U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

February 2025 Semester End Main Examinations

Programme: B.E. **Semester: IV**
Branch: Medical Electronics **Duration: 3 hrs.**
Course Code: 23MA4BSMMD **Max Marks: 100**
Course: Mathematical Methods for Medical Electronics

Instructions:
1. All units have internal choice, answer one complete question from each unit.
2. Missing data, if any, may be suitably assumed.
3. Use of statistical tables is permitted.

			CO	PO	Marks
		UNIT - 1			
1	a)	If $f(z)$ is an analytic function of z, then prove that $\left(\frac{\partial^2}{\partial x^2}+\frac{\partial^2}{\partial y^2}\right)\left(\left\|f(z)\right\|\right)^2 = 4\left\|f'(z)\right\|^2$.	1	1	**6**
	b)	Determine the imaginary part of the complex function $f(z)$ whose real part is $e^{2x}\left(x\cos(2y)-y\sin(2y)\right)$.	1	1	**7**
	c)	State and prove Cauchy's theorem.	1	1	**7**
		OR			
2	a)	Find the analytic function $f(z)$ where $v = r^2\cos(2\theta) - r\cos(\theta) + 2$ using Milne-Thompson method.	1	1	**6**
	b)	Discuss the transformation $w = z^2$.	1	1	**7**
	c)	Apply Cauchy's integral formula to evaluate $\int_C \frac{e^z}{\left(z^2+\pi^2\right)^2} dz$ over the circle $C: \left\|z\right\| = 4$.	1	1	**7**
		UNIT – 2			
3	a)	The results of measurement of electric resistance R of a copper bar at various temperature t^0c are listed below: t: 19, 25, 30, 36, 40, 45, 50 R: 76, 77, 79, 80, 82, 83, 85 Find a least squares straight line of the form $R = a + bt$ where a and b are constants.	1	1	**6**
	b)	The following table shows the recorded data of the test scores made by the salesman on an intelligence test and their weekly sales. Salesman: 1, 2, 3, 4, 5 Test scores: 92, 89, 87, 86, 83 Sales: 86, 88, 91, 77, 68 Calculate the coefficient of correlation between the test scores and the sales. Hence find the regression line of sales on test scores and estimate	1	1	**7**

		the most probable weekly sales volume if a salesman makes a score of 85.			
	c)	Compute the rank-correlation coefficient for the given data: x: 21, 23, 30, 54, 57, 58, 72, 78, 87, 90 y: 60, 71, 72, 83, 110, 84, 100, 92, 113, 135	*1*	*1*	**7**
		OR			
4	a)	The equations of the regression lines of x on y and y on x are $x+0.87y=19.13$ and $y+0.5x=11.64$ respectively. Find the correlation coefficient and the means of x and y.	*1*	*1*	**6**
	b)	If the coefficient of correlation between two variables x and y is 0.5 and the acute angle between their lines of regression is $\tan^{-1}\left(\frac{3}{5}\right)$, show that $\sigma_x=\frac{1}{2}\sigma_y$.	*1*	*1*	**7**
	c)	Estimate the chlorine residual in a swimming pool 5 hours after it has been treated with chemicals by fitting a curve of the form $y=ax^b$ to the following data: x (no. of hours): 2, 4, 6, 8, 10, 12 y (chlorine residual parts/million): 1.8, 1.5, 1.4, 1.1, 1.1, 0.9	*1*	*1*	**7**
		UNIT – 3			
5	a)	The joint probability distribution of two random variables X and Y is given below: X \ Y: 3, 4, 5 2: $\frac{1}{6}$, $\frac{1}{6}$, $\frac{1}{6}$ 5: $\frac{1}{12}$, $\frac{1}{12}$, $\frac{1}{12}$ 7: $\frac{1}{12}$, $\frac{1}{12}$, $\frac{1}{12}$ i)Find the marginal distributions of X and Y ii) $Cov(X,Y)$.	*1*	*1*	**6**
	b)	A certain screw making machine has a chance of producing 2 defectives out of 1000. The screws are packed in boxes of 100. Apply Poisson distribution to find the approximate number of boxes containing: (i) no defective screw (ii) one defective screw (iii) two defective screws, in a consignment of 5000 boxes.	*1*	*1*	**7**
	c)	A manufacturer of air-mail envelopes knows from experience that weight of the envelopes is normally distributed with mean 1.95g and standard deviation 0.05g. About how many envelopes weighing: (i) 2g or more (ii) 2.05g or more can be expected in a given packet of 100 envelopes.	*1*	*1*	**7**
		OR			
6	a)	Derive an expression for mean and variance of Poisson distribution.	*1*	*1*	**6**
	b)	In a normal distribution, 31% of the items are under 45 and 8% are over 64. Find the mean and the standard deviation of the distribution.	*1*	*1*	**7**

