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Second Semester Examination
2023/2024 Academic Session

July/August 2024

**EBS329/3 – Engineering Geophysics
(*Geofizik Kejuruteraan*)**

Duration : 3 hours
(Masa : 3 jam)

Please check that this examination paper consists of EIGHTEEN (18) pages of printed material before you begin the examination.

[Sila pastikan bahawa kertas peperiksaan ini mengandungi LAPAN BELAS (18) muka surat yang bercetak sebelum anda memulakan peperiksaan ini].

Instruction: Answer **ALL** questions from PART A and PART B and **TWO (2)** questions from PART C.

[Arahan: Jawab **SEMUA** soalan dari BAHAGIAN A dan BAHAGIAN B dan **DUA (2)** dari BAHAGIAN C].

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

[Sekiranya terdapat sebarang percanggahan pada soalan peperiksaan, versi Bahasa Inggeris hendaklah digunakan].

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SECTION A : Multiple Choice (20 questions)**BAHAGIAN A : Soalan Aneka Pilihan** (20 soalan)

Answer all questions. Please choose the most appropriate answer.

Jawab semua soalan. Sila pilih jawapan yang paling tepat.

- (1). In geophysical survey, a variation in physical properties relative to some background value due to burial target is called as?

Dalam survei geofizik, perubahan sifat-sifat fizik adalah relatif kepada sasaran tertimbus yang dikenali sebagai?

- (a). Geophysical target (*Sasaran Geofizik*)
- (b). Geophysical anomaly (*Anomali Geofizik*)
- (c). Residual effects (*Kesan Baki*)
- (d). Responding values. (*Nilai-nilai tindakbalas*)

- (2). In Ground Penetrating Radar (GPR) system, the speed of radio waves in any medium is dependent upon, EXCEPT?

Dalam sistem Radar Penusukan Bumi (GPR), kelajuan gelombang radio dalam sebarang medium bergantung terhadap, KECUALI?

- (a). Speed of the light (*Kelajuan cahaya*)
- (b). Relative dielectric constant (*Pemalar relatif dielektrik*)
- (c). Relative magnetic permeability (*Ketelapan magnetic relatif*)
- (d). Wavelength (*Panjang gelombang*)

- (3). Induced Potential (IP) is similar to resistivity, but in this method the following is monitored.

Potensi teraruh (IP) adalah serupa dengan keberintangan, tetapi dalam kaedah ini perkara berikut diperhatikan.

- (a). Instantaneous of decay potential - chargeability of a medium (*keupayaan pereputan seponan – kebolehcak suatu medium*)
- (b). The resistivity of mediums (*keberintangan medium*)
- (c). Natural potential differences on the surface of the earth (*perbezaan potensi semulajadi dipermukaan*)
- (d). Potential difference created from chemical reaction (*perbezaan keupayaan dijana oleh tindakbalas kimia*)

- (4). $g_{obs} - g_n + 0.3086 h - 0.0419h$ (mgal) is a corrected data gravity expression up to EXCEPT

$g_{obs} - g_n + 0.3086 h - 0.0419h$ (mgal) adalah pembetulan data graviti hingga ke peringkat, KECUALI

- (a). Terrain (*Terain*)
- (b). Latitude (*Latitud*)
- (c). Bouguer gravity (*Graviti Bouguer*)
- (d). Free air (*Udara bebas*)

- (5). P-wave propagates through a medium depending on the physical properties or characteristics of the rock, EXCEPT

Gelombang P merambat menerusi suatu medium bergantung kepada sifat atau ciri-ciri batuan, KECUALI

- (a). Rigidity and density (*Ketegaran dan ketumpatan*)
- (b). Rock type (*Jenis batuan*)
- (c). Degree of homogeneity of the rock (*Darjah kehomogenan batuan*)
- (d). Saturation (*Ketepuan*)

