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# UNIVERSITI SAINS MALAYSIA

Second Semester Examination  
Academic Session 2007/2008

April 2008

## **EBS 329/3 - Engineering Geophysics** **[Geofizik Kejuruteraan]**

Duration : 3 hours  
[Masa : 3 jam]

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Please ensure that this examination paper contains EIGHT printed pages before you begin the examination.

*[Sila pastikan bahawa kertas peperiksaan ini mengandungi LAPAN muka surat yang bercetak sebelum anda memulakan peperiksaan ini.]*

This paper contains SEVEN questions. TWO questions in PART A and FIVE questions in PART B.

*[Kertas soalan ini mengandungi TUJUH soalan. DUA soalan di BAHAGIAN A dan LIMA soalan di BAHAGIAN B.]*

**Instructions:** Answer **FIVE** questions. Answer **ALL** questions from PART A and **THREE** questions from PART B. If a candidate answers more than five questions only the first five questions in the answer sheet will be graded.

**[Arahan:** Jawab **LIMA** soalan. Jawab **SEMUA** soalan dari BAHAGIAN A dan **TIGA** soalan dari BAHAGIAN B. Jika calon menjawab lebih daripada lima soalan hanya lima soalan pertama mengikut susunan dalam skrip jawapan akan diberi markah.]

Answer to any question must start on a new page.

*[Mulakan jawapan anda untuk setiap soalan pada muka surat yang baru.]*

You may answer a question either in Bahasa Malaysia or in English.

*[Anda dibenarkan menjawab soalan sama ada dalam Bahasa Malaysia atau Bahasa Inggeris.]*

**PART A****BAHAGIAN A**

Answer **ALL** the following questions in this section.

Jawab **SEMUA** soalan dalam bahagian ini.

1. Answer **all** the questions.

- (a) State and briefly describes the electrical conductivity mechanism in subsurface earth's materials. Which mechanism is more prevalent in resistivity survey and why?
- (b) What are the main differences between seismic reflection and seismic refraction? Discuss factors or materials properties that governed the speed of seismic wave propagated within subsurface.
- (c) Geophysical survey is alternative techniques in subsurface investigation to conventional approaches. Briefly state and discuss the advantages of geophysics?

Jawab **semua** soalan-soalan berikut.

- (a) Nyatakan atau secara ringkas terangkan mengenai mekanisma pengaliran elektrik dalam bahan bumi. Mekanisma yang manakah lebih menonjol atau ketara dalam survei kerintangan dan mengapa?
- (b) Apakah perbezaan utama antara kaedah seismik biasan dan balikan? Huraikan faktor-faktor atau sifat-sifat bahan bumi yang lazim mempengaruhi perambatan gelombang seismik dalam bahan bumi.
- (c) Survei geofizik adalah kaedah alternatif untuk penyiasatan keadaan subpermukaan (bumi) berbanding pendekatan tradisi lain. Secara ringkas nyata dan bincangkan kelebihan survei geofizik?

(20 marks/markah)

2. Answer all the following questions.

- (a) Briefly defines or describes the following:
- (i) Natural and artificial source types of survey methods.
  - (ii) Unit of gravity and "shape of the earth" factor to gravity acceleration.
  - (iii) Self-Potential method.
- (b) Magnetic field at Earth's surface depends on field generated in Earth's core, magnetic mineral content of surface materials, and remnant magnetisation of surface rocks which are the basis for magnetic survey application. State and describe the major application of this technique?

Jawab semua soalan-soalan berikut.

- (a) Secara ringkas takrif atau terangkan mengenai perkara-perkara berikut:
- (i) Sumber (isyarat) jenis-jenis tabii dan buatan dalam kaedah geofizik.
  - (ii) Unit graviti dan "faktor bentuk bumi" terhadap pecutan graviti.
  - (iii) Kaedah "keupayaan diri".
- (b) Kewujudan medan magnet pada permukaan bumi adalah bergantung kepada medan yang terhasil dalam teras bumi, kandungan mineral dan kemagnetan baki batuan pada permukaan bumi. Ia menjadi asas kepada aplikasi survei magnet. Nyata dan bincangkan penggunaan utama kaedah ini.

(20 marks/markah)

**PART B****BAHAGIAN B**

Answer any **THREE (3)** questions in this section.

Jawab mana-mana **TIGA (3)** soalan dalam bahagian ini.

3. Answer all the following questions.

- (a) Each geophysical technique measures a specific parameter, which depends on one, or perhaps more, variation in physical properties of the Earth (subsurface materials). Please state and discuss these relationships (depending parameters/physical properties) with relevant survey methods.
- (b) Gravity surveys measure the acceleration due to gravity,  $g$ . Density,  $\rho$ , is physical parameter to which gravity surveys are sensitive to which determine the "scale" of gravity survey and application objectives. Please state and describe such scale categories and application.
- (c) What is Nearnst (shale) Potential?

Jawab semua soalan-soalan berikut.

