## JEPPIAAR ENGINEERING COLLEGE

Jeppiaar Nagar, Rajiv Gandhi Salai - 600 119

#### **DEPARTMENT OF S & H**

### **QUESTION BANK**



#### **II SEMESTER**

MA 3251 - Statistics and Numerical Methods

Regulation - 2021

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TEPP	Ecce	Sub Code &	Name: MA 3251				
			STATISTICS AND NUMER	ICAL METHODS		Somosto	r·II
1997 C 20	CHENNAL CATION MAINTERS BRYOUTUNON	Unit: I	Branch:			Semeste	
		<u> </u>	UNIT I TESTING OF HYP	OTHESIS			
rge sam distribut <b>ference</b> blishers	ple test based o tions for testing Grewal. B.S., New Delhi, 200	n Normal dist g means and and Grewal. 07.	ribution for single mean and variances – Contingency ta J.S., "Numerical Methods	d difference of mean able (Test for Indepo in Engineering and	is - Tests bas endency) — C Science'', 9t	ed on t, Goodness th Editio	<i>Chi <sup>2</sup> ai</i> s of fit. n, Khann
			PART – A				
 D.No.				BT Level	Compete	ence	PO
1.	What is statis	stical hypothe	sis?(Nov/Dec-2017)	BTL -1	Remembe	ering	PO1
2.	Define chi-sq	uare. ?(Nov/D	vec-2017)	BTL -1	Remembe	ering	PO1
3.	Write type I ov/Dec-2013)	and type II er (May/Jun-201	rors .(Apr/May- 6)	BTL -1	Remembe	ering	PO1
4.	What are the 2016)(Apr/M	assumptions ay-2015)	in 't' distribution?(Nov/Dec	BTL -1	Remembe	ering	PO1
5.	State the imp ( Apr/May-20	ortant proper 015)	rties of the t-distribution.	BTL -1	Remembe	ering	PO1
6.	Write any th distribution.(	ree applicatio May/Jun-2014	ns of Chi-Square	BTL -1	Remembe	ering	PO1
7.	Define null a	nd alternative	hypothesis.	BTL -2	Understan	ding	PO2
8.	When do we	use the t-dist	ribution? (Nov/Dec-2016)	BTL -2	Understanding		PO2
9.	What is mea	nt by level of s	ignificance? (Apr/May-2016	) BTL -2	Understan	ding	PO2
10.	Define Stand 2016)	ard error and	Critical region. (Nov/Dec-	BTL -2	Understan	ding	PO2
11.	Write any tw	o applications	of 't'-distribution. (Nov/Dec	BTL -3	Applyin	Ig	PO3
12.	Write the co	ndition for the	application of $\chi^2$ test.	BTL -3	Applyin	g	PO3
13.	Write any th (Nov/Dec-202	ree applicatio 15)	ns of 'F' distribution.	BTL -6	Creatin	ng	PO1,PO2 PO5
14.	State the (Nov/Dec-202	important 11)	properties of F-distri	oution. BTL -4	Analyzir	ng	PO1,PO2 PO5
				I			
15.	Define sampl	ling distributic	n. (Apr/May-2013)	BTL -4	Analyzir	ng	PO1,PO2 PO5

17	Write down the form population mean in	n of terr	f the ms o	95% confidence interval for the fopulation S.D.	BTL -5	Evaluating	PO1,PO2, PO5
18.	What is the Standar means of two larges with known SD's	d er sam	ror o ples	of the difference between the drawn from different populations	BTL -5	Evaluating	PO1,PO2, PO5
19.	What is the test stat difference between	istic sm	c use all sa	d to test the significance of the ample,mean and population?	BTL -6	Creating	PO1,PO2, PO5
20.	What is the test stat ce between the mea	cistio ns c	c use of tw	d to test the significance of the o small samples?	BTL -4	Analyzing	PO1,PO2, PO5
21	Write down the forr significance of dif	nula fere	a of t ence	est stastistic 'Z' to test the between the means (large s)	BTL -3	Applying	PO5
22	Write down the form significance of diffe samples).	nula reno	a of t ce be	est statistic 'Z' to test the etween the proportions(large	BTL -3	Applying	PO5
23	What is the test stat difference betweer same size, when the	istic n th e sar	c use ie m mple	d to test the signifiance of the eans of two small samples of items are correlated?	BTL -6	Creating	PO1,PO2, PO5
24	What are the expect given below.	a C	freq b d	uency of 2x2 contigency table	BTL -4	Analyzing	PO1,PO2, PO12
25	Write down the 1% two tailed Tests.	and	d 5%	critical values for right tailed	BTL -4	Analyzing	PO1,PO2, PO12
26	What is the differen tolerance limits?	ce b	oetw	een confidence limits and	BTL -3	Applying	PO12
27	What are the assum	ptic	ons o	f large sample?	BTL -5	Evaluating	PO1,PO2, PO12
28	What is test of good	lnes	s of	fit?	BTL -3	Applying	PO12
29	Define hypothesis				BTL -6	Creating	PO1,PO2, PO5
30	What is meant by po	opul	latio	1?	BTL -4	Analyzing	PO1,PO2, PO5
	- 1			PART – B	1	L	1

