

**CONFIDENTIAL**



**UNIVERSITI TUN HUSSEIN ONN  
MALAYSIA**

**FINAL EXAMINATION  
SEMESTER II  
SESSION 2017/2018**

COURSE NAME : INDUSTRIAL ENGINEERING  
COURSE CODE : DAM 31802  
PROGRAMME CODE : DAM  
EXAMINATION DATE : JUNE / JULY 2018  
DURATION : 2 HOURS 30 MINUTES  
INSTRUCTION : ANSWER **FOUR (4)**  
QUESTIONS ONLY

**TERBUKA**

THIS QUESTION PAPER CONSISTS OF **FIFTEEN (15)** PAGES

**CONFIDENTIAL**

## QUESTION IN ENGLISH

- Q1** (a) *There are three basic of layout types which are product layout, process layout and fixed position layout. Explain briefly the differences of these three layouts.*  
(9 marks)
- (b) *Wyres Trucking Inc. is planning a new warehouse to serve the West. Denver, Santa Fe, and Salt Lake City are under consideration. For each location, annual fixed costs (rent, equipment, and insurance) and average variable costs per shipment (labor, transportation, and utilities) are listed in **Table Q1(b)**. Sales projections range from 550,000 to 600,000 shipments per year.*
- (i) *Plot the total cost curves for all the locations on a single graph.*  
(11 marks)
- (ii) *Determine locations that provide the lowest overall cost.*  
(5 marks)
- Q2** (a) *Briefly explain the definition of the following:*
- (i) *Run time.*  
(ii) *Queue time.*  
(iii) *Wait time.*  
(9 marks)
- (b) ***Table Q2(b)** shows the activity sampling data of a work measurement study conducted at a seafood processing factory.*
- (i) *Due to the recently low demand, the company plans to have its operation only for 8 hours per day and 20 days per month. Estimate the monthly capacity of this factory.*  
(6 marks)
- (ii) *A few months in a year, the product rejection rate is at 13 %. If the company has set the production target for these months to be at 396.50 kg/month, compute the daily overtime cost for each worker assuming all workers are willing to do the overtime work. The wage during the overtime is 1.8 times the normal wage and the overtime is distributed evenly for every workday.*  
(10 marks)

**TERBUKA**

**Q3** (a) *Based on principles of motion economy, describe **four (4)** appropriate principles related to arrangement of the work place.*  
(8 marks)

(b) *The following table **Table Q3(b)** gives the map coordinates and the shipping loads for a set of cities that FDI Company wish to connect through a central hub. Assume that, the costs per unit movement are the same within both places.*

- (i) *Determine the optimum location for this central hub.*
- (ii) *If the cost is RM2.50/distance, calculate the total cost for this optimum location.*

(17 marks)

**Q4** (a) *Explain the differences of qualitative method and quantitative method in forecasting approaches.*  
(6 marks)

(b) *List down **three (3)** objectives of scheduling.*  
(3 marks)

(c) *Forecasting is the method of estimating the amount of customer future demand in order for product to be supplied. According to **Table Q4(c)**, forecast the demand for year of 2009 using the methods described by (i)-(iv) only.*

(i) *Naive method.*  
(1 marks)

(ii) *4-period simple moving average.*  
(2 marks)

(iii) *3-period weighted moving average with weightage value of 0.5, 0.35 and 0.15 (highest value for the most recent period).*  
(2 marks)

(iv) *Simple exponential smoothing with  $\alpha = 0.3$ . Assume the forecast for year of 2006 is 30,000 units.*

$$F_t = F_{t-1} + \alpha(A_{t-1} - F_{t-1})$$

(4 marks)

(v) *Using regression technique, forecast also the demand for year of 2009 and 2012.*

$$b = \frac{n \sum xy - \sum x \sum y}{n \sum x^2 - (\sum x)^2}; \quad a = \frac{\sum y - b \sum x}{n}$$

(7 marks)

