First Semester Examination
Academic Session 2018/2019

December 2018/January 2019

EAA211 – Engineering Mathematics for Civil Engineers (*Matematik Kejuruteraan Untuk Jurutera Awam*)

Duration : 2 hours
(Masa : 2 jam)

Please check that this examination paper consists of **NINE (9)** pages of printed material before you begin the examination.

*[Sila pastikan bahawa kertas peperiksaan ini mengandungi **SEMBILAN (9)** muka surat yang bercetak sebelum anda memulakan peperiksaan ini.]*

***Instructions** : This paper contains **FIVE (5)** questions. Answer **FOUR (4)** questions.*

***[Arahan** : Kertas ini mengandungi **LIMA (5)** soalan. 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 digunapakai.]

(1). (a). In error problem for the tension of construction materials, certain corresponding values of *x* and *ln x* are (300, 2.4771), (304, 2.4829), (305, 2.4843) and (307, 2.4871). Find *ln* (301) by using the Lagrange multiplier method.

Bagi ralat ketegangan bahan binaan, nilai yang sepadan dengan x dan ln x ialah (300, 2.4771), (304, 2.4829), (305, 2.4843) dan (307, 2.4871). Dapatkan nilai ln (301) menggunakan kaedah pendarab Lagrange.

[10 marks/*markah*]

(b). The data from construction site are randomly collected during site survey for construction process improvement. Use Lagrange interpolation polynomial method of the first and second order to evaluate *ln 2* on the basis of data given below:

Data daripada tapak pembinaan diambil secara rawak ketika kajian tapak bagi tujuan penambahbaikan proses pembinaan. Gunakan kaedah polinamial interpolasi Lagrange *kepada tahap pertama dan kedua untuk menilai ln 2 berdasarkan kepada data yang diberikan di bawah*.

$x_0 = 1, \ f(x_o) = 0$
$x_1 = 4, \ f(x_1) = 1.386294$
$x_2 = 6, \ f(x_2) = 1.791760$

[15 marks/*markah*]

(2). (a). In construction project, the sensibility of the construction materials is a priority. The expansion of the construction materials in construction project is given by $x^3 - 9x + 1 = 0$. Find the root between $x = 2$ and $x = 4$, by using the Bisection Method.

Di dalam projek pembinaan, kepekaan bahan binaaan adalah suatu keutamaan. Persamaan $x^3 - 9x + 1 = 0$ *adalah mewakili pembesaran bahan binaan dalam projek pembinaan. Cari nilai punca sebenar antara* $x = 2$ dan $x = 4$, *menggunakan Kaedah Bisection.*

[10 marks/*markah*]

(b). In construction process, the material usage is given as below. Using Newton's divided difference formula, find the quadratic equation for the given data.Subsequently, find y(2).

Di dalam proses pembinaan, bahan mentah yang digunakan diberikan seperti di bawah. Dengan menggunakan "Newton's divided difference formula", dapatkan persamaan kuadratik bagi data yang diberikan. Seterusnya, dapatkan y(2).

Material/ *Bahan*	Water/ *Air* (m^3)	Cement/ *Simen* (m^3)	Glue/ *Gam* (m^3)
x	0	1	4
y	2	1	4

[15 marks/*markah*]

(3). (a). An engineer needs 4800 m^3, 5810 m^3, and 5690 m^3 of sand, fine gravel, and coarse gravel, respectively, at a construction site. There are three sources where these materials can be obtained and the composition of the material from these sources is given in **Table 1**.

Determine how many cubic meters must be hauled from each source in order to meet the engineer's needs. Solve the above problem using Gauss method.

*Seorang jurutera memerlukan masing-masingnya 4800 m^3, 5810 m^3, dan 5690 m^3 pasir, kelikir halus, dan kerikil kasar, di tapak pembinaan. Terdapat tiga sumber di mana bahan-bahan ini boleh diperolehi dan komposisi bahan dari sumber-sumber ini diberikan dalam **Jadual 1**.*

Tentukan berapa meter padu mesti diangkut dari setiap sumber untuk memenuhi keperluan jurutera. Selesaikan masalah di atas menggunakan kaedah Gauss.

Table 1/ *Jadual 1*

Sources	Sand (%)	Fine gravel (%)	Coarse gravel (%)
1	52	30	18
2	20	50	30
3	25	20	55

[9 marks/*markah*]

(b). Distinguish between direct and iterative (indirect) methods of solving simultaneous equations.

Bezakan kaedah langsung dan kaedah berulang (tidak langsung) untuk menyelesaikan persamaan serentak.

[6 marks/*markah*]

...5/-

(c). A polluted lake has an initial concentration of bacteria of 10^7 parts/m^3, while the acceptable level is only 5 x 10^6 parts/m^3. The concentration of the bacteria will reduce as fresh water enters the lake. The differential equation that governs the concentration, *C* of the pollutant as a function of time (in weeks) is given by:

Sebuah tasik tercemar mempunyai kepekatan asal bakteria sebanyak 10^7 bahagian/m^3, manakala tahap yang boleh diterima hanya 5 x 10^6 bahagian/m^3. Kepekatan bakteria akan berkurangan apabila air tawar memasuki tasik. Persamaan pembezaan yang mengawal kepekatan C bahan pencemar sebagai fungsi masa (dalam minggu) diberikan oleh;

$$\frac{\mathrm{d}C}{\mathrm{dt}} + 0.06C = 0; \quad C(0) = 10^7$$

Using Euler's method and a step size of 3.5 weeks, estimate the concentration of the pollutant after 7 weeks.