1.(a)	The mean life by a compan deviation of 9 mean life tim 1600 hours.	e time o y is foun 90 hours ne of the (Apr/Ma	f a sample d to be 15 . Examine tubes pro y-2016)	of 100   80 hour the hyp duced b		BTL -1	Remembering	PO1			
1. (b)	Test of fidelit	ty and se	electivity of	190 rad	dio recei	vers					
	produced the	e results	shown in t	he follc	wing tal	ble					
		Fideli	ty								
	Selectivit		Averag	Hig							
	У	LOW	е	n							504
	Low	6	12	32					BIL-1	Remembering	PO1
	Average	33	61	18							
2. (a)	High Use 0.01 level relationship l A sample of 2 The mean he Can it be reas	13 between 100 stud ight of t sonably	15 ificance to fidelity an ents is tak he student regarded t	0 test wi d select en from s in this hat this	hether th ivity. (No a large s sample sample	nere is a ov/Dec popula is 160c is from	a - 2017 tion. cms. a	7)			
	population o Also estimate 2015)	f mean 1 e the 959	165 cm and % fiducial li	l standa mits fo	ard devia r the me	ition 10 an. (Ap	or/Ma	<b>у</b> -	BTL -1	Remembering	PO1
	Given the fol value of Chi-s and eye colo	lowing t square. I r? (Nov/ Hai	able for ha s there goo Dec-2012) ir color	ir color od assoc	and eye ciation b	color, etween	ident 1 hair	ify th colo	r r		
2 (b)		Fair	Brow	Blac	Total				BTL_1	Remembering	PO1
2.(6)	Blue	15	5	20	40					Kennenibering	101
	Grev	20	10	20	50						
	Brown	25	15	20	60	•					
	Total	60	30	60	150	-					
3. (a)	Two indepen	dent sar	nples of siz	es 8 an	d 7 cont	ained tl	he				
	following val	ues. (No	v/Dec-201	3)							
	Sample I	19 1	.7 15	21 1	.6 18	16	1	4	BTL -2	Understanding	PO2
	Sample II	15 1	4 15	19 1	.5 18	16					
2 (b)	(Apr/May-20	16)									
3.(0)	The following	g data gi	ves the nu	nber of	aircraft	accider	nts th	at			
	accidents are	ing the v	various day nlv distribu	ted over	veek. Fin or the we	ia whet Yek	ner ti	ne			
		. unnonn					ı.		BTL -2	Understanding	PO2
			Su Mo	Tue	We	Th	Fr	Sa		Shacistanang	_
	Days	o into	n n	S	d	u	Ì	t			
		ents	14 16	0	12	11	0	11			
			14   16	ð	12	11	9	14			