**TERBUKA**

- Q5** (a) Describe product structure in capacity planning. (4 marks)
- (b) A manufacturing company has an assembly line consist of 3 machines and 5 types of jobs as shown in **Table Q5(b)**. The production manager has two (2) optional sequences which are B1-B2-B3-B4-B5 and B5-B4-B1-B2-B3. Determine which one is a better job sequence and state a reason of that selection. (7 marks)
- (c) The owner of a well-known high performance lubrication oil manufacturer is considering expanding its business by increasing the number of salesman. The data representing the actual sales for the past six years are shown in **Table Q5(c)**. The company intends to increase the number of salesman to 30 for next year.
- (i) Forecast the new expected sales by using regression method. (8 marks)
- (ii) Crude oil need to go through 3 process to manufacture the lubricating oil, which are sedimentation, filtering and additives. Scrap rate for each process is 2.5 %, 1.5 % and 2.0 % respectively. Calculate the crude oil need to be purchased per year in order to meet the forecast. (6 marks)
- Q6** (a) Discuss four (4) purpose of Control Chart. (4 marks)
- (b) Data in **Table Q6(b)** shows a 10 sub-group of shaft diameter with  $n = 5$ , taken from turning process.
- (i) Compute and complete the **Table Q6(b)**. (3 marks)
- (ii) Prepare the  $\bar{X}$ -bar chart and R chart for this process (show the calculation in answer script) by refer to **Table Q6(b)(ii)**. (7 marks)
- (c) The demand for subassembly product AAA is 150 units in week 7. Each unit of AAA requires 2 units of B and 1 unit of C. Each unit of B requires 3 units of D, 2 units of E, and 1 unit of F. Finally, each unit of C requires 3 units of E and 2 units of F. One firm manufactures all items. It takes 2 weeks to make AAA, 2 weeks to make B, 1 week to make C, 2 weeks to make D, 2 weeks to make E, and 1 week to make F. **Table 6(c)** shows the on hand inventory and lot-sizing rules for each item.
- (i) Construct a product structure for product AAA. (3 marks)
- (ii) Prepare a net material requirements plan (MRP) for item E. Fill in related information in **Table Q6(c)(ii)** and attach it along with your answer script. (8 marks)

-END OF QUESTIONS –

**TERBUKA**



## SOALAN DALAM BAHASA MELAYU

- S1 (a) Terdapat tiga jenis susunatur asas iaitu susunatur produk, susunatur proses dan susunatur posisi tetap. Terangkan secara ringkas perbezaan bagi ketiga-tiga susunatur tersebut.
- (9 markah)
- (b) Wyres Trucking Inc. merancang untuk membina sebuah gudang baru untuk memberi perkhidmatan di kawasan sebelah barat. Denver, Santa Fe, dan Salt Lake City merupakan lokasi yang akan dipertimbangkan. Bagi setiap lokasi, kos tetap tahunan (sewa bangunan, peralatan, dan insuran) dan purata kos berubah per penghantaran (pekerja, pengangkutan, dan utiliti) adalah seperti yang tertera di **Jadual S1(b)**. Unjuran jualan adalah dalam julat dari 550,000 ke 600,000 penghantaran setahun.
- (i) Plot graf jumlah kos untuk semua lokasi pada satu graf sahaja.
- (11 markah)
- (ii) Tentukan lokasi yang memberikan kos keseluruhan yang paling rendah.
- (5 markah)
- S2 (a) Terangkan secara ringkas definisi bagi perkara berikut:
- (i) Masa perubahan bentuk.
- (ii) Masa menunggu giliran.
- (iii) Masa menunggu pergerakan.
- (9 markah)
- (b) **Jadual S2(b)** menunjukkan data pensampelan aktiviti bagi kajian pengukuran kerja yang dijalankan di kilang pemprosesan makanan laut.
- (i) Oleh kerana permintaan yang rendah baru-baru ini, syarikat merancang untuk menjalankan operasinya hanya untuk 8 jam sehari dan 20 hari sebulan. Anggarkan kapasiti bulanan kilang ini.
- (6 markah)
- (ii) Beberapa bulan dalam setahun, kadar penolakan produk ialah 13 %. Sekiranya syarikat telah menetapkan sasaran pengeluaran untuk bulan-bulan ini pada 396.50 kg / bulan, kira kos lebih masa harian bagi setiap pekerja dengan menganggap semua pekerja bersedia melakukan kerja lebih masa. Kadar upah kerja lebih masa adalah 1.8 kali daripada kadar gaji biasa dan masa tambahan yang diperlukan dibahagi secara rata untuk setiap hari bekerja.
- (10 markah)

