
UNIVERSITI SAINS MALAYSIA

Second Semester Examination
2014/2015 Academic Session

June 2015

EPM 322 – Industrial Engineering
[Kejuruteraan Industri]

Duration : 3 hours
Masa : 3 jam

Please check that this paper contains **ELEVEN** printed pages, **FOUR** pages appendix and **SIX** questions before you begin the examination.

*[Sila pastikan bahawa kertas soalan ini mengandungi **SEBELAS** mukasurat bercetak, **EMPAT** mukasurat lampiran dan **ENAM** soalan sebelum anda memulakan peperiksaan.]*

1. Appendix/Lampiran

[4 pages/mukasurat]

INSTRUCTIONS : Answer **FIVE (5)** questions.

*[**ARAHAN** : Jawab **LIMA (5)** soalan.]*

You may answer all questions in **English** OR **Bahasa Malaysia** OR a combination of both.

*[Calon boleh menjawab semua soalan dalam **Bahasa Inggeris** ATAU **Bahasa Malaysia** ATAU kombinasi kedua-duanya.]*

Answer to each question must begin from a new page.

[Jawapan untuk setiap soalan mestilah dimulakan pada mukasurat yang baru.]

In the event of any discrepancy, the English version shall be used.

[Sekiranya terdapat sebarang percanggahan, versi Bahasa Inggeris akan digunapakai.]

Q1. [a] Provide THREE (3) reasons for job design based on job expansion approach is better than mechanistic approach .

Berikan TIGA (3) sebab mengapa rekabentuk kerja berdasarkan pendekatan pengembangan kerja adalah lebih baik daripada pendekatan mekanistik.

(30 marks/markah)

[b] Job expansion consists of three main approaches. Contrast the three approaches in terms of :

- **The task within a job.**
- **The level of interactions with other workers.**
- **The level of mental capacity deployed.**

Pengembangan kerja terdiri daripada tiga pendekatan utama. Bezakan tiga pendekatan dari segi:

- *Tugas di dalam pekerjaan.*
- *Tahap interaksi dengan pekerja-pekerja lain.*
- *Tahap kemampuan mental yang digunakan.*

(35 marks/markah)

[c] Two different occupations shown in Table Q1[c] has the following rating

Dua jawatan yang berbeza yang ditunjukkan dalam Jadual S1[c] mempunyai penarafan berikut:

Table Q1[c]
Jadual S1[c]

	Skill variation <i>Variasi kemahiran</i>	Job identity <i>Jatidiri kerja</i>	Job significance <i>Signifikan kerja</i>	Autonomy <i>Otonomi</i>	Feedback <i>Timbalbalas</i>
Occupation A	4	2	6	6	3
Occupation B	6	2	5	4	4

- (i) **What is the difference between job identity and job significance? (Differentiate is not to define the terminology separately)**
- (ii) **Which occupation is better in term of potential motivation? Give ONE (1) reason for your answer.**
- (iii) **Give ONE (1) reason why providing the workers with more autonomy will motivate them more compared to expanding their job.**

- (i) *Apakah perbezaan di antara identiti kerja dan signifikan pekerjaan ? (Bezakan bukan takrifkan istilah)*
- (ii) *Pekerjaan yang mana lebih baik dari segi potensi motivasi? Berikan SATU (1) sebab bagi jawapan anda.*
- (iii) *Berikan SATU (1) sebab mengapa menyediakan pekerja-pekerja yang lebih berautonomi akan memberikan mereka motivasi yang lebih tinggi berbanding dengan meluaskan pekerjaan tersebut.*

(35 marks/markah)

Q2. [a] Provide TWO (2) reasons why productivity improvement based on human is more significant than productivity improvement based on technology.

Berikan DUA (2) sebab mengapa peningkatan produktiviti berdasarkan manusia lebih signifikan daripada peningkatan produktiviti berasaskan teknologi.