4. (a)	Two indep the followi Use 0.05 L	ender ng Va OS to	it sam lues c test	ples of the	of 8 a varia	nd 7 i ble(w	tems i eight i	respectin kgs)	tively	y had	BTI -2	Understanding	ΡΟ2
	Sample I	1 1	$\frac{1}{1}$	$\frac{1}{2}$ 10	) 14	15	9	10	14			onderstanding	102
	whether th	ne vari	ance	$\frac{2}{5}$ of the	$r_{14}$		ulatio	n's sai	nple	are			
	equal. (Apr	/May	-2014	.)									
5. (a)	A group of	10 ra	ts fed	on d	iet A a	and ar	nothe	r grou	p of 8	3 rats			
	fed on diet	t B. Re	corde	ed the	e follo	wing	increa	ase th	е				
	tollowing i	ncreas	se in v	veign	t.(gm)	)			_				
	Diet A	56	8	1 1	L2 4	3	96	5 10			BTL -2	Understanding	PO2
	Diet B	2 3	6	8 1	10	2	8 -	-					
	Find the va	ariance	es are	signi	ficant	ly diff	ferent	. (Use	F–te	st)			
<b>F</b> (L)	(Nov/Dec-2	2014)				f 0 #0	<u></u>						
(a) <sup>2</sup>	students a	nd and	neu b hther	y a gr	oup c n of 1	n 9 re 1 nart	guiar time	cours	e e stu	dents in			
	a test are a	riven l	pelow	gi 0 uj /:	5011	r part	. time	cours	e stu				
	Sample	5	6 6	5 5	6	5	6 6	5 5					
		6	2 3	3 4	0	1	7 9	8			BTI -4	Applying	PO12
	Sample	6	7 7	76	6	5	7 6	5 7	6	6	012 1	трылтв	1012
	П	2	0 1	L 2	0	6	5 4	1 2	8	6			
	Examine w	hethe	r the	mark	s obta	ained	by reg	gular s	tude	nts and			
	part – time	e stuu onifica		/Anr/l	Mav-2	10112)	y at 53	% anu	1%				
6 (a)		ondor	t com				nd 7 c	ontair	and th	20			
0. (d)	following	values	it saii	ipies	01 5126	25 O di		Untai	ieu ti	ie			
	Sample							1	[	1			
	I	19	17	15	21	16	18	16	14		BTL -2	Understanding	PO2
	Sample												
	II	15	14	15	19	15	18	16					
	Test if the	two p	opula	tions	have	the sa	ame v	ariand	æ.				
6.(b)	In a certai	n fact	ory th	nere a me ite	re tw	o inde	epend	lent p weigh	roces It in a	ses			
	of 250 iten	ns pro	duce	d fron	n one	proce	ess is	found	to be	e 120			
	Ozs, with a	stand	dard o	deviat	ion o	f 12 O	)zs, wl	hile th	e		BTL -4	Applying	PO12
	correspond	ding fi	gures	in a s	sampl	e of 4	00 ite	ems fr	om th	ne other			
	sample me	e 124 eans si	anu 1 gnific	ant?	(Nov/	Dec-2	2014)	tweer	i the	lwo			
			0		/		• /						
	Records ta	ken o	f the I	numb	er of	male	and fe	emale	birth	s in			
	800 familie	es hav	ing fo	ur									
	Number of	e as t male	0110W hirth	s : c	• (	n	1	2	z	Л			
	Number of	fema	le bir	ths	:	4	<u>-</u> 3	2	1	- 0			
7. (a)	Number of	Fami	ies	-	:3	2 1	.78 2	290	236	64	BTL -4	Analyzing	PO1,PO2,
	Infer whet	her t	he da	ata ar	e coi	nsiste	nt wi	th the	e hyp	othesis			rU3
	that the b	inomi male	al lav hirth	v hol	ds th	e cha	ance o	otar r/Man	nale	birth is			
	equal to le	male	un til,	nanne	- y y -	- /2 -	ч. (Ар	i / ivid	y-201				