**TERBUKA**

- S3 (a) Berdasarkan prinsip pergerakan ekonomi, huraikan **empat (4)** prinsip yang berkaitan dengan susunan tempat kerja. (8 markah)

- (b) **Jadual S3(b)** di bawah memberikan koordinat lokasi dan beban penghantaran untuk setiap bandar-bandar di mana Syarikat FDI berhasrat untuk menyambung melalui hab pusat. Anggapkan bahawa pergerakan kos per unit adalah sama dalam kedua-dua tempat.

- (i) Tentukan lokasi optimum untuk hab pusat ini.  
 (ii) Jika kos adalah RM2.50 / jarak, kirakan jumlah kos untuk lokasi optimum ini. (17 markah)

- S4 (a) Jelaskan perbezaan kaedah kualitatif dan kaedah kuantitatif dalam pendekatan ramalan. (6 markah)

- (b) Senaraikan **tiga (3)** objektif penjadualan. (3 markah)

- (c) Ramalan merupakan suatu kaedah menganggarkan kuantiti permintaan pelanggan pada masa hadapan terhadap sesuatu produk yang perlu dibekalkan. Berdasarkan **Jadual S4(c)**, sediakan ramalan permintaan pelanggan bagi tahun 2009 menggunakan kaedah-kaedah seperti di maklumat (i)-(iv) sahaja.

- (i) Kaedah naif. (1 markah)

- (ii) 4-tempoh purata pergerakan mudah. (2 markah)

- (iii) 3-tempoh purata bergerak berpemberat dengan nilai pemberat ialah 0.5, 0.35 dan 0.15 (nilai tertinggi bagi masa terkini). (2 markah)

- (iv) Pelicinan eksponan mudah dengan  $\alpha = 0.3$ . Anggapkan ramalan bagi tahun 2006 ialah 30,000 unit.

$$F_t = F_{t-1} + \alpha(A_{t-1} - F_{t-1})$$

(4 markah)

- (v) Menggunakan kaedah regresi, ramalkan pula kadar permintaan pada tahun 2009 dan 2012.

$$b = \frac{n \sum xy - \sum x \sum y}{n \sum x^2 - (\sum x)^2}; \quad a = \frac{\sum y - b \sum x}{n}$$

(7 markah)

- S5** (a) Terangkan struktur produk dalam perancangan kapasiti. (4 markah)
- (b) Sebuah syarikat pembuatan mempunyai aturan pemasangan yang terdiri daripada 3 mesin dan 5 jenis pekerjaan seperti ditunjukkan dalam **Jadual S5(b)**. Pengurus pengeluaran mempunyai dua urutan pilihan iaitu B1-B2-B3-B4-B5 dan B5-B4-B1-B2-B3. Tentukan urutan kerja yang lebih baik dan nyatakan sebab pemilihan urutan tersebut. (7 markah)
- (c) Pemilik pengeluar minyak pelincir berprestasi tinggi ternama mempertimbangkan untuk mengembangkan lagi perniagaan dengan meningkatkan bilangan jurujual. Data menunjukkan jualan sebenar bagi enam tahun yang lepas seperti ditunjukkan pada **Jadual S5(c)**. Pihak syarikat bercadang untuk menambah jurujual kepada 30 orang pada tahun hadapan.
- (i) Tentukan ramalan jangkaan baru jualan menggunakan kaedah Regressi. (8 markah)
- (ii) Minyak mentah perlu melalui 3 proses untuk mengeluarkan minyak pelincir, iaitu pemendapan, penapisan dan bahan tambahan. kadar skrap untuk setiap proses masing-masing ialah 2.5 %, 1.5 % dan 2.0 %. Kirakan minyak mentah yang perlu dibeli setahun bagi memenuhi ramalan tersebut. (6 markah)

