



Second Semester Examination  
Academic Session 2018/2019

June 2019

**EPM322 – Industrial Engineering**  
***[Kejuruteraan Industri]***

Duration : 3 hours  
*Masa : 3 jam*

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Please check that this examination paper consists of NINE [9] printed pages before you begin the examination.

*[Sila pastikan bahawa kertas soalan ini mengandungi SEMBILAN [9] mukasurat bercetak sebelum anda memulakan peperiksaan.]*

**INSTRUCTIONS** : Answer **ALL FIVE [5]** questions.

**[ARAHAN** : Jawab **SEMUA LIMA [5]** soalan.]

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

*[Sekiranya terdapat sebarang percanggahan pada soalan peperiksaan, versi Bahasa Inggeris hendaklah diguna pakai.]*

...2/-

1. [a] **Productivity is an inevitable tool in assessing and checking performance of a business or organization. Its measurement can be immensely powerful when focused at specific issues and problems. Provide THREE (3) significance of productivity measurement to the management.**

*Produktiviti adalah alatan yang diperlukan dalam menilai dan memantau prestasi organisasi atau perniagaan. Pengukurannya menjadi sangat penting apabila difokuskan kepada isu-isu dan masalah-masalah yang spesifik. Berikan TIGA (3) signifikansi pengukuran produktiviti kepada pihak pengurusan.*

**(25 marks/markah)**

- [b] **There are many techniques to improve productivity. However, a variety of factors can affect productivity. Briefly explain THREE (3) techniques for Green productivity to prove that Green productivity can help industry.**

*Terdapat banyak teknik untuk meningkatkan produktiviti. Walau bagaimanapun, pelbagai faktor boleh menjejaskan produktiviti. Terangkan dengan ringkas TIGA (3) teknik produktiviti Hijau bagi membuktikan produktiviti Hijau dapat membantu industri.*

**(25 marks/markah)**

- [c] **A team of workers makes 400 units of a product, which is sold in the market for RM10 each. The accounting department reports that for this job the actual costs are RM400 for labor, RM1,000 for materials, and RM300 for overhead.**

*Satu pasukan pekerja membuat 400 unit produk, yang dijual di pasaran pada RM10 setiap satu. Jabatan perakaunan melaporkan bahawa untuk pekerjaan ini, kos sebenar ialah RM400 untuk pekerja, RM1,000 untuk bahan, dan RM300 untuk overhead.*

- (i) **Calculate the Multi-factor Productivity**  
*Kira Produktiviti Pelbagai faktor*

**(15 marks/markah)**

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- (ii) Give comment on the yearly labor productivity based on Table 1[c]

*Berikan komen tentang produktiviti pekerja tahunan berdasarkan Jadual 1[c].*

**(15 marks/markah)**

- (iii) Calculate the multifactor productivity 2017 and 2018 based on Table 1[c].

*Kirakan produktiviti multifaktor tahun 2017 dan 2018 berdasarkan Jadual 1[c].*

**(20 marks/markah)**

**Table 1[c]**  
*Jadual 1[c]*

	<b>2018</b>	<b>2017</b>	<b>2016</b>
<b>Factory unit sales/</b> <i>Jualan unit kilang</i>	2,762,103	2,475,738	2,175,447
<b>Labor hour (hrs)/ Masa</b> <i>Kerja (jam)</i>	112,000	113,000	115,000
<b>Sales of manufactured products (RM)/</b> <i>Jualan produk perkilangan (RM)</i>	RM49,363	RM40,831	RM38580
<b>Total manufacturing cost of sales (RM)/</b> <i>Jumlah kos pembuatan jualan (RM)</i>	RM39,000	RM33,000	RM29000

2. [a] Material quantities, as they pass through processing operations, can be described by material balances. Such balances are statements on the conservation of mass. Similarly, energy quantities can be described by energy balances and statements on the conservation of energy. If there is no accumulation, what goes into a process must come out. This is true for batch operation. It is equally true for continuous operation over any chosen time interval. Discuss why material and energy balances are particularly important in an industry.

