



QUESTION BANK

Year / Semester: **II B. Tech I Semester**

Regulation: **R23**

Subject and Code: **NUMERICAL & STATISTICAL METHODS (23BSC233)**

SYLLABUS

23BSC233	NUMERICAL & STATISTICAL METHODS	L	T	P	C
	(CIVIL)	3	1	-	4

Pre-requisite: Calculus, Differential equations, Set theory, **Permutations and Combinations**,

COURSE EDUCATIONAL OBJECTIVES:

1. To develop skill to analyze appropriate method to find the root of the Algebraic and Transcendental Equations and to develop skill to apply the concept of interpolation
2. To learn the method of evaluation of numerical derivative, numerical integration
3. To learn the method of evaluation of solve ordinary differential equations numerically using numerical methods.
4. To inculcate skill to investigate different applications of statistical distributions and the Corresponding conclusions required for the analysis of sample data.
5. To develop skill to apply the concept of test of significance using t-test, f-test, chi-square test, suitable of the required conclusion.

UNIT I: SOLUTION OF ALGEBRAIC & TRANSCENDENTAL EQUATIONS AND INTERPOLATION
09

Introduction-Bisection Method-Iterative method, Regula-falsi method and Newton Raphson method Finite differences-Newton's forward and backward interpolation formulae – Lagrange's formulae.

UNIT II: Numerical Differentiation, Numerical Integration and Curve Fitting
09

Numerical differentiation: Newton's forward and backward formulae
Numerical integration: Trapezoidal rule - Simpson's 1/3 Rule -Simpson's 3/8 Rule
Curve fitting: Fitting of straight line, second-degree and Exponential curve by method of least squares.

UNIT III: Solution of Initial value problems to Ordinary differential equations
09

Numerical solution of Ordinary Differential equations: Solution by Taylor's series-Picard's Method of successive Approximations-Euler's and modified Euler's methods-Runge-Kutta methods (second and fourth order).

UNIT IV: Estimation and Testing of hypothesis-large sample tests
09

Estimation-parameters, statistics, sampling distribution, point estimation, Formulation of null hypothesis, alternative hypothesis, the critical and acceptance regions, level of significance, two types of errors and power of the test. Large Sample Tests: Test for single proportion, difference of proportions, test for single mean and difference of means. Confidence interval for parameters in one sample and two sample problems

UNITV: Testing of hypothesis-Small sample tests
09



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Student t-distribution (test for single mean, two means and paired t-test), testing of equality of variances (F-test), χ^2 - test for goodness of fit, χ^2 - test for independence of attributes.

COURSE OUTCOMES:

On successful completion of the course, students will be able to		Pos
C01	Demonstrate the knowledge in solving algebraic and transcendental equations by various mathematical methods and Design novel mathematical methods for constructing the interpolating polynomials to the given data	PO1, PO2, P03
C02	Demonstrate the knowledge in finding the numerical values to derivatives, integrals through different mathematical methods	PO1, PO2, P03
C03	Demonstrate the knowledge in finding the solution of ordinary differential equations numerically through various methods	PO1, PO2, P03
C04	To identify real life problems into Mathematical Models.	PO1, PO2, P03
C05	To apply the probability theory and testing of hypothesis in the field of engineering Applications.	PO1, PO2, P03

