UNIVERSITI SAINS MALAYSIA

Second Semester Examination
2014/2015 Academic Session

June 2015

EAK163/4 – Geomatic Engineering
[*Kejuruteraan Geomatik*]

Duration: 3 hours
[Masa: 3 jam]

Please check that this examination paper consists of **FOURTEEN (14)** pages of printed materials before you begin the examination.

*[Sila pastikan bahawa kertas peperiksaan ini mengandungi **EMPAT BELAS (14)** muka surat yang bercetak sebelum anda memulakan peperiksaan ini].*

Instructions: This paper contains **FIVE (5)** questions. Answer **ALL** questions.
*[**Arahan**: Kertas ini mengandungi **LIMA (5)** soalan. Jawab **SEMUA** soalan].*

All questions **MUST BE** answered on a new page.
*[Semua soalan **MESTILAH** dijawab pada muka surat baru].*

In the event of any discrepancies, the English version shall be used.
[Sekiranya terdapat percanggahan pada soalan peperiksaan, versi Bahasa Inggeris hendaklah diguna pakai].

Table 1 - Project Description
Jadual 1 - Deskripsi Projek

The state of Kelantan was badly hit by flood at the end of the year 2014. One of the main efforts carried out by the state government under The Flood and Disaster Technical Committee was to establish a monitoring plan to study the effects of the flood and to cater for the needs of the flood victims. A team of engineers was tasked to carry out a survey in Dabong, focusing on monitoring the river banks and its effects to the residents. It was decided to carry out a survey to establish sufficient horizontal and vertical controls and to depict all details and this information will form part of the geospatial database to be used by all experts involved in the study.

Negeri Kelantan telah dilanda banjir pada akhir tahun 2014. Salah satu usaha utama yang dijalankan oleh kerajaan negeri di bawah Jawatankuasa Bencana Banjir dan Teknikal adalah untuk mewujudkan satu pelan pemantauan untuk mengkaji kesan banjir dan memenuhi keperluan mangsa banjir. Sepasukan jurutera telah ditugaskan untuk menjalankan satu kajian di Dabong dan tumpuan diberikan kepada pemantauan tebing sungai dan kesannya kepada penduduk. Satu keputusan telah dibuat untuk menjalankan satu pengukuran bagi mewujudkan kawalan ufuk dan pugak dan mengumpul semua butiran yang mencukupi dan maklumat ini akan dijadikan sebahagian daripada data geospatial untuk digunakan oleh semua pakar yang terlibat dalam kajian ini.

1. According to the Standard Operating Procedure (SOP), the permanent adjustment of the two (2) major survey instruments namely the automatic level and the total station have to be carried out before the survey work as described in **Table 1** is started.

   *Mengikut Prosedur Operasi Standard (SOP), pelarasan tetap bagi dua (2) alat utama iaitu alat aras automatik dan total station mesti dijalankan sebelum kerja ukur seperti yang dinyatakan dalam **Jadual 1** dimulakan.*

   a) Illustrate how the Two Peg Test for the level is carried out and explain the precautions to be taken on site to minimize its effect to the observed data.

Jelaskan bagaimana Ujian Dua Piket bagi alat aras dijalankan dan terangkan langkah-langkah yang perlu diambil di tapak untuk mengurangkan kesan kepada data cerapan.

[8 marks/*markah*]

b)   Explain how the horizontal collimation adjustment for the total station is carried out and how it can the error be removed on-site.

Terangkan bagaimana pelarasan kolimatan ufuk untuk total station diilakukan dan bagaimana ralat ini dihapuskan di tapak.

[8 marks/*markah*]

c)   The basic principle of "working from the whole to the part" was engaged in the preparation of setting out the vertical and horizontal controls at the site. Explain what is meant by this basic principle.

Prinsip asas "bekerja dari keseluruhan ke bahagian" telah digunakan dalam penyediaan kawalan pugak dan ufuk di tapak. Terangkan maksud prinsip asas ini.