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*Kuantiti bahan, semasa ianya melalui operasi pemprosesan, ianya dianggap sebagai imbalan bahan. Imbalan tersebut adalah kenyataan mengenai pemuliharaan jisim. Kuantiti tenaga juga boleh dianggap sebagai imbalan tenaga dan kenyataan mengenai pemuliharaan tenaga. Sekiranya tidak ada pengumpulan, setiap yang masuk ke dalam proses mesti keluar. Hal ini benar untuk operasi kelompok. Ia juga benar untuk operasi berterusan mengikut sela waktu yang dipilih. Bincangkan mengapa imbalan bahan dan tenaga sangat penting dalam industri.*

**(35 marks/markah)**

- [b]** A college office building has five departments: A (accounting office), B (bursary), C (credit department), D (data processing department), and E (educational support services). Paper forms are routed for processing through these departments in the quantities and sequences indicated in the Table 2[b].

*Bangunan pejabat kolej mempunyai lima jabatan: A (pejabat perakaunan), B (bendahari), C (jabatan kredit), D (jabatan pemprosesan data), dan E (perkhidmatan sokongan pendidikan). Aliran borang kertas untuk diproses melalui setiap jabatan dalam kuantiti dan urutan yang ditunjukkan dalam Jadual 2[b].*

**Table 2[b]**  
*Jadual 2[b]*

<b>Product / Produk</b>	<b>Quantities per day / Kuantiti setiap hari</b>	<b>Sequence / Urutan</b>
1	20	A-B-D
2	13	B-E-A
3	10	E-C
4	30	D-A-B-D
5	25	A-C-E-B
6	18	C-B-E-D-A

- (i)** Based on these data, construct a from-to chart.  
*Berdasarkan data ini, bangunkan carta dari-ke.*

**(20 marks/markah)**

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- (ii) **Develop the activity relationship chart for these five departments, given that the from-to chart being the only basis.**

*Bangunkan carta hubungan aktiviti untuk lima jabatan ini, memandangkan hanya berasaskan carta dari-ke.*

**(20 marks/markah)**

- [c] **Discuss how Maslow's needs gratification theory can help in understanding the worker motivation in an industry?**

*Bincangkan bagaimana teori kepuasan keperluan Maslow dapat membantu pemahaman motivasi pekerja dalam industri?*

**(25 marks/markah)**

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**EXHIBIT 1 is a case study for questions 3, 4 and 5. Read the case study to gather information/data before answering the questions.**

*EXHIBIT 1 adalah kajian kes untuk soalan-soalan 3, 4 dan 5. Baca kajian kes bagi mengumpul maklumat/data sebelum menjawab soalan-soalan.*

### EXHIBIT 1

#### OVERVIEW

Optima Sendirian Berhad (OSB) manufactures and assembles automotive water pumps. **Figure 1** shows the production flow at OSB.

The process of manufacturing and assembling the pumps are carried out manually. Due to increase in demand, OSB is inconsistent to meet the daily production schedule and needs high overtime.

Based on the report from Marketing/Sales Department, the trend of pump order will keep on increasing hence this will affect OSB capability to meet customer demand. OSB will need to conduct a thorough study of its plant operations in order to evaluate its capacity.

#### CURRENT OPERATION

OSB runs only 2 shifts/day for 8 hours/shift with 1 operator for each section. However, *Raw Material Storage Section* and *Warehouse Section* are both managed by a dispatch worker.

Workers will clock in at 7.00 am and end their shift at 3.00 pm. The 2<sup>nd</sup> shift will commence at 3.00 pm until 11.00 pm. OSB plant operates for 5 days a week.

Based on the observation, OSB will ensure that there will be no work-in-process (WIP) at the end of the 2<sup>nd</sup> shift. This is possible because all WIP will be processed during overtime.

