DEPARTMENT OF MECHANICAL ENGINEERING

STATISTICS AND NUMERICAL METHODS

MA3251

QUESTION BANK

UNIT-I

TESTING OF HYPOTHESIS

PART-A

1. What are parameters and statistics in sampling?
2. Define Type – I error and Type – II error.
3. What are null and alternate hypothesis?
4. Define sampling distribution.
5. Define level of significance.
6. Define Chi-Square test for goodness of fit.
7. State the application of Chi-square test.
8. Give the formula for the - test of independence for

a	b
c	d

9. Write any two applications of -test
10. W rite any two properties of t-distribution.
11. State the applications of F-distribution.

PART-B

1. Samples of two types of electric balls were tested for length of life and following data were obtained

	Type I	Type II
Sample size	$n_1 = 8$	$n_2 = 7$
Sample mean	$\bar{x}_1 = 1234$ hours	$\bar{x}_2 = 1036$ hours
Sample S.D	$s_1 = 36$ hours	$s_2 = 40$ hours

Is the difference in the means sufficient to warrant that type I is superior to type II regarding the length of life?

2. Examine whether the difference in the variability in yields is significant at 5% level of significance for the following:

	Set of 40 plots	Set of 60 plots
Mean yield per plot	1256	1243
S.D. per plot	34	28

3. A sample of 900 members has a mean 3.4 cm and standard deviation 2.61 cm. Is the sample from a large population of mean 3.25 cms and standard deviation of 2.61cms?

4. Theory predicts that the proportion of beans in four groups A,B,C,D should be 9:3:3:1. In an experiment among 1600 beans, the numbers in the four groups were 882,313,287 and 118. Does the experiment support the theory?
5. Test whether there is any significant difference between the variances of the populations from which the following samples were taken:

Sample I:	20	16	26	27	23	22	
Sample II:	27	33	42	35	32	34	38

6.Two random samples gave the following results:

Sample	Size	Sample mean	Sum of squares of deviation from the mean
1	10	15	90
2	12	14	108

Test whether the samples have come from the same normal population.

7. Two independent samples of eight and seven items respectively had the following values of the variables:

Sample - I	9	11	13	11	15	9	12	14
Sample - II	10	12	10	14	9	8	10	

Do the two estimates of population variance differ significantly at 5% level of significance.

8. Two independent samples of sizes 8 and 7 contanied the following values:

Sample - I	19	17	15	21	16	18	16	14
Sample - II	15	14	15	19	15	18	16	

I s the difference between the sample means significant?

9. A survey of 320 families with five children each revealed the following distribution:

Number of Boys :	0	1	2	3	4	5
Number of Girls :	5	4	3	2	1	0
Number of Families :	12	40	88	110	56	14

Is this result consistent with the hypothesis that male and female births are equally probable?

10. Given the following contingency table for hair colour and eye colour , find the value of Chi-Square. Is there good association between the two?

		Hair Colour			
		Fair	Brown	Black	Total
Eye colour	Blue	15	5	20	40
	Grey	20	10	20	50
	Brown	25	15	20	60
	Total	60	30	60	150

UNIT-II

DESIGN OF EXPERIMENTS

PART-A

1. State the assumptions involved in ANOVA
2. Write the ANOVA table for one way classification.
3. Compare one-way classification model with two-way classification model
4. State the basic principles of design of experiments
5. What is meant by Latin square?
6. What are the advantages of a Latin square design?
7. State the merits of Latin square design.
8. Define RBD.
9. Discuss the advantages and disadvantages of Randomized block design.
10. State the advantages of a factorial experiment over a simple experiment
11. What are the advantages of a completely randomized experimental design?

PART-B

1. The following data give the yields, of 12 plots of land in three samples, each of plots, under varieties of fertilizers. A, B and C.

three A	B	C
25	20	24
22	17	26
24	16	30
21	19	20

Is there any significant difference in the average yields of land, under the three varieties of fertilizers?

2.An experiment was designed to study the performance of 4 different detergents for cleaning fuel injectors. The following "cleanliness" readings were obtained with specially designed equipment for 12 tanks of gas distributed over 3 different models of engines.

	Engine 1	Engine 2	Engine 3	Total
Detergent A	45	43	51	139
Detergent B	47	46	52	145
Detergent C	48	50	55	153
Detergent D	42	37	49	128
Total	182	176	207	565

3. A tea company appoints four salesmen A,B,C and D and observes their sales in threeseasons- summer, winter and monsoon. The figures(in lakes) are given in the following table.

Seasons	Salesmen				Season's Total
	A	B	C	D	
Summer	36	36	21	35	128
Winter	28	29	31	32	120
Monsoon	26	28	29	29	112
Salesmen's Total	90	93	81	96	360

(i) Do the Salesmen significantly differ in performance?

(ii) Is there significant difference between the seasons?