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- (6). Which statement is UNTRUE about Self-Potential (SP)
Kenyataan mana yang tidak benar mengenai Keupayaan–Diri (SP)
- (a). A passive method (*Suatu kaedah pasif*)
 - (b). Possess positive and negative anomaly (*Mempunyai anomali positif dan negatif*)
 - (c). Depends on geometry factors (*Bergantung kepada faktor geometri*)
 - (d). Measured between two points on the ground surface (*Diukur antara dua titik di permukaan tanah*)
- (7). Typically, two corrections often applied to SP data:
Lazimnya, dua pembetulan dilakukan terhadap data SP
- (a). Heavy rainfall and latitude effects (*Kesan hujan lebat dan latitud*)
 - (b). Regional trend and Bioelectric effects (*Kesan corak serantau dan bioelektrik*)
 - (c). Electrode configurations and orientation effects (*Konfigurasi elektrod dan orientasi*)
 - (d). Mineral and background potential effects (*Kesan potensi mineral dan latar belakang*)
- (8). Typical geophone construction consists, EXCLUDED
Binaan lazim geofon terdiri daripada, KECUALI
- (a). Terminal cables/wires (*Terminal kabel/dawai*)
 - (b). Magnet and Coil (*Magnet dan gelong*)
 - (c). Accelerometer (*Pemecut*)
 - (d). Top and bottom spring (*Spring atas dan bawah*)

- (9). In resistivity survey, the following statement refer to which electrode configuration.

Dalam survei keberintangan, kenyataan berikut merujuk kepada konfigurasi elektrod

“All electrodes have to be moved for each measurement”

Kesemua elektrod perlu digerak untuk setiap pengukuran

- (a). Wenner (*Wenner*)
- (b). Schlumberger (*Schlumberger*)
- (c). Square (*Empat segi*)
- (d). Dipole-dipole (*Kutub-kutub*)

- (10). There are two main resistivity survey methods, what Constant Separation Traversing (CST) method refers to

Terdapat dua kaedah survei keberintangan elektrik, Kaedah Pemisahan Tetap (CST) adalah merujuk kepada

- (a). Lateral variation in resistivity (*Variasi keberintangan mendatar*)
- (b). Depth variation in resistivity (*Variasi kedalaman keberintangan*)
- (c). Measurement of repeat array (*Susunan pengukuran berulang*)
- (d). Electrode configuration (*Konfigurasi elektrod*)

- (11). Gravity methods are sensitive to density contrasts within the sub-surface and so are ideal for exploring

Kaedah graviti adalah sensitif terhadap perbezaan ketumpatan bahan bawah permukaan bumi dan ideal untuk kegunaan penerokaan

- (a). Forensic geophysics (*Geofizik forensik*)
- (b). Hydrological investigation (*Penyiasatan hidrogeologi*)
- (c). Major sedimentary basin study (*Kajian lembangan sedimen utama*)
- (d). Engineering site investigations (*Penyiasatan tapak kejuruteraan*)

(12). Which geophysical method is considered as “primary method for “leachate and contamination plump” mapping?

Kaedah geofizik yang manakah dikira sebagai paling utama untuk pemetaan “punca larutlesap dan pencemaran”

- (a). Resistivity (*Keberintangan elektrik*)
- (b). Electromagnetics (*Elektromagnetik*)
- (c). Seismic reflection (*Seismik pantulan*)
- (d). Self-Potential (*Keupayaan diri*)

(13). Which statement is untrue about velocity-dielectric-resistivity-permittivity relationship in some geophysical survey techniques

Kenyataan manakah tidak benar mengenai perhubungan sifat-sifat halaju-dielektrik-keberintangan-permitiviti

- (a). Resistivity decreases exponentially with porosity (*Resistiviti berkurang secara eksponensial dengan keporosan*)
- (b). Permittivity generally increases with porosity (*Permitiviti amnya meningkat dengan keporosan*)
- (c). Resistivity exponentially increases with porosity (*Keberintangan meningkat secara eksponen dengan keporosan*)
- (d). Seismic velocity decrease with porosity (*Halaju seismic berkurang dengan keporosan*)

