MURANG'A UNIVERSITY OF TECHNOLOGY

SCHOOL OF PURE, APPLIED AND HEALTH SCIENCES

DEPARTMENT OF MATHEMATICS AND ACTUARIAL SCIENCE

UNIVERSITY ORDINARY EXAMINATION

2023/2024 ACADEMIC YEAR

FOURTH YEAR **SECOND** SEMESTER EXAMINATION FOR BMCS, BASP, BAS, BME

AMS407: NON PARAMETRIC METHODS

DURATION: 2 HOURS

INSTRUCTIONS TO CANDIDATES:

1. Answer Question one and any other two questions.

2. Mobile phones are not allowed in the examination room.

3. You are not allowed to write on this examination question paper.

SECTION A: ANSWER ALL QUESTIONS IN THIS SECTION

QUESTION ONE (30 MARKS)

a) State any five differences between parametric and non-parametric tests.   (5marks)

b) The number of defective items produced form two machines A and B are given as in the table below

No. of defectives from machine A	26,27,31,26,19,21,20,25,30,32,19,20,25,33,34
No. of defectives from machine B	23, 28, 26, 27, 22, 19, 24

Test whether the two samples comes from the same population using median test at 5% significant level.   (6marks)

c) Two commentators gave rating out of one hundred for ten sports personalities. The ratings are shown in the table below

Personality	A	B	C	D	E	F	G	H	I	J
Commentator 1	82	86	65	78	76	73	72	74	75	83
Commentator 2	89	86	80	79	78	77	72	89	91	82

Calculate the spearman rank correlation for the ratings and test whether there is any association between the two commentators at 5% significant level on both ends. (5marks)

d) A random sample of 395 people was surveyed and each person was asked to report to the highest education level they obtained.

Sex	Education level				
	High school	Bachelors	Masters	PhD	Total
Female	60	54	46	41	201
Male	40	44	53	57	194
Total	100	98	99	98	395

Are gender and education level dependent at a 5% level of significance?   (6marks)

e) A coin is tossed 20 times and the following sequence of heads (H) and tails(T) is obtained as
H T T H H T T H T H HH T T H H T H HH
Use run test to determine at 5% level of significance of the coin is unbiased.   (5marks)

f) State any three advantages of non-parametric tests   (3marks)

SECTION TWO: ANSWER ANY TWO QUESTIONS IN THIS SECTION

QUESTION TWO (20 MARKS)

a) The data below shows three judges each of whom gave a single score on a rating scale of eight projects.

Projects	Judges		
	1	2	3
1	23	22	59
2	26	27	66
3	51	39	38
4	49	29	49
5	58	46	56
6	37	48	60
7	29	49	56
8	44	65	62

Using Kruskal Willis test, determine whether there is statistically significant difference between the median of the projects rated by the three judge at 5% significant level. (7marks)

b) Five consumers of similar profile rated eight different colours of packages for biscuits to find out the most preferred one. The results are shown on the table.

Colours	Consumers				
	1	2	3	4	5
Red	1	2	1	1	2
Yellow	2	1	2	3	4
Orange	3	4	3	2	6
Green	4	3	6	6	7
Blue	5	6	4	4	3
Pink	6	5	8	7	8
Violet	1	8	7	5	5
Black	2	7	5	8	6

Calculate the Kendall's coefficient of concordance for the rating of the packages. (6 marks)

c) The department of public health and safety wanted to find out whether measures taken to clean up drinking water were effective. The data below shows the trihalomethanes (THMS) levels for 12 counties drinking water compared before cleaning, 1 week later and 2 weeks after clean up.

County	Trihalomehares (THMS) levels		
	Before clean up	1 week later	2 weeks after cleaning
1	21.1	19.2	18.4
2	24.1	22.3	21.2
3	14.1	12.9	12.9
4	18.1	17.8	17.3
5	15.4	15.1	14.9
6	16.2	15.1	15.1
7	7.4	7.2	6.8
8	7.5	6.7	6.1
9	14.2	13.6	13.1
10	21.3	20.9	20.4
11	9.5	9.8	9.2
12	11.9	10.5	10.1

Using Friedman test, find whether the clean-up system had any effect on trihalomethanes(THMS) at 5% significant level. (7 marks)

QUESTION THREE (20 MARKS)

a) A manufacturer of food products uses a machine to insert randomly one of the two type of gifts in each box. The manufacturers want randomness so that every purchases in the neighbourhood does not get the same gift. A sample of 60 successive boxes was chosen to see if the machine is properly mixing the two types of gifts. Using the symbol X and Y for gifts the examination of 60 boxes revealed the date on gifts as

Y Y X Y Y X XX Y Y X X Y X Y YY X XX
X X Y Y X XX Y YYY X Y X XX Y YY X
Y YY X X Y Y X XX Y Y X X Y X Y Y X X

Using the RUN test, what will you conclude about the randomness at 5% significant level.

(7marks)

b) Each person in a random sample of n=18 employees was asked about x, the daily time wasted at workplace during non-work activities in hours, such as surfing the internet and emailing friends. The results data in hours are as follows

1.41, 0.26, 1.97, 0.33, 0.55, 0.77, 1.46, 1.18. Is there evidence to suggest that the data were not randomly sampled from a uniform (0,2) distribution at 5% significant level

(6marks)

c) Let $x_1, x_2, \ldots, x_n$ be an exponential distribution with parameter θ. Given that the mean of this distribution is $\frac{1}{\theta}$, obtain the c.d.f and p.d.f of the first order and nth order statistics. (7marks)

QUESTION FOUR (20 MARKS)

a) The following data indicate the lifetime (in hours) of samples two kinds of light bulbs in a continuous use.

Brand A: 603 625 641 622 585 593 660 600 633 580 615 648

Brand B: 620 640 646 620 652 639 590 646 631 669 610 619

Using Mann Whitney U test would you conclude whether the samples came from identical

Populations at 5% significant level.   (9marks)

b) ABC university football team is considering a change to the diet the recommend for their offensive line men, hoping to health increase their weight. The record shows the weight of their 17 offensive linemen, put them on the new diet and record their weight again resulting in the following data

Weight pre-diet	311	297	274	345	249	309	287	304	304	282
Weight post diet	317	297	288	36	262	301	298	313	315	294

327	301	315	265	251	278	292
327	294	311	285	267	280	303

Conduct a 10% significance sign test to determine if the median weight of the players measured on the new diet.   (6marks)

c) The manufacturer of a hot tub is interested in testing the difference between heating elements for his product. The element must produce the maximum heat gain after 15 minutes is as follows

Unit1	25	27	29	31	30	26	24	32	33	38
Unit 2	31	33	32	35	34	29	38	35	37	40

Test whether there is any reason to suspect that one unit is superior to the other using Wilcoxon rank sum test at a=0.05   (5marks)