- (a) Setiap teknik geofizik mengukur parameter-parameter spesifik yang bergantung kepada satu atau mungkin lebih variasi sifat-sifat fizik bahan bumi (bahan subpermukaan). Sila nyata serta bincangkan perhubungan (parameter pergantungan itu/sifat-sifat fizik) dengan kaedah/survei yang setara dengannya.
- (b) Survei graviti mengukur kadar pecutan graviti,  $g$ . Survei graviti amat peka kepada perubahan parameter fizik, iaitu ketumpatan,  $\rho$  yang menjadi asas teknik graviti dan yang juga menentukan "skala" survei graviti serta objektif penggunaannya.
- (c) Apakah itu keupayaan "Nearnst (Shale)"?

(20 marks/markah)

4. Briefly define or describe the following.

- (a) Mineral Potential
- (b) Induced and Remnant Magnetizations
- (c) Observed Gravity ( $g_{obs}$ )
- (d) Geophone
- (e) Constant Separation Traversing (CST) - resistivity survey

*Secara ringkas takrif atau terangkan mengenai perkara-perkara berikut.*

- (a) *Keupayaan Mineral*
- (b) *Kemagnetan teraruh dan kemagnetan baki*
- (c) *Graviti cerapan, ( $g_{obs}$ )*
- (d) *Geofon*
- (e) *Rintisan Pemisahan Tetap (RPT) - survei kerintangan*

(20 marks/markah)

5. Answer the following questions.

- (a) A seismograph records (time-distance) as acquired from a shallow seismic refraction survey for an engineering site investigation is given in Table A. This survey involved forward and reversed shots. Plot and determine the velocities of bedrock and upper layer (overburden), and overburden thickness
- (b) Briefly shows the usefulness of shallow seismic refraction study in engineering geology.

Jawab semua soalan-soalan berikut.

- (a) Jadual A memaparkan data rakaman seismik (masa-jarak) yang diperolehi daripada penyiasatan geofizik sebuah tapak kejuruteraan. Survei ini melibatkan tembakan mara dan undur. Plot dan tentukan halaju seismik batuan dasar dan beban atas serta ketebalannya.
- (b) Secara ringkas nyatakan kebergunaan kajian seismik biasan cetek dalam bidang geologi kejuruteraan.

**Table A : Seismic records for geophysical site investigation at Engineering Campus, USM**  
*Jadual A : Rekod seismik bagi penyiasatan geofizik tapak Kampus Kejuruteraan USM*

No	Geophone Interval Geofon Sela	First break Titik tiba (ms)	Geophone Interval Geofon Sela	First break Titik tiba (ms)
	5.0 m	Forward Mara	4.5 m	Reversed Undur
1	2000	0	2005.5	56
2	2005	15	2010.0	53
3	2010	29	2014.5	50
4	2015	37	2019.0	48
5	2020	39	2023.5	45
6	2025	42	2028.0	43
7	2030	45	2032.5	40
8	2035	48	2037.0	38
9	2040	50	2041.5	36
10	2045	53	2046.0	25
11	2050	56	2050.5	12
12	2055	59	2055.0	2

(20 marks/markah)

6. Plot cumulative apparent resistivity (C. Apparent Resistivity vs. electrode spacing) and determine depth of layer boundaries from the cross-over distances of the line segments in the graph.

*Plot nilai tokok kerintangan ketara (C. Kerintangan Ketara lawan sela elektrod) dan tentukan kedalaman sempadan-sempadan berdasarkan titik pintasan pada segmen-segmen garisan dalam graf tersebut.*

<b>Apparent Resistivity Formula for Wenner Electrode System: <math>R_a = 2 \pi a dV / I</math></b>				
<i>Formula Kerintangan Ketara Sistem Elektrod Wenner: <math>R_a = 2 \pi a dV / I</math></i>				
<b>Electrodes Half-Distance</b> <i>Elektrod Separuh- jarak</i> <b>a, (feet)</b>	<b>Current Applied</b> <i>Arus dikenakan</i> <b>I, (mA)</b>	<b>Potential Difference</b> <i>Perbezaan keupayaan</i> <b>dV, (mV)</b>	<b>Apparent Resistivity</b> <i>Kerintangan Ketara</i> <b><math>R_a</math> (ohm-feet)</b>	<b>C. Apparent Resistivity</b> <i>C. Kerintangan ketara</i> <b><math>\Sigma R_a</math> (ohm-feet)</b>
2	115	230	.	.
4	123	75	.	.
6	135	35	.	.
8	130	20	.	.
10	187	18	.	.
12	375	25	.	.
14	345	15	.	.
16	320	12	.	.
18	315	10	.	.
20	330	9	.	.

(20 marks/markah)

7. Answer all the following questions.

- (a) Describe or define the following:
- (i) Curie temperature (Magnetic survey).
  - (ii) Free air corrected gravity, gfa (gravity). Write down the formula of such correction.
- (b) Give explanation how the SP surveying is carried out in descriptions of instrument used and surveying methods?

*Jawab soalan-soalan berikut.*

- (a) *Perihal atau takrifkan yang berikut.*
- (i) *Suhu Curie (Survei Magnet).*
  - (ii) *Graviti pembetulan udara bebas, gfa (gravity). Tuliskan rumus pembetulan tersebut.*
- (b) *Jelaskan bagaimana survei SP dilakukan dalam pengertian peralatan yang digunakan serta kaedah survey?*

(20 marks/markah)