(14). Seismic refraction is a commonly used geophysical technique to determine the following except

Kaedah seismic biasanya lazim diguna pakai dalam penentuan kecuali

- (a). Depth-to-bedrock and competence of bedrock, (*Kedalaman dasar batuan dan ketegaran batuan*)
- (b). Depth to the water table (*Kedalaman ke paras air tanah*)
- (c). Bedrock lithologic contact and rippability (*litologi batuan dasar dan keboleh kikis*)
- (d). Elastic Modulus of the rock (*Modulus keelastikan batuan*)

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(15). Which statement is UNTRUE about Ground Penetrating Radar (GPR) survey/techniques

Penyataan manakah TIDAK BENAR mengenai Radar Penusukan Bumi (GPR)

- (a). It can detect objects, changes in material, and voids and cracks (*Boleh mengesan objek, perubahan bahan, serta rongga dan retakan*).
- (b). GPR uses high-frequency (usually polarized) radio waves (UHF/VHF) (*GPR menggunakan gelombang radio (lazimnya terkutub) berfrekuensi tinggi (UHF/VHF)*).
- (c). Apply an EM pulse is sent through an antenna, penetrating into the surveyed material (*Menggunakan denyutan EM yang dipancar menerusi antena, menerobosi kedalam bahan yang dikaji*).
- (d). Acoustic energy is used instead of Electromagnetic energy (*Tenaga akustik digunakan berbanding tenaga elektromagnetik*).

(16). Which statement is TRUE about a Spontaneous Potential (SP) in geoelectrical survey methods

Penyataan manakah BENAR mengenai Keupayaan Sepontan (SP) dalam kaedah-kaedah survei geoelektrik

- (a). Resistance to movement of charge (*Rintangan terhadap pergerakan caj*).
- (b). Measure apparent resistance of ground (*Mengukur nilai keberintangan nyata bumi*).
- (c). Measures naturally occurring DC currents (*Mengukur arus DC semulajadi*).
- (d). Measure apparent resistance of ground (*Mengukur nilai keberintangan nyata bumi*).

- (17). Geophysical method that uses the natural fields of the Earth, EXCEPT
Kaedah Geofizik yang menggunakan (isyarat) medan semulajadi bumi, KECUALI
- (a). Gravity and Magnetic survey (*Survei graviti dan Magnetik*)
 - (b). Magnetic and seismic survey (*Survei Magnetik dan Seismik*)
 - (c). Ground Penetrating Radar (GPR) (*Radar Penusukan Bumi*)
 - (d). Induced Polarization (IP) and Gravity Survey (*Aruhan Pengutuban (IP) dan Survei Graviti*)
- (18). Which rock type have significant mafic mineral component and highest magnetic susceptibilities
Batuan manakah yang mempunyai komponen mineral mafik/legap dan ketelapan kemagnetan yang tinggi
- (a). Mafic rocks (*Batuan mafik*)
 - (b). Sedimentary (*Sedimen*)
 - (c). Metamorphic (*Metamorf/Jelmaan*)
 - (d). Felsic rocks (*Batuan felsik*)
- (19). The following often exercise in gravity data reduction process EXCEPT
Pembetulan berikut sering dilakukan dalam proses pembetulan data survei graviti, KECUALI
- (a). Instrument drift (*Rayapan alat*)
 - (b). Free air and Bouguer correction (*Pembetulan udara bebas dan Bouguer*)
 - (c). Latitude and Terrain correction (*Pembetulan Latitud dan Terrain*)
 - (d). Bouguer Anomaly correction (*Pembetulan Anomali Bouguer*)

(20). The following are wireline logs which widely used to record and to locate the depth of stratigraphic formations in oil field exploration, EXCEPT
Kaedah pengelogan wayar berikut digunakan secara meluas sebagai rekod untuk menjejak kedalaman formasi stratigrafi penting dalam eksplorasi minyak, KECUALI

- (a). Gamma ray and sonic logging (*Pengelogan sinar gamma dan sonik*)
- (b). Resistivity and SP logging (*Pengelongan keberintangan elektrik dan SP*)
- (c). Electrical logging (*Pengelongan elektrik*)
- (d). Neutron logging (*Pengelongan neutron*)

(20 marks/markah)

PART B / BAHAGIAN B (COMPULSORY)

(1). Briefly discuss or elaborate the followings.

