



M.TECH DEGREE EXAMINATIONS: MAY 2018

(Regulation 2015)

Second Semester

BIOTECHNOLOGY

P15MAT201: Applied Mathematics for Biotechnologists

(Use of statistical table permitted)

COURSE OUTCOMES

- CO1:** Form and solve the ordinary differential equations of certain types
- CO2:** Acquire the knowledge in Laplace transforms and its properties.
- CO3:** Discover the equations of curve fit and compute various statistical measures.
- CO4:** Analyze sample data and interpret the same for population.
- CO5:** Analyze the experimental design based on one-way, two-way and Latin squares.

Time: Three Hours

Maximum Marks: 100

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. Assertion (A) : Analysis of variance of 2 X 2 Latin square is not possible. CO5 [K₂]
Reason (R): For $n = 2$, degrees of freedom of SSE =0 and hence MSE is not defined.
- a) both A and R are individually true and R is the correct explanation of A b) both A and R are individually true but R is not the correct explanation of A
- c) A is true but R is false d) A is false but R is true.

2. Match list I with list II and select the correct answer using the codes given CO4 [K₃]

List I	List II
A) For independent samples, to test difference between 2 means	1) Chi-square test
B) For dependent samples, to test difference between 2 means	2) F-test
C) To test difference between two variances	3) paired t test
D) To test goodness of fit	4) t-test

- a) A-4,B-3,C-2,D-1 b) A-3,B-2,C-4,D-1
- c) A-2,B-1,C-4,D-3 d) A-4,B-2,C-1,D-3

6. Consider the following statements CO3 [K₄]
- 1) The positive square root of the A.M. of squares of deviations of observations from their A.M. is standard deviation.
 - 2) Correlation coefficient is the product of the regression coefficients.
 - 3) Median for the distribution 25, 20, 15, 35, 18 is 20.
 - 4) If $b_{yx} = 0.8$, $r_{xy} = 0.6$, $\sigma_x = 3$, then $\text{Var}(Y) = 4$.
- Which of these statements are correct?
- a) 2,3 b) 1,3,4
- c) 1,3 d) 2,3,4
7. Consider the following statements CO4 [K₂]
- i. Frame null and alternate hypothesis.
 - ii. Decide whether null hypothesis is accepted or not.
 - iii. Pick the table value corresponding to LOS of the particular distribution.
 - iv. Find the test static using the formula.
- The correct sequence in testing of hypothesis is _____
- a) iii-iv-ii-i b) i-iii-ii-iv
- c) i – ii-iii-iv d) i-iv-iii-ii
8. The Laplace transform of $\frac{1}{\sqrt{t}}$ is CO2 [K₃]
- a) $\sqrt{\frac{\pi}{s}}$ b) $\frac{\sqrt{\pi}}{2s}$
- c) $\sqrt{\frac{1}{s}}$ d) $\frac{2\sqrt{\pi}}{s}$
9. $y = ax - a^2$ is the general solution of _____ CO1 [K₃]
- a) $y' = a$ b) $y'' = 0$
- c) $y'^2 + xy' + y = 0$ d) $y'^2 - xy' + y = 0$
10. Write the correct sequence of the steps involved in carrying out an analysis of variance for a Latin square design CO5 [K₂]
1. Draw the ANOVA table and find the F-ratios.
 2. Find the grand total and correction factor.
 3. Compare with tabulated F-values and write the conclusions.
 4. Find the various sums of squares required.
- a) 1-2-4-3 b) 2-4-1-3
- c) 2-4-3-1 d) 2-3-4-1

PART B (10 x 2 = 20 Marks)