(30 marks/markah)

[b] Provide TWO (2) contrasts between Economic Productivity and Green Productivity for each:

- i. Input**
- ii. Output**

Berikan DUA (2) kontras di antara produktiviti ekonomi dan Produktiviti Hijau bagi setiap:

- i. Input*
- ii. Output*

(30 marks/markah)

[c] In 2012, Tenaga Bhd. (TB) gains RM 5 billion from their operations and the gross profit is RM 1 billion. In 2013, the revenue increases by 5 % while operation cost increases by 4%. Ending 2014 compared to 2013, the revenue had decreased by 3% while the cost also reduces by 4%. Malaysia's inflation rate for the year 2013 and 2014 is 4% while the base-lending rate (BLR) is 6%.

Bagi tahun 2012, Tenaga Bhd. (TB) berpendapatan RM 5 bilion dan keuntungan kasar RM 1 bilion daripada operasi mereka. Pada tahun 2013 pendapatan bertambah sebanyak 5% manakala peningkatan kos operasi pula sebanyak 4%. Pendapatan pada akhir 2014 berbanding 2013 berkurangan sebanyak 3% manakala kos pula berkurangan sebanyak 4% . Kadar inflasi Malaysia bagi tahun 2013 dan 2014 adalah 4% manakala kadar asas-pinjaman (BLR) adalah 6%.

- (i) **Why inflation rate and BLR are not considered in your calculation, although they are financially important factors?**

Mengapa kadar inflasi dan BLR tidak diambil kira dalam pengiraan anda, walaupun ianya juga faktor-faktor kewangan yang penting?

- (ii) **Calculate the productivity index of 2013 and 2014.**

Kirakan Indeks produktiviti tahun 2013 dan 2014.

- (iii) **Has the productivity for TB improved in 2013 and 2014? Prove your answer numerically.**

Adakah produktiviti TB bertambah baik pada tahun 2013 dan 2014? Buktikan jawapan anda menerusi pengiraan .

(40 marks/markah)

- Q3. [a] Provide TWO(2) examples how Marslow theory of needs is used in allocation of workers to a task.**

Berikan DUA (2) contoh bagaimana teori keperluan Marslow digunakan untuk melakukan peruntukan pekerja untuk sesuatu tugas.

(30 marks/markah)

- [b] Quantitative and qualitative methods are used in job evaluation. State ONE (1) condition when**

- (i) **Qualitative methods are better than quantitative methods.**
 (ii) **Quantitative methods are better than qualitative methods.**

Kaedah kuantitatif dan kaedah kualitatif digunakan dalam penilaian kerja. Nyatakan keadaan di mana

- (i) *Kaedah kualitatif lebih baik daripada kaedah kuantitatif.*
 (ii) *Kaedah kuantitatif lebih baik daripada kaedah kualitatif.*

(35 marks/markah)

- [c] An employer has developed Table Q3[c] using point factor method. He wishes to evaluate two jobs (A & B) and assign the points for each sub factor of each job.**

Seorang majikan telah membangunkan Jadual S3[c] untuk digunakan dalam kaedah factor mata. Dia ingin menilai dua jenis pekerjaan (A & B) dan telah menetapkan mata bagi setiap subfaktor pekerjaan tersebut.

Table 3[c]
Jadual 3[c]

Factor <i>Faktor</i>		Sub factor of job factor <i>Sub faktor bagi faktor kerja</i>	1	2	3	4	5	JOB A <i>Kerja A</i>	JOB B <i>Kerja B</i>
Skill kemahiran	1	Education <i>Pendidikan</i>	14	28	42	56	70	1	2
	2	Experience <i>pengalaman</i>	22	44	66	88	110	1	1
	3	Initiative <i>inisiatif</i>	14	28	42	56	70	2	2
Effort Usaha	4	Physical demand <i>Permintaan fizikal</i>	10	20	30	40	50	4	3
	5	Mental demand <i>permintaan mental</i>	5	10	15	20	25	1	2
Responsibility tanggungjawab	6	Equipment <i>peralatan</i>	5	10	15	20	25	2	1
	7	Material <i>bahan</i>	5	10	15	20	25	2	2
	8	Safety of others <i>Keselamatan orang lain</i>	5	10	15	20	25	2	1
	9	Work of others <i>Kerja orang lain</i>	5	10	15	20	25	1	2
Job condition Keadaankerja	10	Working condition <i>keadaanbekerja</i>	10	20	30	40	50	2	2
	11	Hazards <i>Bencana</i>	5	10	15	20	25	1	1

- (i) **Calculate the point score for each job.**

Kira mata skor bagi setiap kerja.