7. (b)	Samples of life and	of two t follow	types of e ving data	electric bu were ob	ulbs wer tained.	e tested fo	r length			
				Tvp	e - I	Type - II				
		Samp	le size		3	7				
		Samp	le mean	123	4 hrs	1036 hrs		BTL -3	Applying	PO12
		Samp	le S.D	36	hrs	40 hrs				
	Analyze tl	hat, is t	he differ	ence in th	ne mear	is sufficient	to			
	warrant t	hat typ	e I is sup	erior to t	ype II re	garding th	e length			
	of life? (N	lov/Dec	:-2015)							
8. (a)	A survey of following	of 320 f distrib	families v ution	with 5 chi						
	Boys	5	4	3 2	1	0				
	Girls	0	1	2 3	4	5		BTL-6	Creating	PO1,PO2,
	Famili							DIL U	Creating	PO12
	es	14	56 1	10 88	40	12				
	Is this res	ult con	sistent w	hth the hy	/pothesi	s that male	and			
	female bi	rths are	e equally	probable	27	6 4 9 9 6				
8.(b)	The mean	) produ	ce of wh	eat from	a sampl	le of 100 fie	elds Fiolds			
	gives a m	zookg ean 22	0 kg per	acre. Assi	uming th	ne standard				
	deviation	of the	yield at 1	11 kg for	the univ	verse, test i	f there is	2 ודם	Understanding	DOJ
	a significa	nt diffe	erence b	etween th	ne mear	ns of the sa	mples?	DIL-Z	Understanding	PO2
	(Apr/May	-2015)								
9. (a)	Two inde	pender	it sample	es of sizes	9 and 7	from a noi	mal			
	populatio	n had t	he follov	wing value	es of the	e variables	Sample 1			
		18	13	12 15	12 14	16 14	15		Demonshering	DO1
	Sample 2	16	19	13 16	18 13	3 15		BIL-T	Remembering	201
	Justity wh	ether t	he differ	ence bet	ween th	e means of	samples			
	of sample	es signif	ricant? (N	Nov/Dec-2	2016)					
9.(b)	A simple s	sample	of heigh	ts of 640	0 Englisl	hmen has a	mean of			
	1/0cms a	nd a st	andard d	leviation (	of 6.4cm	is, while a s	Simple			
	and a star	ndard c	eviation	of 6.3cm	s. Do th	e data indi	cate that			
	American	s are, o	on the av	erage, tal	ler than	Englishme	n?(BTL4)	BTL -1	Remembering	PO1
	(Apr/May	-2016)		0 - /		0				
	,									
10.(a)	Two rand	om san	nples gav	e the foll	owing r	esults:				
	Sampl	c:	Sampl	Su	m of sq	uares of				
	е	Size	e Mean	ue	mea	nom me				
			Wiedh					BTL -1	Remembering	PO1
		10	15		90		_			
		12	14		108	<u>5</u>				
	Analyze w	/nether	the sam	ples have	e come f	rom the sa	me			
10 /63	normal po	pulation	on. (Nov,	/Dec-2013	5) Diaschir	of 10 pation	itc			
(a).UI	resulted i	n the fo	ollowing	increases	in the F	3.P. 8. 8. 7.	5, 4,			
	1, 0, 0, -1	, -1. Ca	n it be co	oncluded	that the	medicine v	vas	BTL -1	Remembering	PO1
	responsib	le for t	he increa	ase in B.P	. 5% l.o.	s (Apr/May	- 2012)		Kennennbernig	
							-			

11.(a)	200 digits were chosen at random from a set of tables. The frequencies of the digits were given below: Use $\chi^2$ test to access the correctness of hypothesis that the digits were distributed in equal nos. in the table, given that the values of $\chi^2$ are16.9, 18.3, 19.7 for 9, 10, 11 degrees of freedom at 5% level of significance.	BTL -3	Applying	PO12
11.(b)	4 coins were tossed 160 times and the following results were obtained No. of heads : 0 1 2 3 4 Observed frequencies: 17 52 54 31 6 Under the assumption that the coins are balanced, find the expected frequencies of getting 0, 1, 2, 3, 4 heads and test the goodness of fit. (Nov/Dec-2014)	BTL -5	Evaluating	PO1,PO2, PO5
12.(a)	A sample of 200 persons with a particular disease was selected. Out of these, 100 were given a drug and the others were not given any drug. The result are as follows:DrugNo DrugsNumber of personssDrugsTotalCured6555120Not Cured354580Total100100200Test whether the drug is effective or not? (Apr/May- 2015)	BTL -1	Remembering	PO1
12.(b)	A certain stimulus administered to each of 12 patients resulted in the following increase of blood pressure 5,2,8,-1,3,0,-2,1,5,0, 4 & 6 can it be concluded that the stimulus will, in general, be accompanied by an increase in blood pressure?	BTL -6	Creating	PO1,PO2, PO12
13.(a)	In a referendum submitted by the students to the body at a university, 850menand 560 women voted. 500 men and 320 women voted favorably. Does this indicate a significant difference of opinion between men and women on this matter at 1% level of significance? (Nov/Dec-2014)	BTL -1	Remembering	PO1
13.(b)	Random samples drawn from two places gave the following data relating to the heights of male adults:Place APlace BMean height8S.D1234 hrs1036 hrsNo. of sample36 hrs40 hrsTest at 5 % level, that the mean height is the same for adults the two places. (Apr/May-2012)	BTL -2	Understanding	PO2
14.(a)	In a random sample of 1000 people from city A, 400 are four to be consumers of rice. In a sample of 800 from city B, 400 are found to be consumers of rice. Does this data give a significant difference between the two cities as far as the proportion of rice consumers is concerned?	BTL -4	Analyzing	PO1,PO2, PO5

