UNIVERSITY OF MAURITIUS

FACULTY OF ENGINEERING

SECOND SEMESTER EXAMINATIONS

MAY 2015

PROGRAMME	**BSc (Hons) Software Engineering-MIXED MODE - E320M/14**		
MODULE NAME	**Discrete Mathematics for Software Engineering**		
DATE	**Wednesday 13 May 2015**	**MODULE CODE**	**CSE1014Y(1)**
TIME	**09:30 – 12:30 Hrs**	**DURATION**	**3 hours**
NO. OF QUESTIONS SET	**5**	**NO. OF QUESTIONS TO BE ATTEMPTED**	**5**

INSTRUCTIONS TO CANDIDATES

Answer ALL questions.

All questions carry equal marks.

Normal Distribution Table is attached.

Answer ALL questions.

All questions carry equal marks.

Question 1

(a) Solve the following system of linear equations using Gaussian elimination:

$$\mathbf{x - 2y + z = 0}$$

$$\mathbf{2x + y - 3z = 5}$$

$$\mathbf{4x - 7y + z + -1}$$

[7 marks]

(b) Find the Inverse of the following matrix A using **Elementary Row Operations.**

$$A = \begin{bmatrix} 3 & 0 & 2 \\ 2 & 0 & -2 \\ 0 & 1 & 1 \end{bmatrix}$$

[5 marks]

(c) Find the eigenvalues and eigenvectors of the following 3 by 3 matrix A:

$$A = \begin{pmatrix} 1 & -1 & 0 \\ -1 & 2 & -1 \\ 0 & -1 & 1 \end{pmatrix}$$

[8 marks]

Question 2

(a) Consider the following system of linear equation:

$x_1 + 3x_2 - x_3 = 5$
$3x_1 - x_2 = 5$
$x_2 + 2x_3 = 1$

(i) Check for the convergence of the given system for an iterative solution.
(ii) Rewrite the system of equation in matrix form for an iterative solution. The equation must be in the form X = BX + C
(iii) Starting with $x_0 = (0,0,0)$, perform 3 iterations using Jacobi's algorithm.
(iv) Starting with $x_0 = (0,0,0)$, perform 3 iterations using Gauss-Siedel algorithm.
(v) Compare your answers to part (iii) and (iv) above.

[1+ 2+ 3+ 3+ 1 marks]

(b) Consider the following matrix:

$$A = \begin{pmatrix} 1 & 2 & 0 \\ -2 & 1 & 2 \\ 1 & 3 & 1 \end{pmatrix}$$

Starting with $x_0 = (1,1,1)$, use the power method to find the dominant eigenvalue and eigenvector of the matrix A.

[4 marks]

(c) Consider the following data about the mileage (in 1000 km) and maintenance cost (in Bitcoin) for 5 cars:

Student #	1	2	3	4	5
km driven	80	29	53	13	45
cost	1200	150	650	200	320

(i) Determine the regression equation in the form: $\hat{y} = b_0 + b_1x$ by writing the matrix equation about the given data or otherwise.

(ii) Determine the coefficient of determination, r^2, which gives the variation in maintenance cost that can be explained by the relationship found in part (i) above.

[4 + 2 marks]

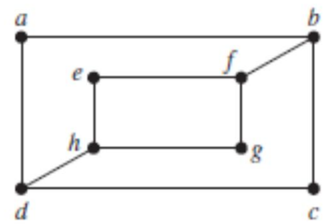
Question 3

(a) Find a solution to the following recurrence relation:

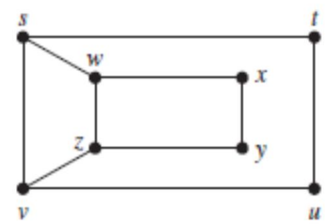
$$a_n=a_{n-1}+2a_{n-2},\ a_0=2,\ a_1=7.$$

[5 marks]

(b) Determine whether the graphs G and H shown below are isomorphic.



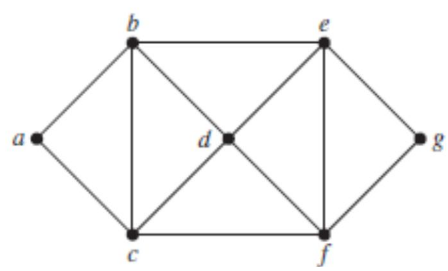
G



H

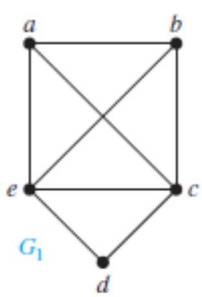
[5 marks]

(c) Determine the chromatic number of the graph shown in the figure below.

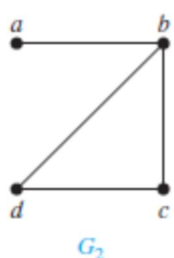


[5 marks]

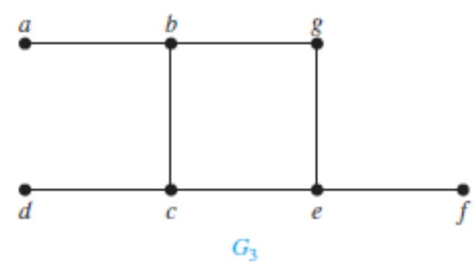
(d) Identify the Hamilton circuit or Hamilton path of the simple graphs shown below if they exist. Also state whether it is a circuit or a path.



G1



G2



G3

[5 marks]

Question 4

(a) Consider the following conditional statement: “The home team wins whenever it is raining.”

Using propositional logic, write:

(i) the above statement in conditional form: “if … then ….”

(ii) the contrapositive, the converse, and the inverse of the above conditional statement. Also state which statement is equivalent to the original one.

[1+4 marks]

(b) Consider a game in which two players take turns removing any positive number of matches they want from one of two piles of matches. The player who removes the last match wins the game.

Use strong induction to show that if the two piles contain the same number of matches initially, the second player can always guarantee a win.

[5 marks]

(c) Let $R = \{(1, 1), (2, 1), (3, 2), (4, 3)\}$. Find the powers R^n, $n = 2, 3, 4, \ldots$.

[5 marks]

(d) Draw a circuit diagram for f(x,y,z) = (xy' + x'y)z, making use of logic gates.

[5 marks]

Question 5

(a) Consider a code repository containing a library of 100 programs. Each week bugs are found and corrected in 2 programs on average.

(i) Use a Binomial distribution to calculate the probability of having bugs in not more than 3 programs in a week.

[4 marks]

(ii) Use a Poisson approximation to calculate the same probability.

[4 marks]

(b) Consider the measured radiation emissions (in W / kg) corresponding to a sample of cell phones listed below:

0.38	0.55	1.54	1.55	0.50	0.60	0.92	0.96	1.00	0.86	1.46

We assume that

- σ is known and = 0.480 W / kg,
- the sample is a simple random sample, and
- the data is from a normally distributed population.

Use a 0.05 level of significance to test the claim that cell phones have a mean radiation level that is less than 1.00 W / kg by

(i) building a confidence interval for μ, and
(ii) by doing a Hypothesis test.

[6 + 6marks]

END OF QUESTION PAPER

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