**TERBUKA**

- S6** (a) Bincangkan **empat (4)** tujuan Carta Kawalan. (4 markah)
- (b) Data **Jadual S6(b)** menunjukkan 10 sub-kumpulan diameter aci dengan  $n = 5$ , diambil daripada proses larik;
- (i) Hitung dan lengkapkan **Jadual S6(b)**. (3 markah)
- (ii) Sediakan Carta X-bar dan Carta R chart bagi proses ini (tunjukkan pengiraan dalam skrip jawapan) dengan merujuk kepada **Jadual S6(b)(ii)**. (7 markah)
- (c) Permintaan untuk produk *subassembly* AAA ialah 150 unit pada minggu 7. Setiap unit AAA memerlukan 2 unit B dan 1 unit C. Setiap unit B memerlukan 3 unit D, 2 unit E, dan 1 unit F. Akhirnya, setiap unit C memerlukan 3 unit E dan 2 unit F. Satu firma menghasilkan semua item. Ia mengambil masa 2 minggu untuk menghasilkan AAA, 2 minggu untuk menghasilkan B, 1 minggu untuk menghasilkan C, 2 minggu untuk menghasilkan D, 2 minggu untuk menghasilkan E, dan 1 minggu untuk menghasilkan F. **Jadual S6(c)** menunjukkan inventori dalam simpanan dan peraturan berasaskan lot untuk setiap item.
- (i) Bina struktur produk untuk produk AAA. (3 markah)
- (ii) Sediakan *net material requirements plan* (MRP) untuk item E. Isikan maklumat yang berkaitan dalam **Jadual Q6(c)(ii)** dan sertakannya sekali bersama skrip jawapan anda. (8 markah)

**TERBUKA**

- SOALAN TAMAT -



FINAL EXAMINATION

SEMESTER / SESSION : SEM 2 2017/2018

PROGRAMME : DAM

COURSE NAME : INDUSTRIAL ENGINEERING

COURSES CODE : DAM 31802

**Rumus/Formula:**

$$TC = FC + VC(Q)$$

$$f(x, y) = \sum_{i=1}^n w_i (|x - a_i| + |y - b_i|) \rightarrow \text{Minisum formula}$$

$$f(x, y) = \max(|x - a_i| + |y - b_i|)$$

$$\text{First point: } (x_1, y_1) = 0.5(c_1 - c_3, c_1 + c_3 + c_5)$$

$$\text{Second point: } (x_2, y_2) = 0.5(c_2 - c_4, c_2 + c_4 - c_5)$$

} Minimax formula

$$\text{Normal time} = \frac{(\text{Total observation time})x(\text{Productive})x(\text{Rating})}{\text{Total Output}}$$

$$a = \frac{\sum y - b \sum x}{n} \quad b = \frac{n \sum (xy) - \sum x \sum y}{n \sum x^2 - (\sum x)^2} \rightarrow \text{Regression formula}$$

$$Q^* = \sqrt{\frac{2DS}{H}}$$

$$TC = \frac{D}{Q}S + \frac{Q}{2}H$$

**TERBUKA**

$$Q^* = \sqrt{\frac{2DS}{H(1-d/p)}}$$

$$TC = \frac{D}{Q}S + \frac{Q}{2}H^*(1-d/p)$$

$$d = \frac{D}{\text{working days/year}}$$

## FINAL EXAMINATION

SEMESTER / SESSION : SEM 2 2017/2018

PROGRAMME : DAM

COURSE NAME : INDUSTRIAL ENGINEERING

COURSES CODE : DAM 31802

Table Q1(b)

Jadual S1(b)

Location	Annual Fixed Costs	Variable costs per shipment
Denver	RM 5,000,000	RM 4.50
Santa Fe	RM 4,200,000	RM 6.25
Salt Lake City	RM 3,500,000	RM 7.50

Table Q2(b): Activity Sampling Data

Jadual S2(b): Data persampelan aktiviti

Operators working in fast mode	120 observations
Operators working in slow mode	17 observations
No operator	4 observations
Machine breakdown	3 observations
Total processed product	50.2 kg
Observation period	
- day	8 hours
- night	8 hours
Rating during the study	95 %
Allowances	18 %
Average salary for each worker	RM 80 / day

