Second Semester Examination
Academic Session 2018/2019

June 2019

EMT 212 – Computational Engineering
[Kejuruteraan Pengkomputeran]

Duration :3 hours
[Masa : 3 jam]

Please check that this paper contains **FIVE** **[5]** printed pages including appendix before you begin the examination.

*[Sila pastikan bahawa kertas soalan ini mengandungi **LIMA** **[5]** mukasurat bercetak beserta lampiran 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.]

1. **Figure 1 shows triangle C. Verify Green's Theorem for $\int(\boldsymbol{xy^2 + x^2})\boldsymbol{dx} + (\boldsymbol{4x - 1})\boldsymbol{dy}$ applied to solve triangle C below:**

Rajah 1 menunjukkan segitiga C. Sahkan Teorem Hijau untuk $\int(xy^2 + x^2)dx + (4x - 1)dy$ digunakan untuk menyelesaikan segi tiga C di bawah:

(i) **Using the line integral.**
Menggunakan garis integral.

(40 marks/*markah***)**

(ii) **Using Green's Theorem to compute the line integral.**
Menggunakan Teorem Hijau untuk mengira garis integral.

(60 marks/*markah***)**

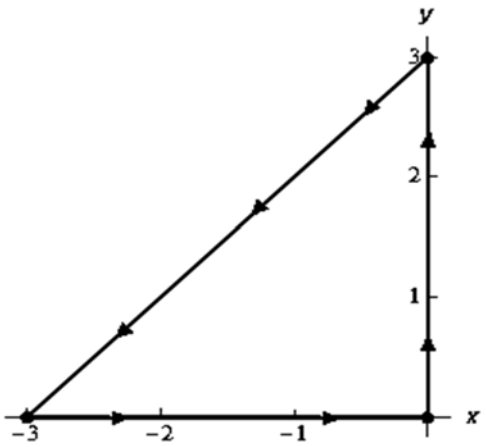


Figure 1
Rajah 1

2. **A local company restores cars and trucks for resale. Each vehicle must be processed in the refinishing/paint shop and the machine/body shop. Each car (on average) contributes RM 3000 to profit, and each truck contributes (on average) RM 2000 to profit. The refinishing/paint shop has 2400 work-hours available and the machine/body shop has 2500 work-hours available. A car requires 50 work-hours in the machine/body shop and 40 work-hours in the refinishing/paint shop, whereas a truck requires 50 work-hours in the machine/body shop and 60 work-hours in the refinishing/paint shop.**

Syarikat tempatan membetulkan semula kereta dan trak untuk dijual kembali. Setiap kenderaan mesti diproses di kedai pemulihan/cat dan kedai mesin/badan. Setiap kereta (secara purata) menyumbang RM 3000 untuk keuntungan, dan setiap trak menyumbangkan (secara purata) RM 2000 untuk keuntungan. Kedai pemulihan/cat memerlukan 2400 jam kerja dan mesin/badan memerlukan 2500 jam kerja. Sebuah kereta memerlukan 50 jam kerja di kedai mesin/badan dan 40 jam kerja di kedai pemulihan/cat, manakala trak memerlukan 50 jam kerja di kedai mesin/badan dan 60 jam kerja di kedai pemulihan/cat.

(i) Sketch a graphical linear programming to determine a daily production schedule that will maximize the company's profits.

Lakarkan pengaturcaraan linear grafik untuk menentukan jadual pengeluaran harian yang akan memaksimumkan keuntungan syarikat.

(50 marks/*markah***)**

(ii) Use Simplex Method to compare your answer with graphical method that you have constructed.

Gunakan Kaedah Simpleks untuk membandingkan jawapan anda dengan kaedah grafik yang telah dibina.

(50 marks/*markah***)**

3. [a] Describe differential equation based on type, order and linearity.

Terangkan persamaan pembezaan berdasarkan jenis, peringkat terbitan dan kelinearan.

(30 marks/*markah***)**

[b] Find the general solution of the following differential equation.

Cari penyelesaian am persamaan pembezaan berikut.

$$\frac{dy}{dt} = (1 + t^2)(1 + y^2)$$

Then, find the solution for Initial Value Problem. The initial condition is given as $y(0) = 1$.

Kemudian, cari penyelesaian untuk masalah nilai awal. Keadaan nilai awal diberikan sebagai $y(0) = 1$.

(70 marks/*markah***)**

4. Consider the forward difference for second-order derivative.

Pertimbangkan pembezaan hadapan untuk terbitan peringkat kedua.

$$u''(x_i) = \frac{u_{i+2} - 2u_{i+1} + u_i}{(\Delta x)^2} + O(\Delta x)$$

Use the Taylor series to prove that the forward difference scheme above is of $O(\Delta x)$. Use $u(x_{i+2}) - 2u(x_{i+1})$ to find the forward difference scheme mentioned above.

Gunakan siri Taylor untuk membuktikan bahawa skema perbezaan hadapan adalah $O(\Delta x)$. Gunakan $u(x_{i+2}) - 2u(x_{i+1})$ untuk mencari skema perbezaan hadapan yang diberi di atas.

(100 marks/*markah***)**

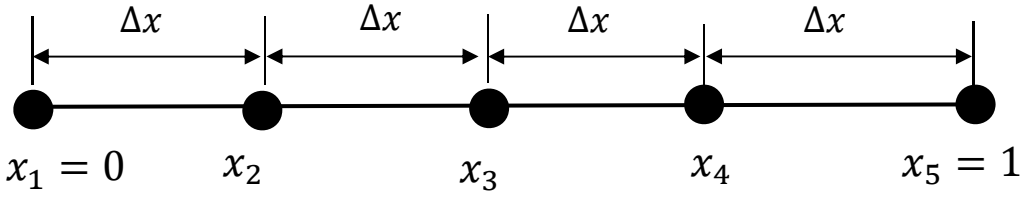
5. Use the central difference approximation to solve the following boundary value problem.

Gunakan anggaran pembezaan pusat untuk menyelesaikan masalah nilai sempadan berikut.

$$\frac{d^2u}{dx^2} = 1, \quad 0 \le x \le 1$$

With boundary conditions $u(0) = 0, u(1) = 0$. Divide the solution domain into four sub intervals with $\Delta x = 0.25$. Find the values of u at $x_2 = 0.25$, $x_3 = 0.5$ and $x_4 = 0.75$.

Dengan syarat sempadan $u(0) = 0, u(1) = 0$. Bahagikan domain penyelesaian kepada empat selang dengan $\Delta x = 0.25$.Cari nilai u pada $x_2 = 0.25$, $x_3 = 0.5$ dan $x_4 = 0.75$.



(100 marks/*markah***)**

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Appendix 1
Lampiran 1

Formulation

Green's Theorem

$$\oint_C M(x,y)dx + N(x,y)dy = \iint_R \left(\frac{\partial N}{\partial x} - \frac{\partial M}{\partial y}\right) dxdy$$

Taylor series expansion,

$$u(x) = \sum_{n=0}^{N} \frac{u^{(n)}(x_0)(x-x_0)^n}{n!} + TE$$

Integral formulations

$$\int \frac{1}{y} dy = \ln y$$

$$\int \frac{1}{ay+b} dy = \frac{1}{a}\ln(ay+b)$$

$$\int \frac{1}{1+y^2} dy = \tan^{-1} y$$

$$\int \frac{1}{a^2+y^2} dy = \frac{1}{a}\tan^{-1}(y/a)$$

Central difference approximation for the second-order derivative

$$u''(x_i) = \frac{u(x_{i+1}) - 2u(x_i) + u(x_{i-1})}{(\Delta x)^2}$$