11. Determine the particular integral of $(D^2 + 1)y = 3x^2$. CO1 [K₃]

12. Transform $x^2y'' - xy' - 3y = 0$ into a differential equation with constant coefficients. CO1 [K₃]
13. State and prove change of scale property of Laplace transform. CO2 [K₁]
14. If $L[f(t)] = \frac{1}{s(s+1)}$ then find the value of $f(t)$. CO2 [K₃]
15. Obtain the normal equations for fitting of straight line $y=a+bx$, by least square method. CO3 [K₃]
16. Mean of 20 values is 45. If one of these values is to be taken 64 instead of 46. Compute the corrected mean. CO3 [K₃]
17. Define Type I and Type II errors. CO4 [K₁]
18. Write two applications of chi square test. CO4 [K₁]
19. What are the three basic principles of design of experiments? CO5 [K₁]
20. Compare Randomised Block Design and Latin Square Design. CO5 [K₂]

PART C (6 x 5 = 30 Marks)

21. Solve: $(x^2D^2 - 3xD + 4)y = x^2 \cos(\log x)$, where D is the differential operator. CO1 [K₄]
22. Determine the inverse Laplace transform of $\frac{s^2}{(s^2 + 1)(s^2 + 4)}$ by using convolution theorem CO2 [K₄]
23. By the method of least squares frame the best fitting straight line to the data given below: CO3 [K₄]

x:	5	10	15	20	25
y:	12	17	28	32	40

24. Petroleum pollution in oceans is known to increase the growth of a certain bacteria. Brian did a project for his ecology class for which he made a bacteria count(per 100 milliliters) in nine random samples of sea water. His counts gave the following reading:
17 23 18 19 21 16 12 15 18
(i) Find the sample mean
(ii) Determine the sample standard deviation. CO3 [K₃]

25. A Completely Randomized Design experiment with ten plots and three treatments gave the results given below. CO5 [K₄]

Plot No.	1	2	3	4	5	6	7	8	9	10
Treatment	5	4	3	7	5	1	3	4	1	7
Yield	A	B	C	A	C	C	A	B	A	B

Analyze the results for the effects of treatments.

26. 10 workers are selected at random from a large number of workers in a factory. The number of items produced by them on a certain day are found to be: CO4 [K₄]

51	52	53	55	56	57	58	59	59	60
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In the light of these data, would it be appropriate to suggest that the mean of the number of items produced in the population is 58?.

PART D (4 x 10 = 40 Marks)

Answer any FOUR questions

27. Obtain the solution of the differential equation got by eliminating x from the simultaneous equations $\frac{dx}{dt} - \frac{dy}{dt} - y = -e^t$, $x + \frac{dy}{dt} - y = e^{2t}$ CO1 [K₃]

28. (i) A personnel manager is interested in trying to determine whether absenteeism is greater on one day of the week than on another. His records for the past year show this sample distribution: CO4 [K₄]

Day of the week:	Monday	Tuesday	Wednesday	Thursday	Friday
Number of absentees:	66	57	54	48	75

Test whether the absence is uniformly distributed over the week. (4)

(ii) The mean breaking strength of 100 cables is 1580 with standard deviation 50, Jest at 5% level of significance coheten the mean breaking strength is 1600.

29. The following marks have been obtained by a class of students (out of 100): CO3 [K₅]

Paper I	45	55	56	58	60	65	68	70	75	80	85
Paper II	56	50	48	60	62	64	65	70	74	82	90

- (i) Find the lines of regression of x on y and y on x
 (ii) Find the correlation coefficient

30. A farmer wishes to test the effects of four different fertilizers. A, B, C, D on yield of wheat. In order to eliminate sources of error due to variability in soil fertility, he uses the fertilizers in a Latin Square arrangement as indicated in the following table, where the numbers indicate yields in bushels per unit area. CO5 [K₅]

A18 C21 D25 B11
 D22 B12 A15 C19
 B15 A20 C23 D24
 C22 D21 B10 A17

Perform an analysis of variance to determine if there is a significant difference between the fertilizers at = 0.05 level of significance.

31. (i) Find the Laplace transform of $x(t) = \begin{cases} t, 0 < t < a \\ 2a - t, a < t < 2a \end{cases}$ with $x(t + 2a) = x(t)$. (6) CO2 [K₄]

(ii) Using partial fraction method obtain the inverse Laplace transform (4)
 of $\frac{2}{s^2(s^2 - 4)}$.
