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Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2015/2016

COURSE NAME	:	TECHNICAL MATHEMATICS III
COURSE CODE	:	DAS 21203
PROGRAMME	:	2 DAB / 2 DAJ / 2 DAR / 2 DAK
EXAMINATION DATE	:	DECEMBER 2015/JANUARY 2016
DURATION	:	3 HOURS
INSTRUCTION	:	SECTION A) ANSWER **ALL** QUESTIONS SECTION B) ANSWER **THREE (3)** QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF **EIGHT (8)** PAGES

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SECTION A

Q1 (a) An insurance company offers its policyholders a number of different premium payments options. For a randomly selected policyholder, let X = the number of months between successive payments. The cumulative distribution function of X is as follows:

$$F(x) = \begin{cases} 0 & x < 1 \\ 0.30 & 1 \leq x < 3 \\ 0.40 & 3 \leq x < 4 \\ 0.45 & 4 \leq x < 6 \\ 0.60 & 6 \leq x < 12 \\ 1 & x \geq 12 \end{cases}$$

(i) Find $P\ (3 \leq x \leq 6)$.

(3 marks)

(ii) Construct the probability distribution function for X.

(3 marks)

(iii) Determine the expected value of X and explain what it means.

(4 marks)

(b) Two cards are selected at random without replacement from a box which contains five cards numbered 1, 1, 2, 2 and 3. Let X denote the sum of the numbers drawn.

(i) Construct the probability distribution table for X. (Hint: Draw tree diagram)

x	2	3	4	5	6
$P(X = x)$					

(4 marks)

(ii) Find $E(2X)$ and $E(Y)$, given $Y = X^2 - 6$.

(6 marks)

Q2 (a) Zahran hits 70% of her free throws in basketball games. She had 30 free throws in last week's game. Find the

(i) average number of hits.

(2 marks)

(ii) standard deviation of Zahran's hit.

(2 marks)

(iii) probability that Zahran made at least 5 hits if he had 8 free throws in yesterday's game.

(5 marks)

(b) A clothing store has determined that 25% of the people who enter the store will make a purchase. Ten people enter the store during a one-hour period. Find the probability that at least one person will make a purchase.

(3 marks)

(c) The number of calls coming per minute into a hotels reservation center is Poisson random variable with mean 3. Find the

(i) probability that no calls come in a given 1 minute period.

(2 marks)

(ii) mean number of calls coming for every three minutes.

(2 marks)

(iii) probability the highest number of coming calls for every three minutes.

(4 marks)

SECTION B

Q3 (a) If vector $\boldsymbol{a} = \boldsymbol{i} - 2\boldsymbol{j} - 0.5\boldsymbol{k}$ and $\boldsymbol{b} = \boldsymbol{i} - 2\boldsymbol{j} + 3\boldsymbol{k}$.

(i) Find $\frac{1}{3}|-4\boldsymbol{a} - 2\boldsymbol{b}|$.

(4 marks)

(ii) Find the area of the triangle formed by the vectors.

(5 marks)

(b) Find the values of y if the angle between $3\boldsymbol{i} + 2\boldsymbol{j}$ and $2\boldsymbol{i} + y\boldsymbol{j}$ is $45°$.

(6 marks)

(c) Given that $P(4,2,-1)$ and $Q(-1,1,3)$ are two points in three dimension space. Find the symmetric and parametric equation of the straight line passes through point P and Q.

(5 marks)

Q4 (a) If $z_1 = 3 + 4i$ and $z_2 = 4 - 5i$. Determine

(i) $-4z_2 + z_1$

(2 marks)

(ii) $z_2 z_1$

(3 marks)

(b) Given $z = \frac{9+12i}{3-6i}$

(i) State the conjugate to be used for solving the above equation.

(1 marks)

(ii) Express z in polar form.

(6 marks)

(iii) By using Euler form, find all the 4^{th} root of z.

(8 marks)

Q5 The following data represent the length of life in years, measured to the nearest tenth, of 30 similar fuel pumps:

2.0	3.0	0.3	3.3	1.3	0.4
1.2	6.0	5.5	6.5	0.2	2.3
1.5	4.0	5.9	1.8	4.7	0.7
4.5	0.3	1.5	1.5	2.5	5.0
1.0	6.0	5.6	6.0	1.2	0.2

(a) Construct the frequency distribution table with the class limit 0.0 – 0.9, 1.0 – 1.9 and so on. In the table should include class midpoint, class boundary, frequency and cumulative frequency.

(8 marks)

(b) Find mean, median, mode, variance and standard deviation.

(12 marks)

Q6 (a) For two events A and $B, P(A) = \frac{3}{4}$ and $P(B) = \frac{2}{3}$.

(i) If $P(A \cup B) = \frac{11}{12}$, determine whether or not A and B are mutually exclusive.

(2 marks)

(ii) If $P(A \cup B) = \frac{5}{6}$, find $P(A \cap B)'$.

(2 marks)

(b) A shipment of 50 programmable calculators has just been received by a book store. It is known that 5 of those calculators are defective. A student came in and bought three of the calculators.

(i) Draw a tree diagram from the information above.

(4 marks)

(ii) Find the probability that the first calculator is defective.

(2 marks)

(iii) Find the probability that less than 2 calculators are defective.

(3 marks)

(c) Of 20 rats in a cage, 12 are male and 9 are infected with a virus that causes hemorrhagic fever. Of the 12 male rats, 7 are infected with the virus. One rat is randomly selected from the cage.