Max Marks: 10



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S.No.	C O	Questions	BT																
UNIT-1: SOLUTION OF ALGEBRAIC AND TRANSCENDENTAL EQUATIONS & INTERPOLATION																			
1	1	Find a Positive root of the equation $x^3 - x - 1 = 0$ correct to two decimal places by Bisection method.	L3																
2	1	Find a positive root of the equation $x^3 - 4x - 9 = 0$ using Bisection method.	L3																
3	1	Find a real root of the equation $x \log_{10} x = 1.2$ by Regular-False position method	L3																
4	1	Find a real root of the following equation $x^3 - x - 1 = 0$ by Newton Raphson method.	L3																
5	1	Solve the equation $3x = \cos x + 1$ by Iteration method.	L3																
6	1	Find $f(1.6)$ Using Newton's Forward difference interpolation formula for the data <table><tr><td>X</td><td>1</td><td>1.4</td><td>1.8</td><td>2.2</td></tr><tr><td>F(x)</td><td>3.49</td><td>4.82</td><td>5.96</td><td>6.5</td></tr></table>	X	1	1.4	1.8	2.2	F(x)	3.49	4.82	5.96	6.5	L3						
X	1	1.4	1.8	2.2															
F(x)	3.49	4.82	5.96	6.5															
7	1	Find $f(2.5)$ from the data using Newton's Forward interpolation formula <table><tr><td>X</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr><tr><td>Y(x)</td><td>0</td><td>1</td><td>16</td><td>81</td><td>256</td><td>625</td><td>1296</td></tr></table>	X	0	1	2	3	4	5	6	Y(x)	0	1	16	81	256	625	1296	L3
X	0	1	2	3	4	5	6												
Y(x)	0	1	16	81	256	625	1296												
8	1	For $x=0,1,2,3,4$ and $f(x)=1,14,15,5,6$. Find $f(3.2)$ using Backward difference table.	L3																
9	1	Find $y(9)$ using Newton's Backward difference formula from the table <table><tr><td>X</td><td>2</td><td>5</td><td>8</td><td>11</td></tr><tr><td>f(x)</td><td>94.8</td><td>87.9</td><td>81.3</td><td>75.1</td></tr></table>	X	2	5	8	11	f(x)	94.8	87.9	81.3	75.1	L3						
X	2	5	8	11															
f(x)	94.8	87.9	81.3	75.1															
10	1	Using Lagrange's interpolation formula find the value of $y(10)$ from the following table <table><tr><td>X</td><td>5</td><td>6</td><td>9</td><td>11</td></tr><tr><td>f(x)</td><td>12</td><td>13</td><td>14</td><td>16</td></tr></table>	X	5	6	9	11	f(x)	12	13	14	16	L3						
X	5	6	9	11															
f(x)	12	13	14	16															



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UNIT – 2: NUMERICAL DIFFERENTIATION, NUMERICAL INETEGRATION AND CURVE FITTING																			
1	2	Evaluate $\int_4^{5.2} \log x \, dx$ by using Simpson's 3/8 rule <table><tr><td>X</td><td>4</td><td>4.2</td><td>4.4</td><td>4.6</td><td>4.8</td><td>5.0</td><td>5.2</td></tr><tr><td>Log x</td><td>1.3863</td><td>1.4351</td><td>1.4816</td><td>1.5261</td><td>1.5686</td><td>1.6094</td><td>1.6487</td></tr></table>	X	4	4.2	4.4	4.6	4.8	5.0	5.2	Log x	1.3863	1.4351	1.4816	1.5261	1.5686	1.6094	1.6487	L3
X	4	4.2	4.4	4.6	4.8	5.0	5.2												
Log x	1.3863	1.4351	1.4816	1.5261	1.5686	1.6094	1.6487												
2	2	Evaluate $\int_0^2 e^{-x^2} \, dx$ using simpson's 1/3 rule taking h=0.25	L3																
3	2	Evaluate $\int_0^1 x^3 \, dx$ using with 5 sub intervals by Trapezoidal Rule	L3																
4	2	Evaluate $\int_0^4 e^x \, dx$ using simpson's 1/3 rule with n=10	L3																
5	2	Use the Trapezoidal Rule with n=4 to estimate $\int_0^1 \frac{1}{1+x^2} \, dx$, coreect to four decimal places	L3																
6	2	Evaluate $\int_0^1 \frac{1}{1+x} \, dx$ by using Simpson's 1/3 and using Simpson's 3/8 rule	L4																
7	2	Evaluate $f'(1.5)$ and $f''(1.5)$ from the following table. <table><tr><td>X</td><td>1.5</td><td>2.0</td><td>2.5</td><td>3.0</td><td>3.5</td><td>4.0</td></tr><tr><td>f(x)</td><td>3.375</td><td>7.000</td><td>13.625</td><td>24.000</td><td>38.875</td><td>59.000</td></tr></table>	X	1.5	2.0	2.5	3.0	3.5	4.0	f(x)	3.375	7.000	13.625	24.000	38.875	59.000	L4		
X	1.5	2.0	2.5	3.0	3.5	4.0													
f(x)	3.375	7.000	13.625	24.000	38.875	59.000													
8	2	Using the following table, compute $\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$ at x=1 <table><tr><td>X</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr><tr><td>Y</td><td>1</td><td>8</td><td>27</td><td>64</td><td>125</td><td>216</td></tr></table>	X	1	2	3	4	5	6	Y	1	8	27	64	125	216	L4		
X	1	2	3	4	5	6													
Y	1	8	27	64	125	216													