4. A variable trial was conducted on wheat with 4 varieties in a Latin square design. The plan of the experiment and the per plot yield are given below:

C	25	B	23	A	20	D	20
A	19	D	19	C	21	B	18
B	19	A	14	D	17	C	20
D	17	C	20	B	21	A	15

Analyse data and interpret the result.

5 . The following is a Latin square of a design, when 4 varieties of seeds are being tested. Set up the analysis of variance table and state your conclusion. You may carry out suitable change of origin and scale.

A 105	B 95	C 125	D 115
C 115	D 125	A 105	B 105
D 115	C 95	B 105	A 115
B 95	A 135	D 95	C 115

UNIT-III

SOLUTION OF EQUATION AND EIGEN VALUE PROBLEMS

PART-A

1. Write the formula for Newton Raphson method.
2. State the order of convergence and convergence condition for Newton's method.
3. Define algebraic and transcendental equation.
4. Find an iterative formula to find $\sqrt{N}$ by Newton's method.
5. Arrive a formula to find the value of $\frac{1}{N}$ where $N \neq 0$, using Newton Raphson method
6. Arrive a formula to find the value of $\sqrt[3]{N}$ (N>0) using Newton Raphson method
7. Solve by Gauss Jordan method: $2x + y = 3,\ x - 2y = -1$
8. State the principle used in Gauss- Elimination method
9. Compare Gauss elimination and Gauss Jordan methods.
10. Compare Gauss Jacobi and Gauss Seidel methods.
11. Distinguish between Direct method and In Direct method.
12. Explain the term "Pivot Elements"
13. Find the dominant Eigen value of $A = \begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}$ by power method.

PART-B

1.Find the positive root of $x \log_{10} x - 1.2 = 0$ correct to three decimal places using Newton –Raphson Method.

2.Solve the system of equations by Gauss elimination method

$x + 3y - z = 5$; $4x + 4y - 3z = 3$; $2x - 3y + 2z = 2$

3.Solve by Gauss seidal method correct to two decimal places $10x + y - z = 11.09$;

$x + 10y + z = 28.08$; $-x + y + 10z = 35.61$

4.Solve the system of equations by Gauss Jordan method

$X + 3y + 3z = 16$: $x + 4y + 3z = 18$: $x + 3y + 4z = 19$

5.Using Gauss-Jordan method , find the inverse of the matrix $\begin{bmatrix} 1 & 1 & 3 \\ 1 & 3 & -3 \\ -2 & -4 & -4 \end{bmatrix}$

6.Find the iterative formula the value of $\frac{1}{N}$ where N is a real number using Newton-Raphson method. Hence evaluate $\frac{1}{26}$ correct to 4 decimal places.

7.Using power method, find all the eigenvalues of A $= \begin{bmatrix} 5 & 0 & 1 \\ 0 & -2 & 0 \\ 1 & 0 & 5 \end{bmatrix}$

8.Solve the system of the following equation using Gauss Jordan method correct to two decimal places. $2x_1+2x_2-x_3+x_4=4$; $4x_1+3x_2-x_3+2x_4=6$; $8x_1+5x_2-3x_3+4x_4=12$; $3x_1+3x_2-2x_3+2x_4=6$

9.Using Gauss –Seidel method solve the system of the following equation correct to a decimal places $10x_1-2x_2-x_3-x_4=3$; $-2x_1+10x_2-x_3-x_4=15$; $-x_1-x_2+10x_3-2x_4=27$; $-x_1-x_2-2x_3+10x_4=-9$

10.Find the inverse of matrix $\begin{bmatrix} 2 & 1 & 1 \\ 3 & 2 & 3 \\ 1 & 4 & 9 \end{bmatrix}$ using Gauss Jordan method.

UNIT IV

INTERPOLATION,NUMERICAL DIFFERENTIATION AN NUMERICAL INTEGRATION

PART-A

1. Write down the Lagrangian interpolation formula.

2. Using Lagrange's interpolation, find the polynomial through $(0,0),(1,1)$ and $(2,4)$.
3. Use Lagrange's formula, to find the quadratic polynomial that takes these values.

x	0	1	3
y	0	1	0

4.Construct the divided difference table:

x	2	5	10
y	5	29	109

5. State any two properties of divided differences.
6. What is the nature of n^{th} divided differences of a polynomial of n^{th} degree?
7. Find the second divided differences with arguments a, b, c if $f(x)=\frac{1}{x}$.
8. State Newton's forward interpolation formula.
9. State Newton-Gregory backward interpolation formula.
10. Evaluate $\int_{0.5}^{1}\frac{dx}{x}$ by Trapezoidal rule,dividing the range into 4 equal parts.
11. Write the Newton's formula for $\frac{dy}{dx}$ at $x=x_0$.
12. Write the formula for $\frac{dy}{dx}$ at $x=x_n$ using backward difference operator.
13. State the formula for $(y')and(y'')atx=x_0$ using forward differences.
14. State Simpson's $\frac{1}{3}$ rule of numerical integration
15. Write Simpson's rule, assuming 3n intervals.
16. What is the order of error in Trapezoidal rule?
17. What are the errors in Trapezoidal and Simpson's rules of integration?

