDD
COURSE CODE: BDA40102 / BDA4012

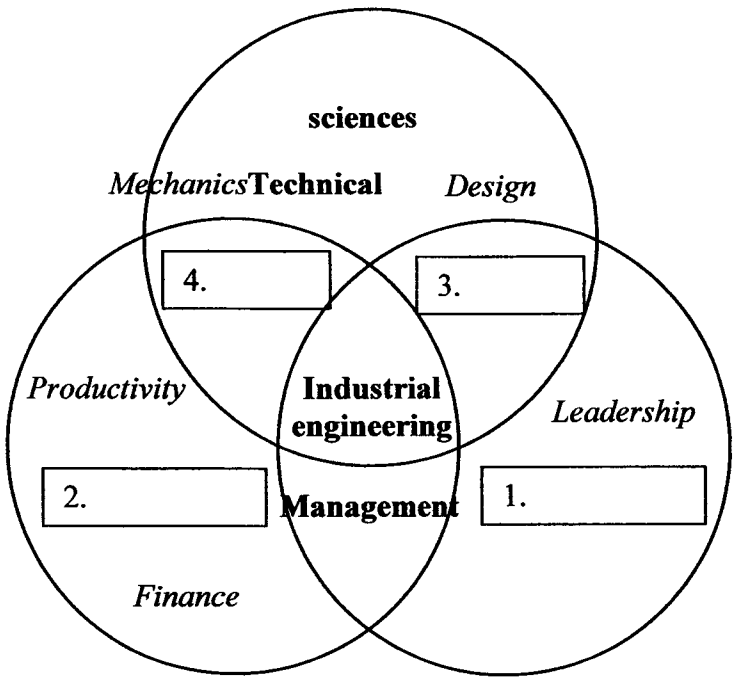

FIGURE Q1 (b)

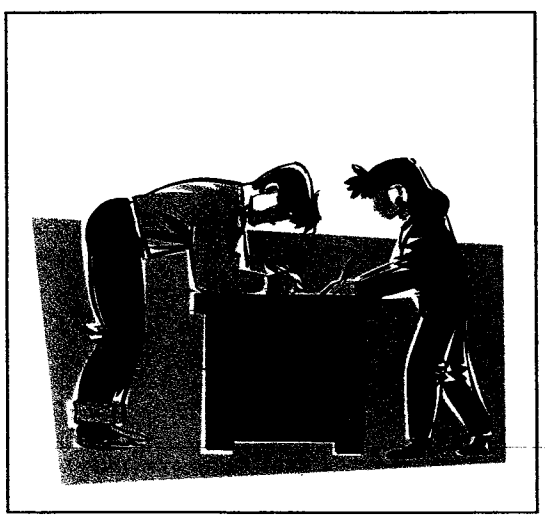

FIGURE Q1(d)(i)

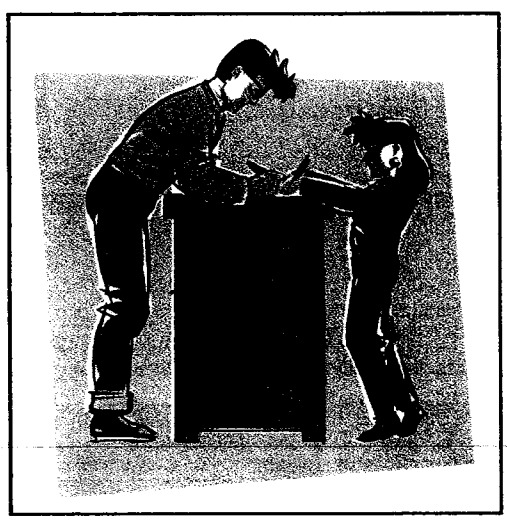

FIGURE Q1(d)(ii)