TERBUKA

## FINAL EXAMINATION

SEMESTER / SESSION : SEM 2 2017/2018

PROGRAMME : DAM

COURSE NAME : INDUSTRIAL ENGINEERING

COURSES CODE : DAM 31802

Table Q3(b)

Jadual S3(b)

City	Map Coordinate ( x , y )	Shipping Load
A	( 5 , 10 )	5
B	( 6 , 8 )	10
C	( 4 , 9 )	15
D	( 9 , 5 )	5
E	( 7 , 9 )	15
F	( 3 , 2 )	10
G	( 2 , 6 )	5

Table Q4(c)

Jadual Q4(c)

Year	Demand (unit)
2001	41,000
2002	35,000
2003	37,000
2004	48,000
2005	40,000
2006	33,000
2007	42,000
2008	45,000
2009	?

**TERBUKA**

## FINAL EXAMINATION

SEMESTER / SESSION : SEM 2 2017/2018

PROGRAMME : DAM

COURSE NAME : INDUSTRIAL ENGINEERING

COURSES CODE : DAM 31802

Table Q5(b)

Jadual S5(b)

Machine	Job processing time (Hour)				
	B1	B2	B3	B4	B5
M1	1	6	4	3	1
M2	5	2	2	2	3
M3	3	6	1	1	3

Table Q5(c)

Jadual Q5(c)

Year	Number of Salesman	Sales Value (liter)
1	32	350,000
2	30	325,000
3	36	342,000
4	29	311,000
5	27	295,000

TERBUKA



## FINAL EXAMINATION

SEMESTER / SESSION : SEM 2 2017/2018

PROGRAMME : DAM

COURSE NAME : INDUSTRIAL ENGINEERING

COURSES CODE : DAM 31802

Table Q6(b)

Jadual Q6(b)

Sub Group	Shaft Diameter (cm)						X Bar	R
	X <sub>1</sub>	X <sub>2</sub>	X <sub>3</sub>	X <sub>4</sub>	X <sub>5</sub>			
1	1.21	1.31	1.22	1.39	1.32			
2	1.21	1.37	1.21	1.25	1.30			
3	1.21	1.28	1.33	1.32	1.31			
4	1.38	1.35	1.38	1.30	1.36			
5	1.38	1.38	1.39	1.39	1.37			
6	1.37	1.32	1.25	1.30	1.28			
7	1.39	1.38	1.40	1.39	1.38			
8	1.34	1.20	1.31	1.26	1.25			
9	1.36	1.35	1.20	1.24	1.22			
10	1.28	1.35	1.38	1.40	1.36			
TOTAL =								