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9	2	Fit a straight line $y=a+bx$ from data	L4												
		<table><tr><td>X</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td>Y</td><td>1</td><td>1.8</td><td>3.3</td><td>4.5</td><td>6.3</td></tr></table>	X	0	1	2	3	4	Y	1	1.8	3.3	4.5	6.3	
X	0	1	2	3	4										
Y	1	1.8	3.3	4.5	6.3										
10	2	Fit a parabola $y=a+bx+cx^2$ to the data given below.	L4												
		<table><tr><td>X</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr><tr><td>Y</td><td>10</td><td>12</td><td>8</td><td>10</td><td>14</td></tr></table>	X	1	2	3	4	5	Y	10	12	8	10	14	
X	1	2	3	4	5										
Y	10	12	8	10	14										
S.No.	C O	Questions	BT												
UNIT-3: SOLUTION OF INITIAL VALUE PROBLEM TO ORDINARY DIFFERENTIAL EQUATION															
1	3	Solve $y^1 = x + y$, given $y(1)=0$.Find $y(1.1)$ and $y(1.2)$ by Taylor's series method.	L3												
2	3	Tabulate $y(0.1)$, $y(0.2)$ and $y(0.3)$ using Taylor's series method given that $y^1 = y^2 + x$, and $y(0)=1$	L3												
3	3	Obtain $y(0.1)$, $y(0.2)$ given $\frac{dy}{dx}=x+y$, $y(0)=1$ using Picard's Method	L3												
4	3	Given $\frac{dy}{dx}=1+xy$ and $y(0)=1$, compute $y(0.1)$, $y(0.2)$ by Picard's Method	L3												
5	3	Solve numerically using Euler's method $y^1 = y^2 + x$, $y(0)=1$.Find $y(0.1)$ and $y(0.2)$, $y(0.3)$	L3												
6	3	Using Euler's method, solve for y at $x=2$ from $y^1 =3x^2 +1$, $y(1)= 2$, taking step size $h=0.25$	L3												
7	3	Apply Runge-Kutta forth order method to find $y(0.1)$ and $y(0.2)$ given that $y^1 = x^2 - y$ and $y(0)=1$	L4												



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8	3	Solve $y' = y - x$ using R-K method of fourth order given $y(0) = 2$, $h = 0.2$ and $y(0.2)$.	L4
9	3	Use Picard's method to approximate y when $x = 0.2$ given that $y = 1$ when $x = 0$ and $\frac{dy}{dx} = x - y$.	L3
10	3	Given $\frac{dy}{dx} = 1 + y^2$ where $y = 0$ when $x = 0$ and $y(0.2)$, $y(0.4)$ using Runge kutta method	L4