- (ii) **Provide ONE (1) decision that can be made based on the difference of the point score.**

Berikan SATU (1) keputusan yang boleh di buat berdasarkan perbezaan mata skor.

(35 marks/markah)

- Q4. [a] Draw and briefly describe the meaning of all symbols used in constructing a flow process chart.**

Lukis dan terangkan secara ringkas maksud semua simbol yang digunakan dalam pembinaan carta aliran proses.

(15 marks/markah)

- [b] Construct ONE (1) flow process chart for the following process of an emergency room admission. The process charting shall begin at the entrance and ends with the patient, Ahmad, exiting after picking up the prescription.**

Binakan SATU (1) carta aliran proses untuk proses kemasukan bilik kecemasan berikut. Catatan proses ini hendaklah bermula dengan pesakit, Ahmad, masuk dari pintu masuk dan berakhir dengan selepas mengambil preskripsi dan keluar.

Ahmad is a patient for emergency room admission, who has twisted his ankle while jogging in a park nearby his house. Upon his arrival to the hospital nearby, he hobbles into the emergency room (ER) entrance and sits down to fill out a patient history while he waits. Soon a nurse escorts him to an ER waiting room, where she checks the severity of his injury. He returns to a seat in the waiting room, until an ER bed opens up for him. There a nurse and doctor inspect the ankle and question Ahmad about the level and type of pain he is experiencing. The doctor determines that X-rays will be necessary, and Ahmad is wheeled to the Radiology Department where the radiologist takes the X-rays. Ahmad then returns to his bed in the ER. Shortly, the doctor returns to tell him that he has a simple strain; suggests RICE treatment; and prescribes a muscle relaxant. Ahmad then checks out at the ER desk and pick up his prescription at the hospital pharmacy on his way out the door.

Ahmad ialah pesakit bilik kecemasan, yang telah terseliuh pergelangan kakinya semasa berjoging di taman berdekatan rumahnya. Apabila tiba di hospital berdekatan, dia berjalan tempang ke pintu masuk bilik kecemasan (ER) dan duduk untuk mengisi borang sejarah pesakit sementara dia menunggu. Tidak lama kemudian seorang jururawat membimbing dia ke bilik menunggu ER, di mana beliau memeriksa tahap kecederaannya. Dia kembali ke tempat duduk di bilik menunggu, sehingga katil ER tersedia baginya. Di situ seorang jururawat dan doktor memeriksa pergelangan kaki dan menyoal Ahmad tentang tahap dan jenis sakit yang dia sedang alami. Doktor menentukan bahawa X-ray akan diperlukan, dan Ahmad dihantar dengan kerusi roda ke Jabatan Radiologi di mana pakar radiologi mengambil X-ray untuknya. Ahmad kemudian kembali ke katilnya di dalam ER. Tidak lama kemudian, doctor kembali untuk memberitahu bahawa dia mempunyai seliuhan ringan; mencadangkan rawatan RICE; dan mempreskripsikan ubat relaksan otot. Ahmad kemudian daftar keluar di kaunter ER dan mengambil preskripsinya di farmasi hospital dalam perjalanan keluar pintu.

(65 marks/markah)

- [c] **Kelvin reached for a spanner in a tool box located in front of him, hesitating momentarily while searching for the spanner size 13 mm in the tool box. Finding the correct size, he picked it up and positioned it to the bolt head of a bolt that had previously been hand-turned into a threaded hole in the work unit. He then twirled the spanner handle with one continuous finger and wrist motion until the bolt had been rotated six turns. At this point he gripped the spanner handle with his hand and tightened the bolt the last quarter turn.**

Kelvin mencapai sepana dalam kotak alatan yang terletak di hadapannya, teragak-agak seketika mencari saiz sepana 13 mm di dalam kotak alatannya. Setelah menjumpai saiz yang betul, beliau mengambil dan memposisikan sepana itu pada kepala bolt yang bolt ini sebelumnya telah diputar dengan tangan ke dalam lubang bebenang dalam unit kerja. Beliau kemudian memutar pemegang sepana dengan satu gerakan berterusan jari dan pergelangan tangan sehingga bolt ini telah diputar enam pusingan. Pada ketika ini beliau mencengkam pemegang sepana dengan tangannya dan memperketatkan bolt ini untuk suku putaran terakhir.