PART-B

1.Using Newton's divided difference formula, find the polynomial of the given data

x	-1	0	1	3
y	2	1	0	-1

2. Find the value of y at $x=28$ from the following data using Newton's formula

x	20	23	26	29
y	0.3420	0.3907	0.4384	0.4848

3..Using Lagrangian's interpolation formula finds the values of y at $x = 10$ from the following data:

x	5	6	9	11
y	12	13	14	16

4. Find the polynomial of f(x) and also find y(12) using Newton's forward difference formula given:

x	10	20	30	40	50
y	46	66	81	93	101

5.The following are data from the steam table:

$Temp\ ^\circ C$	140	150	160	170	180
$\Pr essure(kgf/cm^2)$	3.685	4.854	6.302	8.076	10.225

Using Newton's formula, find the pressure of the steam for a temperature of 142^o and 175^o

6.Using Newton's divided difference formula, find f(x) from the following data and hence find f(4).

x :	0	1	2	5
f(x) :	2	3	12	147

7. Find f '(x) at x=1.5 and x=4.0 from the following data using Newton's formulae for differentiation.

X :	1.5	2.0	2.5	3.0	3.5	4.0
y=f(x) :	3.375	7.0	13.625	24.0	38.875	59.0

8. Evaluate $\int_1^2\int_1^2 \frac{dxdy}{x^2+y^2}$ by Trapezoidal rule numerically with h =0.2 along x-direction and k=0.25 along y-direction.

9. Evaluate $\int_1^2\int_3^4 \frac{dxdy}{(x+y)^2}$ by Simpson's rule taking $h = k = 0.5$

10.The velocity V of a particle at distance from a point on it's path is given by the table

T feet	:	0	10	20	30	40	50	60
V feet/s :	47	58	64	65	61	52	38	

Estimate the time taken to travel 5 and 55 feet by using Newton's method

UNIT V

NUMERICAL SOLUTION OF O.D.E

PART-A

1. Explain one-step methods and multistep methods.
2. Compute $y(1.1)$ by Taylor series method, given $\frac{dy}{dx} = x + y$, $y(1) = 0$.
3. Where the Taylor series method of solving differential equation is powerful?
4. Bring out the merits and demerits of Taylor Series method.
5. Using Eulers method find y(0.2) given $y' = x + y, y(0) = 1$.
6. Find y(0.1) by Euler's method if $\frac{dy}{dx} = x^2 + y^2$, y(0) = 1.
7. Evaluate using Euler method y(0.2) if $y' = \log_e(x + y)$ and y(0) = 2 by taking h = 0.2
8. Using Euler's method find y(0.1) from y' = x+y, y(0) =1.
9. Using modified Euler's method, find $y(0.1)$ if $\frac{dy}{dx} = x^2 + y^2$, $y(0) = 1$.
10. State the Special advantages of Runga-Kutta method over Taylor's method.
11. Write down the Milne's predictor and corrector algorithm.
12. Compare Runge- Kutta methods and Predictor –Corrector methods for the solution of initial value problems.
13. Write the central difference approximations $\frac{dy}{dx}, \frac{d^2y}{dx^2}$.
14. Write the finite difference equivalent of the differential equation $\frac{d^2y}{dx^2} - y = 2$ where y(0) = 0 and y(1) = 1, h = ¼.

PART-B

1. Using Taylor series method, find y at $x = 0.1$, 0.2 given that $\frac{dy}{dx} = x^2 - y$ and $y(0) = 1$
2. Apply fourth order Runge-Kutta method to determine $y(0.2)$ with $h = 0.1$ from $\frac{dy}{dx} = x^2 + y^2$, $y(0) = 1$
3. Using Milne's predictor-corrector method, find $y(4.4)$ given $5xy' + y^2 - 2 = 0$ given $y(4) = 1$, $y(4.1) = 1.0049$, $y(4.2) = 1.0097$, $y(4.3) = 1.0143$.
4. Given $y' = 1 - y$ and $y(0) = 0$ find y(0.1) by Taylor series method
5. Using Milne's predictor-corrector formula , find y at $x = 1.4$ given that $\frac{dy}{dx} = x^2(1 + y)$ and $y(1) = 1$, $y(1.1) = 1.233$, $y(1.2) = 1.548$ and $y(1.3) = 1.979$.
6. Use for modified Euler's method formula to find y (0.4), given $\frac{dy}{dx} = \frac{(1+x^2)y^2}{2}$, $y(0) = 1$ With h= 0.1

7.Apply Runge-Kutta fourth order method,find y(0.1),y(0.2),y(0.3).given $\frac{dy}{dx} = x + y^2, y(0) = 1$

and hence obtain y(0.4) using Milne's predictor-corrector formula method.

8.The finite difference method, compute $y(0.5)$ given $y'' - 64y + 10 = 0$, $x \in (0,1)$,

$y(0) = y(1) = 0$ Subdividing the interval into 4 equal parts.