

SULIT



First Semester Examination
Academic Session 2018/2019

December 2018/January 2019

MSG456 - Mathematical Programming
(*Pengaturcaraan Matematik*)

Duration : 3 hours
(*Masa : 3 jam*)

Please check that this examination paper consists of FIVE (5) pages of printed material before you begin the examination.

[Sila pastikan bahawa kertas peperiksaan ini mengandungi LIMA (5) muka surat yang bercetak sebelum anda memulakan peperiksaan ini.]

Instructions: Answer **FOUR** (4) questions.

[Arahan: Jawab **EMPAT** (4) 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/-

SULIT

Question 1

- (a) Bikes-R-Us Sdn. Bhd. has just developed a new mountain bike. Market research indicates that demand will be linearly related to price as per the following table:

Price (RM)	Estimated Demand
100	300,000
150	250,000
200	200,000
250	150,000

It costs RM60 to produce each bike. Help Bikes-R-Us by formulating a Nonlinear Program that determines the production quantity which will maximise total profit.

[10 marks]

- (b) Consider the function

$$f(u, v, w) = 2u^2 + 2uw + 2avw + 2w^2.$$

- (i) Obtain the Hessian and all principal minors for $f(u, v, w)$.
- (ii) Determine the value or values of a such that $f(u, v, w)$ is
- convex.
 - concave.
 - neither convex nor concave.

[15 marks]

Soalan 1

- (a) *Bikes-R-Us Sdn. Bhd. baru sahaja membangunkan suatu basikal yang baru. Kaji selidik pasaran menunjukkan bahawa permintaan berkait secara linear dengan harga seperti dalam jadual berikut:*

Harga (RM)	Anggaran Permintaan
100	300,000
150	250,000
200	200,000
250	150,000

Kos sebanyak RM60 diperlukan untuk menghasilkan setiap basikal. Bantu Bikes-R-Us dengan merumuskan suatu masalah Pengaturcaraan Tak Linear yang menentukan kuantiti pengeluaran bagi memaksimumkan keuntungan keseluruhan.

[10 markah]

- 3 -

(b) *Pertimbangkan fungsi berikut*

$$f(u, v, w) = 2u^2 + 2uw + 2avw + 2w^2.$$

(i) *Dapatkan Hessian dan kesemua Minor Prinsipal bagi $f(u, v, w)$.*(ii) *Tentukan nilai atau nilai-nilai bagi a supaya $f(u, v, w)$ adalah fungsi*

- *cembung.*
- *cekung.*
- *bukan cembung atau cekung.*

[15 markah]

Question 2

Solve the following Nonlinear Program using the Steepest Ascent Method:

$$\begin{aligned} &\text{maximise } z = 8x - x^2 - 12y - 2y^2 + 2xy \\ &\text{subject to} \\ & \quad x, y \in \mathbb{R}. \end{aligned}$$

Use initial point $(\bar{x}, \bar{y}) = (0, 0)$ and $\varepsilon = 0.1$.

[20 marks]

Soalan 2

Selesaikan masalah Pengaturcaraan Tak Linear berikut menggunakan Kaedah Pendakian Tercuram:

$$\begin{aligned} &\text{maksimumkan } z = 8x - x^2 - 12y - 2y^2 + 2xy \\ &\text{terhadap} \\ & \quad x, y \in \mathbb{R}. \end{aligned}$$

Gunakan titik pemula $(\bar{x}, \bar{y}) = (0, 0)$ dan $\varepsilon = 0.1$.

[20 marks]

...4/-

Question 3

- (a) Formulate an approximating problem for the following Nonlinear Program:

$$\begin{aligned} &\text{maximise } z = x_1^2 - 5x_1 + x_2^2 + 5x_2 - x_3^2 \\ &\text{subject to} \end{aligned}$$

$$\begin{aligned} x_1 + x_2 + x_3 &\leq 4 \\ x_1^2 - x_2 &\leq 3 \\ x_1, x_2, x_3 &\geq 0. \end{aligned}$$

[15 marks]

- (b) Solve the following NLP using the Kuhn-Tucker Conditions:

$$\begin{aligned} &\text{maximise } z = x_1 + 2x_2 - x_2^3 \\ &\text{subject to} \end{aligned}$$

$$\begin{aligned} x_1 + x_2 &\leq 1 \\ x_1, x_2 &\geq 0. \end{aligned}$$

[15 marks]

Soalan 3

- (a) Rumuskan suatu masalah penganggaran bagi masalah Pengaturcaraan Tak Linear berikut:

$$\begin{aligned} &\text{maksimumkan } z = x_1^2 - 5x_1 + x_2^2 + 5x_2 - x_3^2 \\ &\text{terhadap} \end{aligned}$$

$$\begin{aligned} x_1 + x_2 + x_3 &\leq 4 \\ x_1^2 - x_2 &\leq 3 \\ x_1, x_2, x_3 &\geq 0. \end{aligned}$$

[15 markah]

- (b) Selesaikan masalah Pengaturcaraan Tak Linear berikut menggunakan Syarat-syarat Kuhn-Tucker:

$$\begin{aligned} &\text{maksimumkan } z = x_1 + 2x_2 - x_2^3 \\ &\text{terhadap} \end{aligned}$$

$$\begin{aligned} x_1 + x_2 &\leq 1 \\ x_1, x_2 &\geq 0. \end{aligned}$$

[15 marks]

...5/-

Question 4

A machine maintenance worker has four heavy testing devices that weight 20kg, 30kg, 40kg and 20kg respectively. He estimates that the usefulness of each device at his next assignment are 25, 30, 55 and 15 respectively. As he can only carry a maximum of 60kg, he wants to maximise the total usefulness of the devices he carries. Solve the maintenance worker's problem using Dynamic Programming techniques.

[25 marks]

Soalan 4

Seorang pekerja penyelenggaraan mesin mempunyai empat alat penguji berat yang masing-masing beratnya 20kg, 30kg, 40kg dan 20kg. Pekerja tersebut menganggarkan bahawa manfaat setiap alat pada tugasannya adalah 25, 30, 55 dan 15 masing-masing. Oleh kerana dia hanya boleh membawa maksimum 60kg, dia mahu memaksimumkan manfaat alat-alat yang dibawa. Selesaikan masalah pekerja penyelenggaraan mesin menggunakan teknik-teknik Pengaturcaraan Dinamik.

[25 markah]