Write a list of the therbligs that comprise the motion sequence carried out by Kelvin.

Tuliskan satu senarai therbligs yang terdiri daripada urutan gerakan yang telah dilakukan oleh Kelvin.

(20 marks/markah)

- Q5. [a] (i) **Explain ONE (1) difference between the terms ‘methods analysis’ and ‘methods design’ in method engineering.**

Terangkan SATU (1) perbezaan di antara istilah-istilah 'analisa kaedah' dan 'rekabentuk kaedah' dalam kejuruteraan kaedah.

(10 marks/markah)

- (ii) **Briefly describe FOUR (4) objectives of method analysis when the analysis is used to seek improvement on an existing method or process.**

Terangkan dengan ringkas EMPAT (4) objektif analisa kaedah di mana analisa berkenaan digunakan untuk tujuan menambahbaik kaedah atau proses yang sedia ada.

(20 marks/markah)

- [b] In a time study, an average operator is normally selected as the subject of study.**

Dalam kajian masa, pengendali purata biasanya dipilih sebagai subjek kajian.

- (i) List down THREE (3) main criteria for being an average operator.**

Senaraikan TIGA (3) kriteria utama untuk menjadi pengendali purata.

(15 marks/markah)

- (ii) Justify the necessary to conduct performance rating on an average operator during the time study.**

Justifikasikan keperluan untuk menjalankan pengkadaran prestasi terhadap pengendali purata dalam kajian masa.

(15 marks/markah)

- [c] A time study was conducted on an assembly job consisting of three elements in a cycle in a normal 8-hour shift. For every eight cycles, the operator must exchange parts containers which took 1.60 minutes, rated at 95%. The study was conducted using cumulative timing method along with the performance rating. Stopwatch readings in hundredth of a minute and the rating factors are given in Table Q5[c].**

Satu kajian masa telah dijalankan ke atas satu kerja pemasangan yang terdiri daripada tiga unsur dalam satu kitaran syif biasa 8-jam. Untuk setiap lapan kitaran, pengendali perlu menukar bekas bahagian yang mengambil masa 1.60 minit, diberi nilai prestasi 95%. Kajian ini dijalankan dengan menggunakan kaedah masa terkumpul bersama dengan pengkadaran prestasi. Bacaan jam randik dalam pembahagian seratus untuk satu minit dan faktor kadaran diberikan dalam Jadual S5[c].

Table Q5[c]

Jadual S5[c]

Element Elemen	Stopwatch readings Bacaan jam randik					Rating Kadaran
	1	2	3	4	5	
1	10	73	139	203	266	80
2	25	88	155	218	280	100
3	64	128	193	257	320	110

- (i) **If the operator is given 30 minutes lunch break and 20 minutes breaks for personal time and fatigue, compute the PFD allowance factor, A_{pfd} that should be added into the standard time computation.**

Jika pengendali diberikan 30 minit untuk makan tengah hari dan 20 minit untuk masa rehat peribadi dan keletihan, kirakan faktor elaun PFD, A_{pfd} yang perlu ditambah ke dalam pengiraan masa piawai.

(10 marks/markah)

- (ii) **Calculate the standard time in second using the PFD allowance factor obtained in 5[c](i).**

Kirakan masa piawai dalam saat dengan menggunakan faktor elaun PFD yang diperolehi dalam 5[c](i).

(15 marks/markah)

- (iii) **Determine the worker's efficiency if the operator completes 600 parts in a normal 8-hour shift.**

Tentukan kecekapan pengendali jika pengendali melengkapkan 600 bahagian dalam syif biasa 8-jam.