[4 marks/*markah*]

2.   a)   Before establishing the vertical control at the site, it was decided to carry out a Two Peg Test to test the condition of the automatic level to be used. The readings obtained from the test carried out with a single staff set up alternately at two (2) pegs A and B placed 30 m apart were as follows:

Sebelum mewujudkan kawalan pugak di tapak, ia telah diputuskan untuk melakukan Ujian Dua Piket bagi menguji keadaan alat aras automatik yang akan digunakan. Bacaan yang diperolehi dari ujian yang dijalankan menggunakan satu staf yang diset di dua (2) piket A dan B sejauh 30 m adalah seperti berikut:

With the level midway between A and B:

Staff reading at A = 1.283 m

Staff reading at B = 0.806 m

With the level positioned 5 m from B on the line AB produced:

Staff reading at A = 1.612 m

Staff reading at B = 1.219 m

Alat aras berada di antara A dan B:

Bacaan staf di A = 1.283 m

Bacaan staf di B = 0.806 m

Alat aras berada 5 m dari B di atas garisan AB yang dipanjangkan:

Bacaan staf di A = 1.612 m

Bacaan staf di B = 1.219 m

i.   Tell how the level is set up at the test site and how would you determine the collimation error of the level per 30 m of sight.

Nyatakan bagaimana alat aras diset di tapak ujian dan bagaimana anda tentukan ralat kolimatan per 30 m cerapan.

[5 marks/*markah*]

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ii.   What would be the reading obtained from the staff at A held 5 m from B?

Apakah bacaan yang diperolehi pada staf di A dari alat aras di kedudukan 5 m dari B?

[5 marks/*markah*]

b)   A levelling survey was carried out from TBM 4 and closed at TBM 6 for the purpose of monitoring the existing embankment (Table 2). Determine the reduced levels (RLs) of the two (2) end points of the embankment at E and H using the Rise and Fall Method. Is the survey work acceptable under Second Class Survey Specification?
(You may use the Levelling Booking Form A provided)

Ukur aras telah dijalankan dari TBM 4 dan ditutup di TBM 6 untuk tujuan pemantauan benteng sedia ada (Jadual 2). Tentukan aras laras (RL) kedua-dua titik E dan H di penghujung benteng menggunakan Kaedah Naik Turun. Adakah kerja ukur boleh diterima di bawah Spesifikasi Ukur Kelas Kedua?
(Anda boleh guna Borang Pembukuan Ukur Aras A yang disediakan)

[10 marks/*markah*]

Table 2 - Levelling survey *Jadual 2 - Ukur aras*								
BS (PB)	IS (PA)	FS (PH)	Rise (Naik)	Fall (Turun)	Initial RL (AL awal)	Adj. (Pel.)	Adj. RL (AL dilaras)	Remarks (Catatan)
2.191					49.873			TBM 4 RL=49.873 m
	2.505							E (embankment/ *benteng*)
	2.325							F
3.019								G (change point/ *titik alih*)
	2.513							H (embankment/ *benteng*)
1.752		2.811						J (change point/ *titik alih*))
		3.824						TBM 6 RL=48.710 m

3. A horizontal control survey (**Figure 1**) was established at the site and the following information was gathered (**Table 3**).

*Ukuran kawalan ufuk (**Rajah 1**) telah dijalankan di tapak dan maklumat berikut telah dikumpul (**Jadual 3**).*
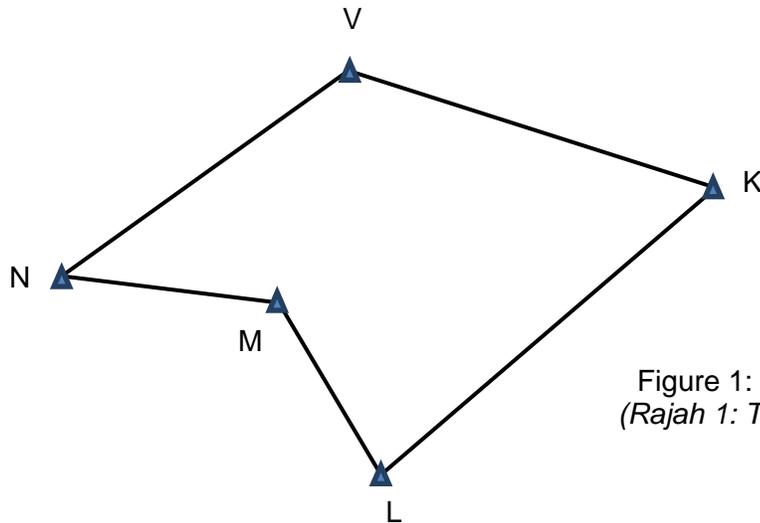
…7/-