S.No.	CO	Questions	BT
UNIT IV: (ESTIMATION AND TESTING OF HYPOTHESIS-LARGE SAMPLES)			
1	4	A sample of 64 students has a mean weight of 70 Kgs. Can this be regarded as a sample from a population with mean weight 56 Kgs and standard deviation 25 Kgs.	L3
2	4	In a random sample of 60 workers, the average time taken by them to get to work is 33.8 minutes with a standard deviation of 6.1 minutes. Can we reject the null hypothesis $\mu = 32.6$ minutes in favour of alternative null hypothesis $\mu > 32.6$ at $\alpha = 0.025$ level of significance.	L3
3	4	A sample of 400 items is taken from a population whose standard deviation is 10. The mean of the sample is 40. Test whether the sample has come from a population with mean 38. Also calculate 95% confidence interval for the population	L4
4	4	The Means of two large samples of sizes 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.	L4
5	4	In a big city 250 men out of 750 men were found to be smokers. Does the information support the conclusion that the majority of men in this city are smokers?	L4
6	4	Random samples of 400 men and 600 women were asked whether they would like to have a flyover near their residence. 200 men and 325 women were in favour of the proposal. Test the hypothesis that proportions of men and women	L4



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		in favour of the proposal are same at 5% level.	
7	4	An ambulance service claims that it takes on the average less than 10 minutes to reach its destination in emergency calls. A sample of 36 calls has a mean of 11 minutes and the variance of 16 minutes. Test the significance at 0.05 level.	L3
8	4	In a big city of 325 men out of 600 men are found to be smokers. Does the information support the conclusion that the majority of men in this city are smokers.	L4
9	4	If 80 patients are treated with an antibiotic 59 for cured. Find a 99% confidence limits to the true population of curve.	L3
10	4	Among 900 people in a state 90 are found to be eaters. Construct 99% confidence interval for the true proportion and also test the hypothesis for single proportion.	L4

S.No.	CO	Questions	BT																
UNIT-5: TESTING OF HYPOTHESIS-SMALL SAMPLE TESTS																			
1	5	Height of 10 males of a given location is found to 70,67,62,68,61,68,70,64,64,66 inches reasonable to believe that the average height is greater than 64 inches? Test at 5% LOS.	L3																
2	5	sample of 26 bulbs gives a mean life of a 990 hours with a Standard Deviation of 20 hours. The manufacturer claims that the mean life of bulb is 1000 hours. Identify the sample not up to the mark. (Single Mean)	L3																
3	5	A random sample of size 16 values from a normal population showed a mean of 53 and sum of squares of deviations from the mean equals to 150 . Can this sample be regarded as taken from the population having 56 as mean ? Obtain 95% confidence limits of the mean of the population	L4																
4	5	Two horses A and B were tested according to the time to run a particular track with the following results .Test whether two horses have same running capacity(Difference of Two Means) <table><tr><td>Horse A</td><td>28</td><td>30</td><td>32</td><td>33</td><td>33</td><td>29</td><td>34</td></tr><tr><td>Horse B</td><td>29</td><td>30</td><td>30</td><td>24</td><td>27</td><td>29</td><td></td></tr></table>	Horse A	28	30	32	33	33	29	34	Horse B	29	30	30	24	27	29		L4
Horse A	28	30	32	33	33	29	34												
Horse B	29	30	30	24	27	29													