Secara ringkas takrif dan terangkan perkara-perkara berikut.

- (a). In general, geophysical surveys fall into two classes, survey types and can be carried out in all environment. Elaborate.

Secara umum, survei geofizik terbahagi kepada dua kelas, jenis survei dan boleh dilakukan dalam semua situasi persekitaran. Ulasakan.

(8 marks/markah)

- (b). (i). Briefly discuss the factors that constraint seismic velocities (P and S wave) through any given medium/geological materials such an igneous and sedimentary bedrocks.

Secara ringkas bincang faktor-faktor geologi yang boleh mengekang atau mengawal halaju gelombang seismik (Gelombang P dan S) dalam lapisan batuan seperti igneus dan sedimen.

(6 marks/markah)

- (ii). P wave is a function of age and depth of rock. Determine the seismic velocity of underlying rock formation which thickness is 300 meter and geological age of 500 million years.

Gelombang P adalah satu fungsi usia dan kedalaman timbusan batuan. Tentukan halaju seismik formasi batuan dengan ketebalan 300 meter dengan skala usia geologi 500 juta tahun.

(6 marks/markah)

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- (2). (a). Briefly elaborate the following:

Terangkan secara ringkas perkara-perkara berikut:

- (i). Magnetic susceptibility, k (in magnetic survey)
Kerentanan magnet, k (in magnetic survey)
- (ii). Remnant Magnetization
Kemagnetan sisa
- (iii). RADAR
Radar
- (iv). Dielectric constants
Pemalar dieletrik
- (v). Diamagnetism
Diamagnetisme
- (vi). Thermal Remnant Magnetisation
Kemagnetan Sisa Terma

(6 marks/markah)

- (b). Other than the ground based magnetic survey, state and discuss another two modes of acquiring magnetic survey observations. Write the advantage for at least one of those two modes of survey.

Selain daripada Tinjauan Magnetik Bumi, nyatakan dan perihalkan lagi dua bentuk perolehan pemerhatian tinjauan magnetik

(6 marks/markah)

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- (c). Describe the field method of ground magnetic survey for mineral exploration

Perihalkan kaedah lapangan tinjauan magnetik bumi untuk carigali mineral.

(8 marks/markah)

PART C / BAHAGIAN C

- (3). (a). Using appropriate illustration, explain the following parameters /terminologies that are essential in seismic reflection data acquisitions which find wide application in oil exploration industry.

Dengan bantuan ilustrasi bersesuaian, terangkan secara ringkas parameter/terminalogi berikut yang amat penting diperolehan dan pemprosesan data seismik pantulan yang meluas diguna pakai dalam industri carigali minyak.

- (i). Common Depth Points (CDP) and Common Middle Point (CMP)
Titik kedalaman sepunya (CDP) dan Titik Tengan Sepunya (CMP)
- (ii). A Seismic reflector
Pemantul seismic
- (iii). Streaming
Streaming

(10 marks/markah)

- (b). What are the electrode configuration/array and geometric factors? List down and illustrates the most common of these electrode arrays in resistivity survey.

Apakah itu konfigurasi/susunan atur elektrod dan faktor geometri? Senaraikan dan ilustrasi susunatur utama elektrod itu dalam survei resistivity/keberintangan

Discuss two main survey/investigation methods practices in earth resistivity techniques.

Bincangkan dua kaedah/penyiasatan utama yang lazim diamalkan dalam survei keberintangan elektrik ini.