The production starts at *Pump Body Casting Section* with a capacity of 50 units/batch, that requires 1 hour to complete a batch. Upon completion, the casting will be put at the *Holding Area* for about 30 minutes to let the casting cool down. Then it will be sent to the *Pump Body Machining Section* for deburring, hole drilling and threading at the rate of 2 minutes/part. All machined pumps will then be transferred to the *Pump Assembly Section*, where all the parts are assembled.

Parts for the assembly i.e. gasket, screw and impeller are taken from the *Raw Material Storage*. Assembling ONE pump takes about 5 minutes to complete. Before transferring all the completed pumps to Warehouse, it will undergo a 100% inspection at *Pump Testing Section*. Inspection needs 1 minute for each pump that includes setting-up the pump on a rig and conducting a test run for pump functionality.

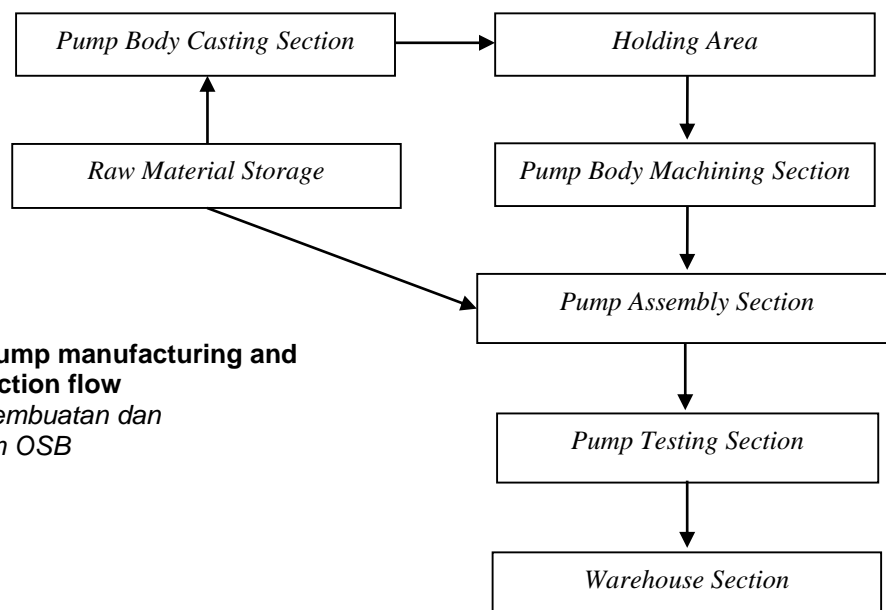
All WIPs move from one section to another section on a pallet of 50 units/batch using a manual trolley by a dispatch worker. Any pallet that does not reach the 50 units of pump will not be moved to the next section. The dispatch worker functions are to move and take parts from *Raw Material Storage* to the manufacturing operation sections, right up to *Warehouse* and managed both *Raw Material Storage* and *Warehouse*.

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## EXHIBIT 1 (continued)

**OBSERVATION AND FINDING**

- Production work only starts 30 minutes after commencing of shift due to set-up at the *Pump Body Casting Section*. 2<sup>nd</sup> shift does not require set-up because it is a continuation operation from the 1<sup>st</sup> shift.
- Transfer of production batch from one section to another section and to the holding area is 0.5 minute.
- High idling time at *Pump Body Machining Section* is observed due to the delay to wait for the hot casting to cool down. *Pump Testing Section* also has a similar situation because of the long cycle time at *Pump Assembly Section*.
- Bottleneck occurs at *Pump Assembly Section* due to the tedious manual assembly. Moreover, there is no proper arrangement of tool and the assembly parts at the operator's work place.
- Although the working hours per shift is 8 hours, the available time per shift is only 7 hours because OSB gives 1 hour of break for each shift.
- You conducted a time study for each section in order to determine the actual manufacturing and assembly times based on performance rating. Following are the data collected;
  - ❖ *Pump Body Machining Section* at 80% performance rating.
  - ❖ *Pump Assembly Section* at 70% performance rating.
  - ❖ *Pump Testing Section* at 90% performance rating.
- The working environment is not well lighted and ventilation of the plant is not properly addressed hence it is quite hot and humid for an average worker to work in. This was a major factor that contributes to the low performance as stated above.