(i) Build the contingency table from the information above.
(3 marks)

(ii) If the selected rat is found to be infected, find the probability that it is female.
(2 marks)

(iii) If the selected rat is found to be male, find the probability that it is not infected.
(2 marks)

Q7 (a) A test has been devised to measure a student's level of motivation during high school. The motivation scores on this test are approximately normally distributed with a mean of 25 and a standard deviation of 6. Find the

(i) percentage of students taking this test will have scores below 10.
(3 marks)

(ii) probability of students score higher than 15.
(3 marks)

(iii) probability of students who received the scores between 15 and 30.
(4 marks)

(b) Professor Erlin has 200 students in his mathematics lecture class. 62% of the students score excellent grade for the subject.

(i) Show that the normal distribution can be used to approximate binomial probabilities.
(3 marks)

(ii) Find the mean and standard deviation.
(3 marks)

(iii) By using the continuity correction factor, find the probability that at least 100 students will score excellent grade for mathematics subject.
(4 marks)

– END OF QUESTION –

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Table 1: Vector

$\lvert\boldsymbol{u}\rvert = \sqrt{a^2+b^2+c^2}$	$\hat{\boldsymbol{u}} = \dfrac{\boldsymbol{u}}{\lvert\boldsymbol{u}\rvert}$
$\boldsymbol{u}\bullet\boldsymbol{v} = u_1v_1 + u_2v_2 + u_3v_3$	$\boldsymbol{u}\bullet\boldsymbol{v} = \lvert\boldsymbol{u}\rvert\lvert\boldsymbol{v}\rvert\cos\theta$
$\theta = \cos^{-1}\left(\dfrac{\boldsymbol{u}\bullet\boldsymbol{v}}{\lvert\boldsymbol{u}\rvert\lvert\boldsymbol{v}\rvert}\right)$	$A = \dfrac{1}{2}\lvert\boldsymbol{u}\times\boldsymbol{v}\rvert$
$\boldsymbol{u}\times\boldsymbol{v} = (u_2v_3 - u_3v_2)\boldsymbol{i} - (u_1v_3 - u_3v_1)\boldsymbol{j} + (u_1v_2 - u_2v_1)\boldsymbol{k}$	
If plane equation is $ax+by+cz+d=0$ Then distance, $D = \left\lvert\dfrac{ax_0+by_0+cz_0+d}{\sqrt{a^2+b^2+c^2}}\right\rvert$	

Table 2: Complex Number

$z = a+bi$ $\bar{z} = a-bi$	$z = r(\cos\theta + i\sin\theta)$
$r = \sqrt{a^2+b^2}$	$\theta = \tan^{-1}\dfrac{b}{a}$
$z_1z_2 = r_1r_2[\cos(\theta_1+\theta_2) + i\sin(\theta_1+\theta_2)]$	
$\dfrac{z_1}{z_2} = \dfrac{r_1}{r_2}[\cos(\theta_1-\theta_2) + i\sin(\theta_1-\theta_2)]$	
$z = re^{i\theta}$	$z^n = r^ne^{in\theta}$
$z^{\frac{1}{n}} = r^{\frac{1}{n}}e^{\left(\frac{\theta+2k\pi}{n}\right)i}$	$z^n = r^n[\cos n\theta + i\sin n\theta]$
$z^{\frac{1}{n}} = r^{\frac{1}{n}}\left(\cos\dfrac{\theta+2k\pi}{n} + i\sin\dfrac{\theta+2k\pi}{n}\right)$	

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Table 3: Probability

$P(A \cup B) = P(A) + P(B) - P(A \cap B)$	$P(A\|B) = \dfrac{P(A \cap B)}{P(B)}$

Table 4: Descriptive Statistics

$\mu = \dfrac{\sum_{i=1}^{n} x_i}{N}$	$\bar{x} = \dfrac{\sum_{i=1}^{n} x_i}{n}$
$\sigma^2 = \dfrac{\sum_{i=1}^{n}(x_i - \mu)^2}{N}$	$s^2 = \dfrac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n-1}$
$s^2 = \dfrac{1}{\sum f - 1}\sum_{i=1}^{n} f_i(x_i - \bar{x})^2$ or	$s^2 = \dfrac{1}{\sum f - 1}[\sum_{i=1}^{n} f_i x_i^2 - \dfrac{(\sum f_i x_i)^2}{\sum f}]$
$M = L_m + C(\dfrac{\frac{n}{2} - F}{f_m})$	$M_0 = L + C(\dfrac{d_1}{d_1 + d_2})$

Table 5: Probability Distribution

Binomial $X \sim B(n,p) = \binom{n}{r} p^r (1-p)^{n-r}$ for $n = 0,1,\dots,n$
Poisson $X \sim P_O(\mu) = \dfrac{e^{-\mu}\mu^r}{r!}$ for $\mu = 0,1,2 \dots$
Normal $X \sim N(\mu, \sigma^2)$, $f(x) = \dfrac{1}{\sqrt{2\pi\sigma^2}} e^{-\left[\frac{(x-\mu)^2}{2\sigma^2}\right]}$
Standard Normal $Z \sim N(0,1)$, $f(z) = \dfrac{1}{\sqrt{2\pi}} e^{-\left[\frac{z^2}{2}\right]}$, $z = \dfrac{x-\mu}{\sigma}$