(10 marks/markah)

- (4). (a). What is Free Air Corrected Gravity (**gfa**)? The form of the Free-Air gravity anomaly, **gfa**, is given by

Apakah itu pembetulan graviti udara bebas (gfa)? Bentuk anomaly gfa adalah diberikan oleh

$$\mathbf{gfa} = \mathbf{gobs} - \mathbf{gn} + 0.3086 \mathbf{h} \text{ (mgal)}$$

Determine the *Corrected Gravity (gfa)* at a gravity station located near 36.37840544N with elevation of 448.96m from goeid? The gravitimeter reading after tidal and drift correction is 979149.9 mgal

Tentukan nilai Pembetulan graviti (gfa) pada suatu stesen graviti yang terletak berhampiran 36.37840544N dengan elevasi 448.96m daripada goeid. Bacaan meter graviti selepas pembetulan pasang surut dan rayapan alat adalah 979149.9 mgal

(5 marks/markah)

- (b). Elaborate the use or function of wireline log survey in geological formation evaluation use in Petroleum exploration?

Describe the function of three (3) common type of logs often used.

Secara ringkas terangkan peranan pengelangan wayer atau teknik pengelogan dalam penilaian formasi geologi dalam aktiviti pencarigalian petroleum. Sebut dan terangkan fungsi tiga (3) jenis log yang lazim diguna?

(5 marks/markah)

- (c). The following Table 1 gives the arrival time-distance data collected from a single forward short profile of a seismic refraction survey over a flat landscape.

Jadual 1 berikut memberikan data ketibaan masa-jarak yang diperolehi daripada survei seismik pembiasaan di kawasan lanskap yang mendatar.

Table 1: Seismic Refraction survey data sheet
 Jadual 1: Lembaran data survey Seismik biasan

| Geophone no (No Geofon) | Location, X Lokasi X (meter) | Arrival times, t (Masa tiba, t), (S) |
|--|---|---|
| Start 0 | 0 | 0.0000 |
| 1 | 3 | 0.0020 |
| 2 | 6 | 0.0045 |
| 3 | 9 | 0.0068 |
| 4 | 12 | 0.0090 |
| 5 | 15 | 0.0110 |
| 6 | 18 | 0.0120 |
| 7 | 21 | 0.0122 |
| 8 | 24 | 0.0126 |
| 9 | 27 | 0.0130 |
| 10 | 30 | 0.0140 |
| 11 | 34 | 0.0145 |
| 12 | 36 | 0.0155 |
| 13 | 39.2 | 0.0160 |
| 14 | 42 | 0.0165 |
| 15 | 45 | 0.0170 |
| End 16 | 48 | 0.0180 |

- (i). Plot travel-time graph or T-X plot.
Plotkan graf jarak perjalanan-masa atau Plot T-X.
- (ii). Determines velocities of layers.
Tentukan halaju-halaju lapisan-lapisan itu.
- (iii). Thickness of overburden of upper layer, t .
Ketebalan lapisan beban atas.

(10 marks/markah)

- (5). Answer all questions.

Jawab semua soalan berikut

- (a). Briefly discuss the principles of Ground Penetrating Radar (GPR).
Explain your answer in term of how this method works.

Secara ringkas bincangkan prinsip Radar Tusukan Bumi (GPR). Jelaskan jawapan anda berdasarkan bagaimana kaedah cara kerjanya.

(8 marks/markah)

- (b). Describe the advantages of GPR application.
Terangkan kelebihan penggunaan GPR.

(4 marks/markah)

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- (c). Rock and the earth's magnetic field; Elaborate the remnant Magnetization, and Detrital Remnant Magnetization (DRM) and the effect to interpretation of magnetic data.

Batuan dan medan magnet bumi; Jelaskan Pemagnetan Baki dan Pemagnetan Baki Detrital (DRM) dan kesan kepada interpretasi magnetic data.

(4 marks/markah)

- (d). Explain the main application of Magnetic Survey

Terangkan penggunaan utama Tinjauan magnetik

(4 marks/markah)

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