**Figure 1: OSB pump manufacturing and assembly production flow**

*Rajah 1: Aliran pembuatan dan pemasangan pam OSB*

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3. [a] **Based on the information and data of the case study;**  
*Berdasarkan maklumat dan data kajian kes;*
- (i) **Construct a detailed Process Flow Chart for OSB with reference to Figure 1 and include the timing for each activity/task.**  
*Bina satu Carta Aliran Proses OSB yang lengkap dengan merujuk kepada "Figure 1" dan sertakan masa yang diperlukan untuk setiap aktiviti/kerja.*  
**(50 marks/markah)**
- (ii) **How many workers are there available at the OSB plant?**  
*Berapa banyak pekerja yang ada di loji OSB?*  
**(5 marks/markah)**
- (iii) **Calculate the total productive man-hours available for ONE (1) shift and ONE (1) day.**  
*Kira jumlah waktu produktif pekerja-jam untuk SATU (1) syif dan SATU (1) hari.*  
**(10 marks/markah)**
- [b] **Determine the number of pump that OSB can produce and store in the Warehouse upon completion of TWO (2) shifts (without overtime).**  
*Tentukan bilangan pump yang boleh dihasilkan dan di simpan di dalam "Warehouse" setelah tamat DUA (2) syif (tanpa lebih masa).*  
**(35 marks/markah)**
4. [a] **In the case study mentioned that OSB has to do overtime to complete WIP at the end of 2<sup>nd</sup> shift. Calculate the minimum required hours for overtime. All timing activity/task must be considered so that it will reflect the real situation.**  
*Di dalam kajian kes ada dinyatakan OSB perlu membuat kerja lebih masa untuk menyiapkan WIP. Kira jumlah jam kerja lebih masa minimum yang diperlukan. Setiap masa untuk aktiviti/kerja mesti diambil kira supaya ianya mencerminkan situasi sebenar.*  
**(25 marks/markah)**

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- [b] Calculate the Normal Time and Standard Time (PFD work allowances given is 10%) for each of the following;

*Kirakan Masa Normal dan Masa Piawai (Elaun masa kerja PFD yang beri adalah 10%) untuk setiap yang berikut:*

- (i) **Pump Body Machining Section**  
Seksyen "Pump Body Machining" (25 marks/markah)
- (ii) **Pump Assembly Section**  
Seksyen "Pump Assembly" (25 marks/markah)
- (iii) **Pump Testing Section**  
Seksyen "Pump Testing" (25 marks/markah)

5. [a] Based from the calculated Standard Time in 4[b] calculate the number of pump that OSB can now be produced and stored in Warehouse upon completion of TWO (2) shifts.

*Berdasarkan Masa Piawai yang dikira dalam 4[b] kirakan bilangan pam yang OSB kini boleh dihasilkan dan disimpan di dalam "Warehouse" setelah tamat DUA (2) syif.*

(30 marks/markah)

- [b] From the observation at Pump Assembly Section, provide ONE(1) quick solution to reduce the impact of the bottleneck.

*Daripada pengamatan di Seksyen "Pump Assembly", berikan SATU(1) penyelesaian pantas untuk mengurangkan kesan dari pencerutan.*

(20 marks/markah)

- [c] Based on Industrial Engineering approach/method, give TWO (2) suggestions that can improve the OSB overall performance. State the benefit(s) and reasoning for each suggestion.

*Berdasarkan pendekatan/kaedah Kejuruteraan Industri, berikan DUA (2) cadangan untuk meningkatkan prestasi keseluruhan OSB. Nyatakan manfaat dan alasan anda untuk setiap cadangan.*

(50 marks/markah)