Figure 1: Study Area
(Rajah 1: Tapak Kajian)

	Table 3: Horizontal Control Survey			
	Jadual 3: Ukur Kawalan Ufuk			
Stn.	**Observed Internal Angles** ***Sudut Dalam Dicerap***	**Line** ***Garisan***	**Distance (m)** ***Jarak (m)***	**Bearing**
K	79° 13′ 13″	K - L	315.352	283° 41′ 17″
L	66° 10′ 36″	L - M	167.956	
M	244° 33′ 09″	M - N	265.338	
N	44° 57′ 36″	N - V	359.274	
V	105° 05′ 41″	V - K	333.470	
Coordinates of Stn. K: 2000.000mN, 1000.000mE *Koordinat Stn. K: 2000.000mU, 1000.000mT*				

a) Using the Bowditch Method of Adjustment, what are the adjusted coordinates of stations L, M, N and V?

(You may use the Horizontal Control Booking Form B provided)

Dengan menggunakan Kaedah Pelarasan Bowditch, apakah koordinat terlaras bagi stesen-stesen L, M, N dan V?

(Anda boleh guna Borang Pembukuan Kawalan Ufuk B yang disediakan)

[18 marks/*markah*]

b) What is the linear misclosure of the horizontal control survey traverse?

Apakah tikaian lurus ukur travers kawalan ufuk?

[2 marks/*markah*]

4. A 01" theodolite having a multiplying constant of 100 and an additive constant of 0 was set up above station R (RL 46.870 m) at a height of 1.480 m. A levelling staff was held vertically at points P (Pump House Gate) and Q (GPS Station) near the work site and the readings obtained are as follows (**Table 4**):

Sebuah tiodolit 01" yang mempunyai pemalar daraban 100 dan pemalar campuran 0 telah diset di atas stesen R (RL 46.870 m) pada ketinggian 1.480 m. Staf aras telah didirikan menegak di titik P (Pagar Rumah Pam) dan Q (Stesen GPS) berhampiran tapak kerja dan bacaan yang diperolehi adalah seperti berikut (Jadual 4):

Table 4 - Tacheometric Survey *Jadual 4 - Ukur Tekimetri*				
Staff position *Kedudukan staf*	**Staff readings (m)** *Bacaan staf (m)*	**Vertical angle readings** *Bacaan sudut pugak*	**Horizontal angle readings** *Bacaan sudut ufuk*	**Remarks** *Catatan*
P	3.240, 3.047, 2.853	87° 38′ 53″	56° 49′ 31″	Pump House Gate *(Pagar Rumah Pam)*
Q	2.458, 2.230, 2.002	92° 21′ 36″	98° 07′ 18″	GPS Station *(Stesen GPS)*

a) Calculate:

Kira:

      i.   the reduced levels (RLs) of points P and Q;

            aras laras (RL) titik-titk P dan Q;

[6 marks/*markah*]

      ii.   the horizontal distance of PQ; and

            jarak ufuk PQ; dan

[4 marks/*markah*]

      iii.   the gradient of PQ.

            kecerunan PQ.

[4 marks/*markah*]

b) It was found out that the reduced levels (RLs) of points P and Q differ by 0.2 m from the earlier survey carried out by a team of land surveyors. State three (3) possible errors that could have occurred at the site that may have caused the RL values to differ and explain how these errors could be minimized.