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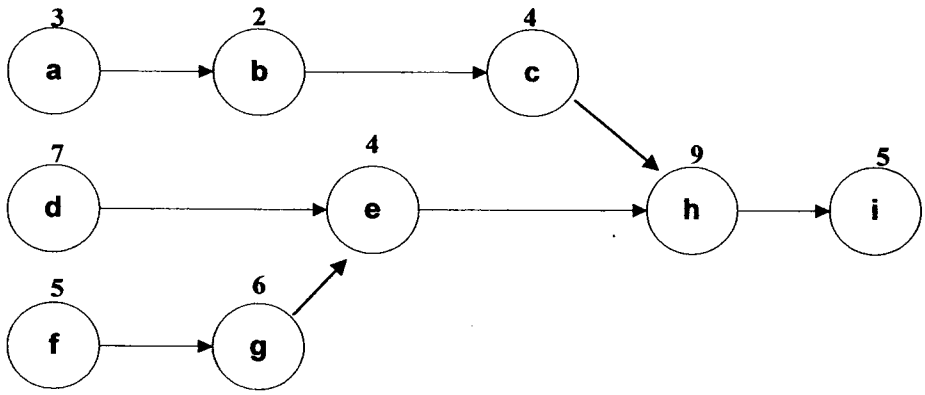

FIGURE Q2 (d)

FINAL EXAMINATION

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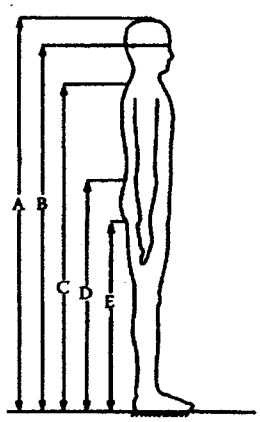
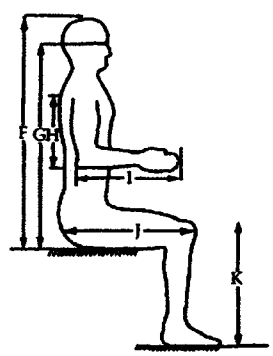
Standing and Sitting Dimensions in meters

		Male			Female		
Name	Dimension	5th%	50th%	95th%	5th%	50th%	95th%
Stature	A	1.649	1.759	1.869	1.518	1.618	1.724
Eye height (standing)	B	1.545	1.644	1.748	1.427	1.520	1.630
Mid shoulder height	C	1.346	1.444	1.564	1.210	1.314	1.441
Waist height	D	0.993	1.102	1.168	0.907	0.985	1.107
Buttocks height	E	0.761	0.839	0.919	0.691	0.742	0.832
Sitting height	F	0.859	0.927	0.975	0.797	0.853	0.911
Eye height (sitting)	G	0.743	0.800	0.855	0.692	0.743	0.791
Upper arm length	H	0.333	0.361	0.389	0.306	0.332	0.358
Lower arm + hand length	I	0.451	0.483	0.517	0.396	0.428	0.458
Upper leg length	J	0.558	0.605	0.660	0.531	0.578	0.628
Lower leg length	K	0.506	0.553	0.599	0.461	0.502	0.546



A. Stature
B. Eye height (standing)
C. Mid shoulder height
D. Waist height
E. Buttocks height



F. Sitting height
G. Eye height (sitting)
H. Upper arm length
I. Lower arm/hand length
J. Upper leg length
K. Lower leg length

Adapted from RL Huston, *Principles of Biomechanics* (CRC Press 2009)

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EQUATIONS

$$f(x,y)=\sum_{i=1}^{n} w_i\left(\left|x-a_i\right|+\left|y-b_i\right|\right) \qquad TC = VC + FCQ$$

$$\mathrm{CL}_{\bar{x}} = \bar{\bar{x}} \pm A_2 \bar{R} \qquad \bar{R}=\frac{\sum R}{g}$$

Average completion time = sum of total flow time / Number of jobs

Utilization = Total jobs processing time / sum of total flow time

Average number of jobs in the system = Sum of flow time/ Total processing time

$$UCL_R = D_4\bar{R} \qquad CL_{\bar{X}} = \bar{\bar{X}} \pm A_2\bar{R}$$

$$LCL_R = D_3\bar{R} \qquad \bar{\bar{X}}=\frac{\sum \bar{X}}{g}$$

$$StdTime = \frac{TotalNormalTime}{1-Allowance}$$

$$NormalTime = Average\ cycle\ Time \times Rating$$

Standard Time, ST

$$= \frac{\text{Total observation time}}{\text{Total output}} \times \text{Productive \%} \times \text{Rating} \times \frac{1}{1-\text{allowance}}$$

$$b=\frac{n\sum xy-\sum x\sum y}{n\sum x^2-\left(\sum x\right)^2} \qquad a=\frac{\sum y-b\sum x}{n}$$