Dengan menggunakan kaedah Euler dan saiz langkah 3.5 minggu, anggarkan kepekatan bahan pencemar selepas 7 minggu.

[10 marks/*markah*]

4. (a). The simply supported beam is subjected to uniformly distributed load, *w* as shown in **Figure 1**. The deflection of the beam is given by;

*Sebuah rasuk tersokong mudah menanggung beban teragih seragam, w seperti yang ditunjukkan dalam **Rajah 1**. Pesongan bagi rasuk tersebut diberi sebagai:*

$$y = -\frac{w}{24EI}((x_o)^4 - 2L(x_o)^3 + L^3x_o)$$

From the elementary theory of bending of beams, bending moment at a point in a beam is governed by;

Dari teori asas lenturan rasuk, momen lentur di satu titik dalam rasuk ditadbir oleh;

$$EI\frac{d^2y}{dx^2} = -M$$

Where, *E* = modulus of elasticity of the material; *I* = second moment of area and *M* = bending moment at any point.

di mana, E = modulus keanjalan bahan; I = momen inersia dan M = momen lentur pada mana-mana titik.

(i). Develop the 2nd order approximation of Taylor series expansion of bending moment (*M*) using the following values:

Bangunkan penganggaran peringkat ke-2 pengembangan siri Taylor bagi momen lentur (M) menggunakan nilai berikut:

$w = 12.5kN/m \qquad L = 10.0\,m \qquad E = 200GPa \qquad I = 60(10^6)mm^4$

[9 marks/*markah*]

(ii). Estimate the maximum bending moment of the beam using Taylor series expansion developed in part (i).

Anggarkan momen lenturan maksimum rasuk menggunakan pengembangan siri Taylor yang dibangunkan di bahagian (i).

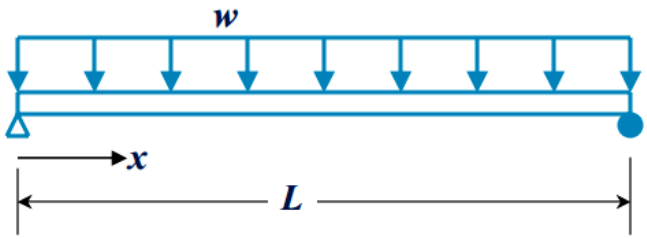

Figure 1/*Rajah 1*

[3 marks/*markah*]

(b). The daily consumption of water (in millions of liters) is a random variable with probability density function

Penggunaan air setiap hari (dalam jutaan liter) adalah pembolehubah rawak dengan fungsi ketumpatan kebarangkalian

$$f(x) = \frac{1}{9} x e^{-x/3} \text{ for } x > 0$$

If the total production is 12 million liters, determine the probability that there is a shortage on any given day.

Jika jumlah keseluruhan pengeluaran ialah 12 juta liter, tentukan kebarangkalian bahawa akan berlaku kekurangan pada sebarang hari.

[6 marks/*markah*]

(c). Companies B1, B2 and B3 produce 30%, 45% and 25% of building materials respectively. It is known that 2%, 3% and 2% of the materials produced from B1, B2 and B3 are defective.

Syarikat B1, B2 dan B3 masing-masingnya menghasilkan 30%, 45% and 25% bahan untuk bangunan. Diketahui bahawa 2%, 3% and 2% daripada bahan yang dihasilkan oleh B1, B2 and B3 adalah cacat.

(i). What is the probability that a material is found to be defective?

Apakah kebarangkalian bahawa bahan itu didapati cacat?

(ii). If a material is found to be defective, what is the probability that this material is produced by company B3?

Jika bahan itu didapati cacat, apakah kebarangkalian bahawa bahan itu dihasilkan oleh syarikat B3?

[7 marks/*markah*]

(5). A traffic engineer need to estimate trip rates for residential areas. The engineer conducts studies in ten residential areas of different densities and development, with the following results:

Seorang jurutera trafik perlu menganggar kadar perjalanan untuk kawasan perumahan. Jurutera tersebut menjalankan kajian di sepuluh kawasan perumahan yang mempunyai perbezaan ketumpatan dan pembangunan. Keputusan yang berikut diperolehi:

X	3	4	8	8	13	15	18	22	24	27
Y	4.5	3.3	3.5	2.3	3.8	2.6	2.7	1.6	1.9	1.7

Here *Y* is the trip rate (daily trips per household) and *X* is the residential density (households per hectare). Determine the strength of the linear relationship between *Y* and *X*.

Disini Y ialah kadar perjalanan (perjalanan harian per isi rumah) and X ialah ketumpatan kawasan perumahan (isi rumah per hektar). Tentukan kekuatan hubungan linear antara Y dengan X.

[10 marks/*markah*]

(b). A study was conducted to determine the relationship between bridge pier scour depths, D and discharge intensity, q. A simple linear regression model of the form $D = \beta_0 q^{\beta_1}$ was proposed. The following data was obtained:

Suatu kajian telah dijalankan untuk menentukan hubungan antara kedalaman hakisan pada tembok sambut jambatan, D *dengan kadar keamatan kadar alir,* q*. Suatu model regresi linear mudah berbentuk* $D = \beta_0 q^{\beta_1}$ *telah dicadangkan. Data yang berikut diperolehi:*

D	12.62	9.76	8.54	13.87	11.60	19.51	11.89	13.72	11.89	12.80
q	11.99	10.33	8.36	8.24	6.29	22.03	11.15	18.59	13.66	15.99

Determine the simple linear regression model.
Dapatkan model regresi linear mudah itu.

[15 marks/*markah*]

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