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Aras laras (RL) titik-titik P dan Q didapati berbeza sebanyak 0.2.m dengan pengukuran yang telah dijalankan oleh pasukan juruukur tanah sebelum ini. Nyatakan tiga (3) ralat yang mungkin berlaku di tapak yang telah menyebabkan berlakunya perbezaan nilai RL ini dan terangkan bagaimana ralat-ralat ini boleh dikurangkan.

[6 marks/*markah*]

5.   a)   **Figure 2** shows a traverse ABCDE carried out at the site and plotted using easting and northing coordinates.

Rajah 2 menunjukkan sebuah travers ABCDE yang dijalankan di tapak dan diplot menggunakan koordinat timur dan utara.
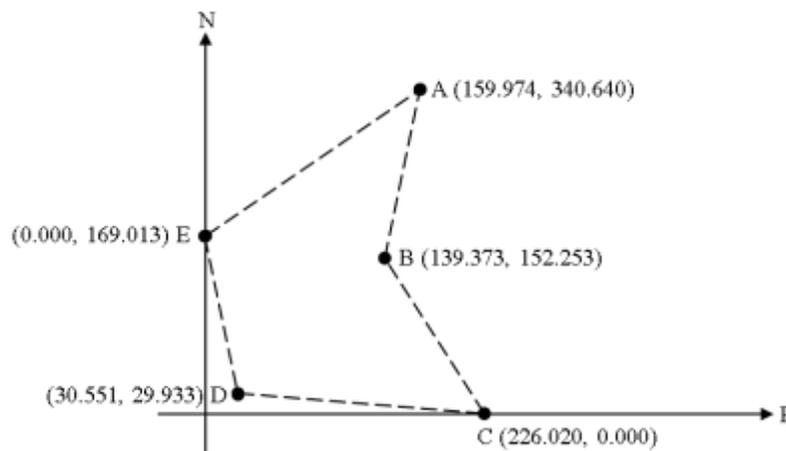

Figure 2: Traverse
Rajah 2: Travers

In general, the area of the traverse is given by the formula; $\frac{1}{2} [\Sigma N_i (E_{i+1} - E_{i-1})]$.

Lazimnya, persamaan untuk keluasan travers ialah; $\frac{1}{2} [\Sigma N_i (E_{i+1} - E_{i-1})]$.

i.   Create a table and fill up the correct values (in meters) of N_i, E_{i+1} and E_{i-1} for stations A, B, C, D and E.

Hasilkan sebuah jadual dan isikan nilai-nilai yang betul (dalam meter) bagi N_i, E_{i+1} dan E_{i-1} untuk stesen-stesen A, B, C, D dan E.

ii.   Use the newly derived values to compute the area of traverse ABCDE and provide your answer in acre unit.

Gunakan nilai-nilai yang telah diperolehi untuk menghitung keluasan travers ABCDE dan beri jawapan anda dalam unit ekar.

[8 marks/*markah*]

b)   **Figure 3** shows a 20 m square grid with reduced levels (RLs) established at the corner points, where RL_A = 2.045 m, RL_B = 1.685 m, RL_C = 3.415 m and RL_D = 1.525 m. In the design work, the cutting level for earthwork removal at that particular grid was proposed at 1.300 m. Apply the necessary formula and show the steps to determine the total volume of earthwork that has to be removed.

Rajah 3 menunjukkan satu grid 20 m persegi di mana aras laras (RL) telah ditentukan pada setiap titik penjuru iaitu RL_A = 2.045 m, RL_B = 1.685 m, RL_C = 3.415 m dan RL_D = 1.525 m. Dalam kerja rekabentuk, aras potongan pada grid untuk kerja pembuangan tanah telah dicadangkan pada nilai 1.300 m. Guna persamaan yang sesuai dan tunjukkan langkah-langkah untuk menentukan jumlah isi padu kerja tanah yang perlu dibuang.