(15marks/markah)

- Q6. [a] The common way of voting by paper ballot, involves a voter picking up a pencil, placing an X in the appropriate box for the candidate he/she chooses, returning the pencil to the table, and then placing the ballot into the ballot box. Assume all items (ballot, pencil and ballot box) are within a forearm reach. (MOST tables are given in Appendices)**

Cara biasa mengundi dengan kertas undi, melibatkan seorang pengundi mengambil pensel, meletakkan X dalam kotak yang sesuai bagi calon yang dipilih, kembalikan pensel ke meja, dan kemudian meletakkan kertas undi ke dalam peti undi . Andaikan semua perkara (kertas undi, pensel dan peti undi) berada dalam jangkauan lengan.(Jadual-jadual MOST diberi dalam Lampiran)

- (i) **Develop the activity sequence model for voting.**

Bangunkan model turutan aktiviti untuk mengundi.

(15 marks/markah)

- (ii) **Calculate a normal time (in second) for voting using MOST.**

Kirakan masa normal (dalam saat) untuk mengundi dengan menggunakan MOST.

(15 marks/markah)

- [b] (i) State THREE (3) errors that might exist in work sampling.**

Nyatakan TIGA (3) ralat yang mungkin wujud dalam pensampelan kerja.

(15 marks/markah)

- (iii) Suggest ONE (1) solution for each error as discussed in 6[b](i).**

Cadangkan SATU (1) penyelesaian untuk setiap ralat seperti yang dinyatakan dalam 6[b](i).

(15 marks/markah)

- [c] A work sampling study was conducted in Sapura Brake Plc. to establish the standard time for an assembly operation of an automotive brake module. The analyst conducted the study for 3 days with normal 8 working hours per day. The observations of the study conducted are listed as below.**

Satu kajian pensampelan kerja telah dijalankan di Sapura Brake Plc. untuk membangunkan masa piawai untuk operasi pemasangan modul brek automotif. Penganalisa ini menjalankan kajian ini selama 3 hari dengan 8 jam waktu kerja normal sehari. Pemerhatian daripada kajian yang dijalankan adalah disenaraikan seperti berikut.

Total number of observations = 160
Jumlah bilangan pemerhatian

Manual operation = 14
Operasi manual

Machine controlled operation = 106
Operasi mesin

Machine idle time = 40
Masa melahu mesin

Average performance rating = 80%
Kadar prestasi purata

Number of module produced = 36
Bilangan modul yang dihasilkan

Allowance for personal needs and fatigue = 10%
Elaun bagi keperluan peribadi dan keletihan

Assuming there is no machine allowance,

Andaikan tiada elaun mesin,

- (i) **Calculate the average task time to produce a brake module.**

Kirakan masa purata kerja untuk menghasilkan satu modul brek.

(10 marks/markah)

- (ii) **Calculate the average task times to produce a brake module in machine controlled operation and in manual operation.**

Kirakan masa-masa purata kerja untuk menghasilkan satu modul brek dengan operasi mesin dan dengan operasi manual.

(10 marks/markah)

- (iii) **Calculate the normal time to produce a brake module for the assembly operation.**

Kirakan masa normal untuk menghasilkan satu modul brek dalam operasi pemasangan ini.

(10 marks/markah)

- (iv) **Calculate the standard time to produce a brake module for the assembly operation.**

Kirakan masa piawai untuk menghasilkan satu modul brek dalam operasi pemasangan ini.

