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VIVEKANANDHA COLLEGE OF ENGINEERING FOR WOMEN
 [AUTONOMOUS INSTITUTION AFFILIATED TO ANNA UNIVERSITY, CHENNAI]
 Elayampalayam – 637 205, Tiruchengode, Namakkal Dt., Tamil Nadu.

Question Paper Code: 20013

M.E. / M.Tech. DEGREE END-SEMESTER EXAMINATIONS – JAN. / FEB. 2026

First Semester

Power Systems Engineering

P23MA102 – APPLIED MATHEMATICS

(Common to VLSI Design)

(Regulation 2023)

Time : Three Hours

Maximum : 100 Marks

Answer ALL the questions

Knowledge Levels	K1 – Remembering	K3 – Applying	K5 - Evaluating
(KL)	K2 – Understanding	K4 – Analyzing	K6 - Creating

PART – A

(10 x 2 = 20 Marks)

Q.No.	Questions	Marks	KL	CO
1.	Define the Critical region.	2	K1	CO1
2.	Find 95 percent and 99 percent confidential interval for a random sample of 16 values with $\bar{x} = 41.5$ and $s = 3$.	2	K2	CO1
3.	Tell the assumptions of Analysis of variance.	2	K1	CO2
4.	Write down the ANOVA table for One-Way classification.	2	K1	CO2
5.	Write some of the criteria to be followed for a good estimator.	2	K1	CO3
6.	State the principle of maximum likelihood estimation.	2	K1	CO3
7.	Define basic feasible solution.	2	K1	CO4
8.	Give the mathematical formulation for assignment problem.	2	K2	CO4
9.	When to Use Dynamic Programming?	2	K2	CO5
10.	State main four components of Cargo loading and unloading procedures.	2	K1	CO5

PART – B

(5 x 16 = 80 Marks)

Q.No.	Questions	Marks	KL	CO																																		
11. a)	i. In a sample of 1000 people in Karnataka 540 are rice eaters and the rest are wheat eaters. Can we assume that both rice and wheat are equally popular in this state at 99% level of significance?	8	K2	CO1																																		
	ii. A random sample of 10 boys had the following IQ's 70,120,110,101,88,83,95,98,107,100. Do these data support the assumption of a population mean I.Q of 100? Find a reasonable range in which most of the mean I.Q values of sample of 10 boys lie.	8	K3	CO1																																		
(OR)																																						
b)	i. Theory predicts that the proportion of beans in 4 groups A, B, C, D should be 9:3:3:1. In an experiment among 1600 beans, the numbers in the 4 groups were 882,313,287,118. Does the experiment support the theory?	8	K3	CO1																																		
	ii. The means 2 large samples 1000 and 2000 members are 67.5 inches and 68.0 inches respectively. Can the samples be regarded as drawn from the same population of S.D 2.5 inches.	8	K2	CO1																																		
12. a)	The following data represent the number of units of production per day turned out by 5 different workers using different types of machines	16	K4	CO2																																		
	i. Test whether the mean production is the same for the different machine types.																																					
	ii. Test whether the 5 men differ with productivity.																																					
	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th rowspan="2">Worker</th> <th colspan="4">Machine type</th> </tr> <tr> <th>1</th> <th>2</th> <th>3</th> <th>4</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>44</td> <td>38</td> <td>47</td> <td>36</td> </tr> <tr> <td>2</td> <td>46</td> <td>40</td> <td>52</td> <td>43</td> </tr> <tr> <td>3</td> <td>34</td> <td>36</td> <td>44</td> <td>32</td> </tr> <tr> <td>4</td> <td>43</td> <td>38</td> <td>46</td> <td>33</td> </tr> <tr> <td>5</td> <td>38</td> <td>42</td> <td>49</td> <td>39</td> </tr> </tbody> </table>	Worker	Machine type				1	2	3	4	1	44	38	47	36	2	46	40	52	43	3	34	36	44	32	4	43	38	46	33	5	38	42	49	39			
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(OR)																																						
b)	Five varieties of wheat A, B, C, D and E were studied. The Latin square plan gave the following results for the varieties in each plot and yields obtained in kg are given in the following table	16	K3	CO2																																		

A90	E80	C134	A112	D92
E85	D84	E70	C141	A82
C110	A90	D87	B84	E69
A81	C125	E85	D76	B72
D82	B60	A94	E85	C88,

Carryout an analysis of variance. What inference can you draw from the given data?

13. a) i. A random sample of size 5 is taken from a population containing 100 units. If the sample observations are 10, 12, 13, 7, 18, find
- an estimate of the population mean
 - an estimate of the standard error of sample mean.

8 K2 CO3

- ii. If X_1, X_2, \dots, X_n are normally distributed random variables with mean μ and variance σ^2 , then: prove that $\bar{\mu} = \frac{\sum x_i}{n}$ and $\sigma^2 = \frac{\sum(x_i - \bar{x})^2}{n}$ are the maximum likelihood estimators of μ and σ^2 , respectively. Are these MLEs unbiased for their respective parameters?

8 K3 CO3

(OR)

- b) Let a random sample of n observations X_1, X_2, \dots, X_n be drawn from a normally distributed population. (i) If mean is and the variance is known, find the maximum likelihood estimate of the mean. Also, (ii) if the mean is known but the variance is unknown, find the maximum likelihood estimate of the variance.

16 K3 CO3

14. a) i. Solve by graphical method:

8 K2 CO4

$$\text{Maximize } Z = 3x_1 + 4x_2$$

subject to the constraints

$$5x_1 + 4x_2 \leq 200, 3x_1 + 5x_3 \leq 150, 5x_1 + 4x_2 \leq 10, 8x_1 + 4x_2 \leq 80, x_1, x_2, x_3 \geq 0.$$

- ii. Find the IBFS of the transportation problem by Vogel's approximation method.

8 K3 CO4

Were houses

		W	X	Y	Z	Capacity
Factory	A	19	30	50	10	7
	B	70	30	40	60	9
	C	40	8	70	20	18
Requirement		5	8	7	14	

(OR)

- b) i. Solve by simplex method Maximize $Z = x_1 - x_2 + 3x_3$ subject to the constraints $x_1 + x_2 + x_3 \leq 10, 2x_1 - x_3 \leq 3, 2x_1 - 2x_2 + 3x_3 \leq 0, x_1, x_2, x_3 \geq 0$. 8 K2 CO4
- ii. Solve the following assignment problem. Cell values represent cost of assigning job A, B, C and D to the machines I, II, III and IV. 8 K3 CO4

		Machines			
		I	II	III	IV
Jobs	A	10	12	19	11
	B	5	10	7	8
	C	12	14	13	11
	D	8	15	11	9

15. a) Use dynamic programming to solve the following problem Minimize $Z = x^2 + y^2 + z^2$ subject to $x + y + z \geq 15$ and all x, y, z are ≥ 0 . 16 K2 CO5

(OR)

- b) A vessel is to be loaded with stocks of 3 items. Each item 'i' has a weight of w_i and a value of v_i . The maximum cargo weight the vessel can take is 5 and the details of the three items are as follows:

j	w_j	v_j
1	1	30
2	3	80
3	2	65

Develop the recursive equation for the above case and find the most valuable cargo load without exceeding the maximum cargo weight by using dynamic programming. (Cargo load problem)