		c)	The joint probability function of two random variables X and Y is given by $f(x,y)=c(2x+y)$ where x and y can assume all integral values such that $0\le x\le 2, 0\le y\le 3$ and $f(x,y)=0$ otherwise. Find i) the value of the constant c ii) Marginal Probability distributions of X and Y.	*1*	*1*	**7**
			UNIT – 4			
	7	a)	Mice with an average lifespan of 32 months will live up to 40 months when fed by a certain nutritious food. If 64 mice fed on this diet have an average lifespan of 38 months and standard deviation of 5.8 months, is there any reason to believe that the average lifespan is less than 40 months? Use 5% level of significance.	*1*	*1*	**6**
		b)	Can we conclude that chronically ill children tend, on the average, to be less self-confident than healthy children? A test designed to measure self-confidence was administered to 16 chronically ill and 21 healthy children. The mean scores and standard deviations were ill Group: mean 22.5, standard deviation 4.1 well Group: mean 26.9, standard deviation 3.2 Use 1% level of significance.	*1*	*1*	**7**
		c)	Following data give weight gains of 8 pairs of experimental animals matched with respect to various growth factors. One of each pair, selected by chance, was given vitamin B_{12} supplement and the other was not given the supplement. Test whether B_{12} supplement is beneficial at 5% level of significance. Pair: 1, 2, 3, 4, 5, 6, 7, 8 With B_{12}: 1.6, 1.68, 1.75, 1.64, 1.75, 1.79, 1.78, 1.77 Without B_{12}: 1.56, 1.52, 1.52, 1.49, 1.59, 1.56, 1.6, 1.56	*1*	*1*	**7**
			OR			
	8	a)	An ambulance service company claims that on an average it takes 20 minutes between a call for an ambulance and the patient's arrival at the hospital. If in 6 calls the time taken (between a call and arrival at hospital) are 27, 18, 26, 15, 20 and 32. Can the company's claim be accepted at 1% level of significance?	*1*	*1*	**6**
		b)	A random sample of 40 'geysers' produced by company A have a mean lifetime (mlt) of 647 hours of continuous use with a standard deviation of 27 hours, while a sample 40 produced by another company B have mean lifetime (mlt) of 638 hours with standard deviation 31 hours. Does this substantiate the claim of company A that their 'geysers' are superior to those produced by company B at 0.05 level of significance?	*1*	*1*	**7**
		c)	Marks obtained in mathematics by 6 students before and after intensive coaching are given below: Before: 24, 17, 18, 20, 19, 23 After: 24, 20, 22, 20, 17, 24 Test at 5% level of significance whether the intensive coaching is useful?	*1*	*1*	**7**

			UNIT - 5			
	9	a)	A commonly prescribed drug for relieving nervous tension is believed to be only 60% effective. Experimental results with a new drug administered to a random sample of 100 adults who were suffering from nervous tension show that 70 received relief. Is this sufficient evidence to conclude that the new drug is superior to the one commonly prescribed? Use α=5% level of significance.	*1*	*1*	**6**
		b)	The number of cars passing a given point in 100 five second intervals was observed as follows: No. of Cars: 0 1 2 3 4 5 No. of intervals: 40 23 15 5 7 10 Fit a Poisson distribution and test for its goodness of fit. Use 5% level of significance.	*1*	*1*	**7**
		c)	Two random samples from two normal populations are given below: Sample I: 16 26 27 23 24 22 Sample II: 33 42 35 32 28 31 At 1% level of significance, do the estimate of population variances differ significantly?	*1*	*1*	**7**
			OR			
	10	a)	A sample analysis of examination results of 500 students was made. It was found that 220 students had failed, 170 had secured third class, 90 had secured second class and 20 had secured first class. Do these figures support the general examination result which is in the ratio 4:3:2:1 for the respective categories? Use 0.05 level of significance.	*1*	*1*	**6**
		b)	In a study of nutrition cares in nursing homes, it is found that among 55 patients with hypertension, 24 were on sodium restricted diets. Of 149 patients without hypertension, 36 were on sodium restricted diets. Can we conclude that in the sampled populations, the proportion of patients on sodium restricted diets is higher amongst the patients with hypertension than among the patients without hypertension? Use 0.01 level of significance.	*1*	*1*	**7**
		c)	Can we conclude that the two population variances are equal for the following data of post graduates passed out from a state and private university. State: 8350 8260 8130 8340 8070 ----- Private: 7890 8140 7900 7950 7840 7920	*1*	*1*	**7**

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