(10 marks/markah)

MOST Parameters and Index Values for the General Move Activity Sequence Model

General Move activity sequence model = A B G A B P A				
Index	A = Action Distance	B = Body Action	G = Gain control	P = Placement
0	Close \leq 5cm (2 in.)			Hold, Toss
1	Within reach (but > 2 in.)		Grasp light object using one or two hands	Lay aside Loose fit
3	1 or 2 steps	Bend and arise with 50% occurrence	Grasp object that is heavy, or obstructed, or hidden, or interlocked	Adjustments, light pressure, double placement
6	3 or 4 steps	Bend and arise with 100% occurrence		Position with care, or precision, of blind, or obstructed, or heavy pressure
10	5, 6, or 7 steps	Sit or stand		
16	8,9, or 10 steps	Through door, or Climb on or off, or Stand and bend, or Bend and sit		

MOST Parameters and Index Values for the Controlled Move Activity Sequence Model

Controlled Move activity sequence model = A B G M X I A				
Index	M = Move, controlled	X = Process time		I = Alignment
		Seconds	Minutes	
1	Push, pull, pivot: button, switch, knob (≤ 12 in.)	0.5	0.01	Align to one point
3	Push and pull, turn, open, seat, shift, press: resistance encountered, or high control required, or 2 stages of control (≤ 12 in.); 1 crank of lever.	1.5	0.02	Align to 2 points, Close align (≤ 4 in.)
6	Open and shut, operate, push or pull: with 1 or 2 steps (> 12 in.); 3 cranks of lever.	2.5	0.04	Align to 2 points, Close align (≥ 4 in.)
10	Manipulate, maneuver, push, or pull with 3, 4, or 5 steps; 6 cranks of lever.	4.5	0.07	Precision align
16	Push or pull with 6, 7, 8, or 9 steps included; 11 cranks of lever.	7.0	0.11	High precision align

MOST Parameters and Index Values for Tool Use – Fasten and Loosen

Tool Use activity sequence model = A B G A B P * A B P A												
Fasten or Loosen = F or L												
	Finger Action	Wrist Action				Arm Action					Tool Action	
Index	Fingers, Screw-driver	Hand, Screw-driver, Ratchet, T-wrench	Wrench, Allen key	Wrench, Allen key, Ratchet	Hand, Hammer	Ratchet	T-wrench, 2 hands	Wrench, Allen key,	Wrench, Allen key, Ratchet	Hand, Hammer	Power wrench	Index
	Spins	Turns	Strokes	Cranks	Taps	Turns	Turns	Strokes	Cranks	Strikes	Diameter	
1	1	-	-	-	1	-	-	-	-	-	-	1
3	2	1	1	1	3	1	-	1	-	1	6 mm (1/4 in.)	3
6	3	3	2	3	6	2	1	-	1	3	25 mm (1 in.)	6
10	8	5	3	5	10	4	-	2	2	5		10
16	16	9	5	8	16	6	3	3	3	8		16
24	25	13	8	11	23	9	6	4	5	12		24
32	35	17	10	15	30	12	8	6	6	16		32
42	47	23	13	20	39	15	11	8	8	21		42
54	61	29	17	25	50	20	15	10	11	27		54

MOST Parameters and Index Values for Tool Use – Cut, Surface treat, Measure, Record and Think

	Cut = C			Surface Treat = S			Measure = M	Record = R	Think = T						
	Cutoff	Secure	Cut	Slice	Air clean	Brush clean	Wipe	Measure	Write	Mark	Inspect	Read			
	Pliers		Scissors	Knife	Nozzle	Brush	Cloth	Measuring Tool	Pen/Pencil	Marker	Eyes, fingers	Eyes			
Index	Wire		Cuts	Slices	4 m ² (1 ft ²)	4 m ² (1 ft ²)	4 m ² (1 ft ²)		Digits	Words	Digits	Points	Digits, single words	Text	Index
1		Grip	1						1		Check	1	1	3	1
3	Soft		2	1			1/2		2		1 Scribe line	3	3	8	3
6	Medium	Twist Form loop	4		1 Spot cavity	1			4	1	2	5 Feel for heat	6	15	6
10	Hard		7	3			1	Profile gauge	6		3	9 Feel defect	12	24	10
16		Secure cotter pin	11	4	3	2	2	Fixed scale, Caliper	9	2	5	14		38	16
24 32			15 20	6 9	4 7	3 5	5	Feeler gauge, Steel tape, Depth micrometer	13 18	3 4	7 10	19 26		54 72	24 32
42			27	11	10	7	7	OD micrometer	23	5	13	34		94	42
54			33					ID micrometer	29	7	16	42		119	54