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5	5	A pair of dice are thrown 360 times and the frequency of each sum is indicated below: <table><tr><td>Sum</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td></tr><tr><td>Frequency</td><td>8</td><td>24</td><td>35</td><td>37</td><td>34</td><td>65</td><td>51</td><td>42</td><td>26</td><td>14</td><td>14</td></tr></table> Would you say that the dice are fair on the basis of the chi-square test at 0.05 level of significance.	Sum	2	3	4	5	6	7	8	9	10	11	12	Frequency	8	24	35	37	34	65	51	42	26	14	14	L5							
Sum	2	3	4	5	6	7	8	9	10	11	12																							
Frequency	8	24	35	37	34	65	51	42	26	14	14																							
6	5	Given the following contingency table for hair colour and eye colour ,Find the value of chi-square. Is there good association between the two? <table><tr><td colspan="2" rowspan="2"></td><th colspan="4">Hair colour</th></tr><tr><th>Fair</th><th>Brown</th><th>Black</th><th>Total</th></tr><tr><th rowspan="4">Eye colour</th><th>Blue</th><td>15</td><td>5</td><td>20</td><td>40</td></tr><tr><th>Gray</th><td>20</td><td>10</td><td>20</td><td>50</td></tr><tr><th>Brown</th><td>25</td><td>15</td><td>20</td><td>60</td></tr><tr><th>Total</th><td>60</td><td>30</td><td>60</td><td>150</td></tr></table>			Hair colour				Fair	Brown	Black	Total	Eye colour	Blue	15	5	20	40	Gray	20	10	20	50	Brown	25	15	20	60	Total	60	30	60	150	L4
		Hair colour																																
		Fair	Brown	Black	Total																													
Eye colour	Blue	15	5	20	40																													
	Gray	20	10	20	50																													
	Brown	25	15	20	60																													
	Total	60	30	60	150																													
7	5	A sample of 10 student's marks in an Entrance test out of 150 marks is given as 70,120, 110, 101, 88, 83, 95, 98, 107, 100. Test whether their mean mark is 100 at 5% LOS.	L3																															
8	5	To examine the hypothesis that the the Husbands are more intelligent than the wives, an investigator took a sample of 10 couples and administrated them a test which measure the I.Q the result are as follows: Test the hypothesis with reasonable test at 0.05 L.O.S <table><tr><td>Husbands</td><td>117</td><td>105</td><td>97</td><td>105</td><td>123</td><td>109</td><td>86</td><td>78</td><td>103</td><td>107</td></tr><tr><td>Wives</td><td>106</td><td>98</td><td>87</td><td>104</td><td>116</td><td>95</td><td>90</td><td>69</td><td>108</td><td>85</td></tr></table>	Husbands	117	105	97	105	123	109	86	78	103	107	Wives	106	98	87	104	116	95	90	69	108	85	L4									
Husbands	117	105	97	105	123	109	86	78	103	107																								
Wives	106	98	87	104	116	95	90	69	108	85																								
9	5	The following random samples are measurement of the heat-producing capacity (in millions of calories per Ton) of specimen of Coal from two mines <table><tr><td>Mine-I</td><td>8260</td><td>8130</td><td>8350</td><td>8070</td><td>8340</td><td>-</td></tr><tr><td>Mine-II</td><td>7950</td><td>7890</td><td>7900</td><td>8140</td><td>7920</td><td>7840</td></tr></table>	Mine-I	8260	8130	8350	8070	8340	-	Mine-II	7950	7890	7900	8140	7920	7840	L4																	
Mine-I	8260	8130	8350	8070	8340	-																												
Mine-II	7950	7890	7900	8140	7920	7840																												



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		Use 0.01 Level of Significance test whether variances of two samples are equal.				
10	5	On the basis of information given below about the treatment of 200 patients suffering from disease, state whether the new treatment is comparatively superior to the conventional treatment.				L4
		Treatment	Favourable	Not Favourable	Total	
		New	60	30	90	
		Conventional	40	70	110	

Note: L1-Remembering, L2-Understanding, L3-Appling, L4-Analyzing, L5-Evaluating, and L6-Creating

Text books:

1. S S Sastry, Introductory Methods of Numerical Analysis, PHI Learning Private Limited.
2. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 2017, 44th Edition
3. Miller and Freunds, Probability and Statistics for Engineers, 7/e, Pearson, 2008.India.

Reference Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 2018, 10th Edition.
2. R.K. Jain and S.R.K. Iyengar, Advanced Engineering Mathematics, Alpha Science International Ltd. 5th Edition (9th reprint).
3. Ronald E. Walpole, Probability and Statistics for Engineers and Scientists, PNIE
4. H. K Das, Er. Rajnish Verma, Higher Engineering Mathematics, S. Chand Publications, 2014, Third Edition (Reprint 2021)