[6 marks/*markah*]
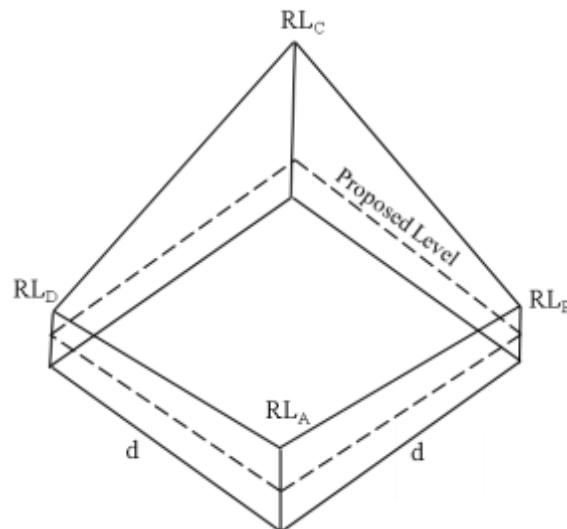
Figure 3 /*Rajah 3*

c)   **Figure 4** shows the Mass Haul Diagram representing earthwork volumes along a linear profile.

Rajah 4 menunjukkan Gambarajah Angkut Jisim yang mewakili isipadu kerja tanah di sepanjang satu profil lurus.
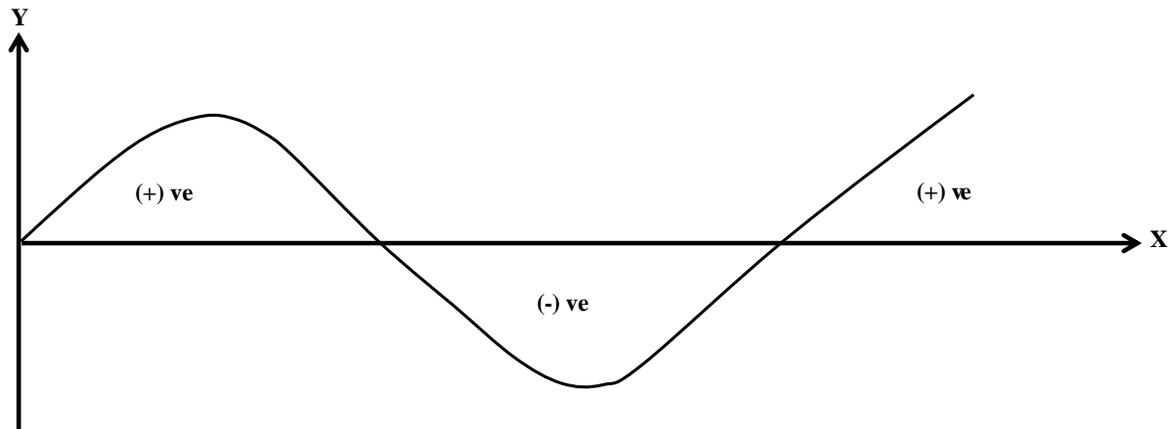
Figure 4: Mass Haul Diagram
Rajah 4: Gambarajah Angkut Jisim

Provide a suitable explanation to the following questions:

Beri penjelasan yang sesuai untuk persoalan-persoalan berikut:

i)   What is the relationship between x-axis and y-axis of a Mass Haul Diagram?

        Apakah hubungan di antara paksi-x dan paksi-y dalam Gambarajah Angkut Jisim?

ii)   What does the upward and downward sloping curve indicate?

        Apakah yang ditunjukkan oleh cerunan lengkung ke atas dan ke bawah?

iii) How would you explain the situation when a positive value (+ve) at the end of the curve is achieved?

Bagaimanakah anda terangkan keadaan apabila nilai positif (+ve) terhasil di penghujung lengkung?

iv) How do you describe the effect of the cumulative volume when a horizontal line intersects two or more points along the curve?

Bagaimanakah anda boleh memperihalkan kesan ke atas isipadu kumulatif apabila garisan ufuk menyilang dua titik atau lebih di sepanjang lengkung?

[6 marks/*markah*]

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