

UNIVERSITY OF MAURITIUS

FACULTY OF ENGINEERING



SECOND SEMESTER EXAMINATIONS

MAY 2015

PROGRAMME	BSc (Hons) Software Engineering (F/T)		
MODULE NAME	Discrete Mathematics for Software Engineering		
DATE	Wednesday 13 May 2015	MODULE CODE	CSE1014Y(1)
TIME	9.30 – 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 [20 marks]

(a) Solve the following system (if possible) using Gaussian elimination:

$$x_1 - 2x_2 - 6x_3 = 12$$

$$2x_1 + 4x_2 + 12x_3 = -17$$

$$x_1 - 4x_2 - 12x_3 = 22.$$

[7 marks]

(b) Solve the following linear system making use of Cramer's rule.

$$3x_1 + x_2 - 2x_3 = 4$$

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

$$2x_1 + x_2 + 4x_3 = -2$$

[5 marks]

(c) Find the eigenvalues and the corresponding eigenvectors of the 3X3 matrix $A = \begin{pmatrix} 5 & 4 & 2 \\ 4 & 5 & 2 \\ 2 & 2 & 2 \end{pmatrix}$.

[8 marks]

Question 2 [20 marks]

- (a) Consider the following system of linear equation:

$$2x_1 - x_2 - 7x_3 = 3$$

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

$$-3x_1 + 9x_2 + x_3 = 2$$

- (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 = 10 marks]

- (b) Each student in a class of 40 plays at least one indoor game chess, carrom and scrabble. 18 play chess, 20 play scrabble and 27 play carrom. 7 play chess and scrabble, 12 play scrabble and carrom and 4 play chess, carrom and scrabble. Find the number of students who play (i) chess and carrom. (ii) chess, carrom but not scrabble.

[4+2 = 6 marks]

- (c) Regression

Consider the following data about 5 Software Engineering students:

Student #	1	2	3	4	5
Marks in Maths	95	85	80	70	60
CPA	85	95	70	65	70

- (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 CPA that can be explained by the relationship found in part (i) above.

[4 marks]

Question 3 [20 marks]

- (a) The traffic light in a town is set to blink red after 45 seconds, orange after 15 seconds and green after 60 seconds. The traffic light is switched on at 6 a.m. in the morning. At what time will the three colours blink together? (*Hint: Use prime factors.*)

[6 marks]

- (b) Using Euclidean algorithm find the value of **s** and **t** for which $\text{GCD}(270, 192) = s(270) + t(192)$.

[4 marks]

- (c) Consider the linear recurrence $a_n = 2a_{n-1} - a_{n-2}$ with initial conditions $a_1 = 3, a_0 = 0$. Find an explicit formula for a_n .

[5 marks]

- (d) Let $A = \{1, 2, 3, 4\}$ and $R = \{(1, 1), (1, 2), (2, 1), (2, 2), (2, 3), (2, 4), (3, 4), (4, 1)\}$

- (i) Show that R^2 is a subset of $A \times A$.
- (ii) Draw the digraph of R^2 .
- (iii) Calculate in degree and out degree of R^2
- (iv) Find M^∞

[5 marks]

Question 4 [20 marks]

(a) Show that $P \rightarrow Q$ and $\sim P \vee Q$ are logically equivalent. [3 marks]

(b) Prove the following using mathematical induction.

$$\text{For } n > 1, 2 + 2^2 + 2^3 + 2^4 + \dots + 2^n = 2^{n+1} - 2$$

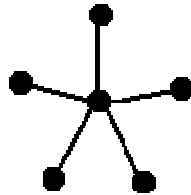
[6 marks]

(c) (i) Write the chromatic polynomial for the graph shown below.

[3 marks]

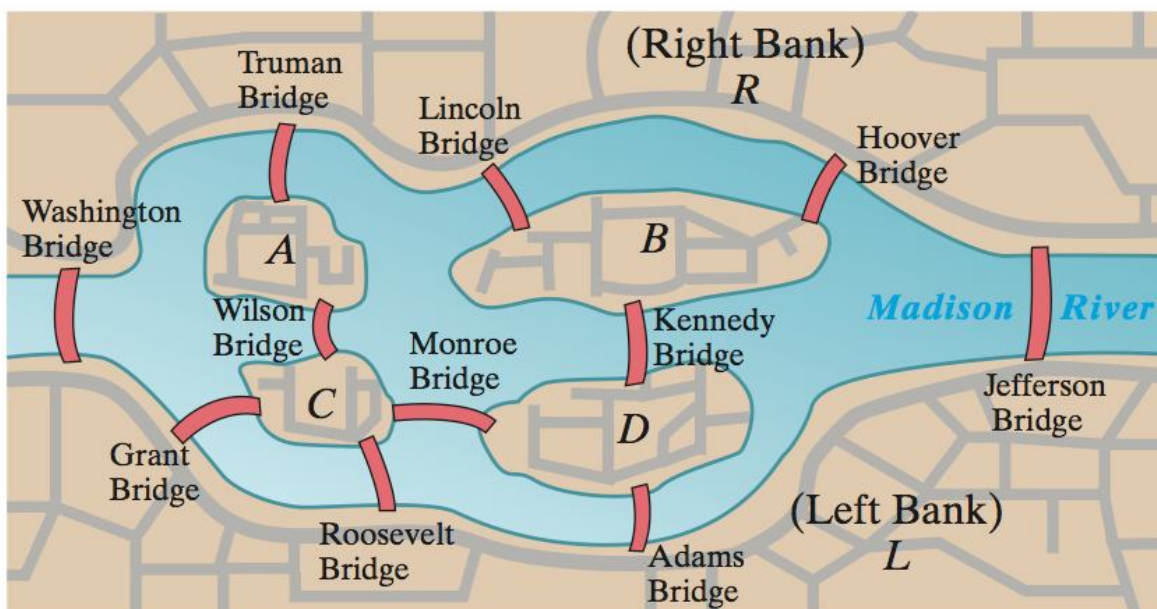
(ii) Find the minimum number of colours required for proper colouring of the graph below.

[3 marks]



(d) Determine whether it is possible or not for a photographer to take photographs of each of the 11 bridges in Madison County in one go i.e. without having to re-cross any bridge twice. Note that he can start where he wants.

Justify your answer.



[5 marks]

Question 5 [20 marks]

- (a) Consider the helpline for a Computer centre. There are 20 phone lines to the helpdesk and they operate independently. The probability that a certain phone line is occupied at a certain point in time is 0.6

- (i) Use a Binomial distribution to find an expression for the probability that 10 or more lines are occupied. Note that the value of the probability is not requested.

[4 marks]

- (ii) Use a Normal distribution approximation to determine the value of the probability.

[4 marks]

- (b) Suppose your company is interested in knowing the percentage of adults who read newspapers online, as part of a new content distribution strategy.

Determine the number of adults that must be surveyed in order to be 90% confident that the sample percentage differs from the population percentage by no more than two (2) percent points, in the following cases:

- (i) A recent result shows that 60% of adults read newspapers online.
- (ii) There is no prior information suggesting a possible value of the proportion.

[6+6 = 12 marks]

END OF QUESTION PAPER

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