*\*Note: Fill in above table and attached together with your answer script.*

**TERBUKA**

**FINAL EXAMINATION**

SEMESTER / SESSION : SEM 2 2017/2018

PROGRAMME : DAM

COURSE NAME : INDUSTRIAL ENGINEERING

COURSES CODE : DAM 31802

**Table Q6(b)(ii)**  
**Jadual Q6(b)(ii)**

**Factors for Computing Central Lines and 3σ Control Limits for  $\bar{X}$ , s and R Charts.**

OBSERVATIONS IN SAMPLE, n	CHART FOR AVERAGES			CHART FOR STANDARD DEVIATIONS				CHART FOR RANGES						
	FACTORS FOR CONTROL LIMITS			FACTOR FOR CENTRAL LINE	FACTORS FOR CONTROL LIMITS				FACTOR FOR CENTRAL LINE	FACTORS FOR CONTROL LIMITS				
	A	A <sub>2</sub>	A <sub>3</sub>	c <sub>4</sub>	B <sub>3</sub>	B <sub>4</sub>	B <sub>5</sub>	B <sub>6</sub>	d <sub>2</sub>	d <sub>1</sub>	D <sub>1</sub>	D <sub>2</sub>	D <sub>3</sub>	D <sub>4</sub>
2	2.121	1.880	2.659	0.7979	0	3.267	0	2.606	1.128	0.853	0	3.686	0	3.267
3	1.732	1.023	1.954	0.8862	0	2.568	0	2.276	1.693	0.888	0	4.358	0	2.574
4	1.500	0.729	1.628	0.9213	0	2.266	0	2.088	2.059	0.880	0	4.698	0	2.282
5	1.342	0.577	1.427	0.9400	0	2.089	0	1.964	2.326	0.864	0	4.918	0	2.114
6	1.225	0.483	1.287	0.9515	0.030	1.970	0.029	1.874	2.534	0.848	0	5.078	0	2.004
7	1.134	0.419	1.182	0.9594	0.118	1.882	0.113	1.806	2.704	0.833	0.204	5.204	0.076	1.924
8	1.061	0.373	1.099	0.9650	0.185	1.815	0.179	1.751	2.847	0.820	0.388	5.306	0.136	1.864
9	1.000	0.337	1.032	0.9693	0.239	1.761	0.232	1.707	2.970	0.808	0.547	5.393	0.184	1.816
10	0.949	0.308	0.975	0.9727	0.284	1.716	0.276	1.669	3.078	0.797	0.687	5.469	0.223	1.777
11	0.905	0.285	0.927	0.9754	0.321	1.679	0.313	1.637	3.173	0.787	0.811	5.535	0.256	1.744
12	0.866	0.266	0.886	0.9776	0.354	1.646	0.346	1.610	3.258	0.778	0.922	5.594	0.283	1.717
13	0.832	0.249	0.850	0.9794	0.382	1.618	0.374	1.585	3.336	0.770	1.025	5.647	0.307	1.693
14	0.802	0.235	0.817	0.9810	0.406	1.594	0.399	1.563	3.407	0.763	1.118	5.696	0.328	1.672
15	0.775	0.223	0.789	0.9823	0.428	1.572	0.421	1.544	3.472	0.756	1.203	5.741	0.347	1.653
16	0.750	0.212	0.763	0.9835	0.448	1.552	0.440	1.526	3.532	0.750	1.282	5.782	0.363	1.637
17	0.728	0.203	0.739	0.9845	0.466	1.534	0.458	1.511	3.588	0.744	1.356	5.820	0.378	1.622
18	0.707	0.194	0.718	0.9854	0.482	1.518	0.475	1.496	3.640	0.739	1.424	5.856	0.391	1.608
19	0.688	0.187	0.698	0.9862	0.497	1.503	0.490	1.483	3.689	0.734	1.487	5.891	0.403	1.597
20	0.671	0.180	0.680	0.9869	0.510	1.490	0.504	1.470	3.735	0.729	1.549	5.921	0.415	1.585

Copyright ASTM, 1916 Race Street, Philadelphia, PA, 19103, Reprinted with permission.

**Table Q6(c)**  
**Jadual S6(c)**

TERBUKA

Item	On-Hand Inventory	Rules	Item	On-Hand Inventory	Rules
AAA	50	L4L	E	30	FOQ = 40
B	35	L4L	F	25	L4L
C	10	FOQ = 30			
D	20	FOQ = 50			

**CONFIDENTIAL****FINAL EXAMINATION**

SEMESTER / SESSION : SEM 2 2017/2018

PROGRAMME : DAM

COURSE NAME : INDUSTRIAL ENGINEERING

COURSES CODE : DAM 31802

**Table Q6(c)(ii)  
Jadual S6(c)(ii)**

Item: AAA	Lot Size: Lead Time:							
	Week							
	1	2	3	4	5	6	7	8
Gross Requirements								
Scheduled Receipts								
Projected-on-hand inventory								
Planned Receipts								
Planned Order Releases								

Item: B	Lot Size: Lead Time:							
	Week							
	1	2	3	4	5	6	7	8
Gross Requirements								
Scheduled Receipts								
Projected-on-hand inventory								
Planned Receipts								
Planned Order Releases								

Item: C	Lot Size: Lead Time:							
	Week							
	1	2	3	4	5	6	7	8
Gross Requirements								
Scheduled Receipts								
Projected-on-hand inventory								
Planned Receipts								
Planned Order Releases								

Item: E	Lot Size: Lead Time:							
	Week							
	1	2	3	4	5	6	7	8
Gross Requirements								
Scheduled Receipts								
Projected-on-hand inventory								
Planned Receipts								
Planned Order Releases								

*\*Note: Fill in above table and attached together with your answer script.*

**CONFIDENTIAL****TERBUKA**