	(Nov/Dec-2012)			
14.(b)	In a year there are 956 births in a town A of which 52.5% were male while in towns A and B combined, this proportion in a total of 1406 births was 0.496.Is there any significant difference in the proportion of male births in the two towns ? (Apr/May-2011)	BTL -2	Understanding	PO2

	UNIT - II DESIGN OF EXPERIMENTS										
	One way and two way classifications - Completely randomized	l design – F	Randomized block des	ign — Latin							
	square design - 2 <sup>2</sup> factorial	design.									
	PARI - A										
Q.No	Question	BT Level	Competence	РО							
1.	Write the advantages of Latin Square (Nov/Dec-2017)	BTL -1	Remembering	PO1							
2.	What are the conditions to be followed in one way classification?(Nov/Dec-2017)	BTL -1	Remembering	PO1							
3.	What is meant by analysis of variance?(May/Jun-2016)	BTL -1	Remembering	PO1							
4.	Why a 2x2 Latin square is not possible?Explain.(May/Jun-2016)(May/Jun-2014).	BTL -1	Remembering	PO1							
5.	Define Replication and Randomization.(Nov/Dec-	BTL -1	Remembering	PO1							
6.	What is the advantage of factorial experiment? (Nov/Dec-2016)	BTL -1	Remembering	PO1							
7.	What is the aim of design of experiment?(Apr/May- 2015)	BTL -2	Understanding	PO2							
8.	What are the basic principles of experimental design? (Apr/May-2015)	BTL -2	Understanding	PO2							
9.	Write the advantages and disadvantages of RBD?(Apr/May-2015)	BTL -2	Understanding	PO2							
10.	What is Latin Square design ?	BTL -2	Understanding	PO2							
11.	Define Raw Sum of Squares and Correction factor	BTL -3	Applying	PO1,PO2,PO12							
12.	Write any 3 applications of LSD. (Nov/Dec-2014)	BTL -3	Applying	PO1,PO2,PO12							
13.	How do you calculate the Correction factor in LSD? (Nov/Dec-2012)	BTL -3	Applying	PO1,PO2,PO12							
14. r	What do you mean by design of nts?(Nov/Dec-2014)	BTL -4	Analyzing	PO5							

15.	What are the subject matters included in the design of experiment?	BTL -4	Analyzing	PO5
16.	What are the assumptions in ANOVA? ?(Apr/May-	BTL -4	Analyzing	PO5
17.	are the three essential steps to plan an experiment?	BTL -5	Evaluating	PO1,PO2,PO5
18.	What are the basic steps in ANOVA? ?(Apr/May-2014)	BTL -5	Evaluating	PO1,PO2,PO5
19.	Write the steps to find F-ratio. (Nov/Dec-2016)	BTL -6	Creating	PO1,PO2,PO5
20.	Discuss the advantages of Completely Randomized block design.	BTL -6	Creating	PO1,PO2,PO5
21	State the uses of ANOVA. ? (Apr/May-2015)	BTL -4	Analyzing	PO12
22	Explain the word treatment in ANOVA. ?(Apr/May- 2015)	BTL -4	Analyzing	PO12
23	What do you mean by 2-way classification?	BTL -4	Analyzing	PO12
24	Indicate the characteristics of a good experimental Design (Nov/Dec-2011)	BTL -5	Evaluating	PO1,PO2,PO5
25	What are the important designs of experiments?	BTL -5	Evaluating	PO1,PO2,PO5
26	What is an experimental error ? (Nov/Dec-2011)	BTL -6	Creating	PO1,PO2,PO5
27	What is meant by CRD? ?(Apr/May-2012)	BTL -6	Creating	PO1,PO2,PO5
28	Compare RBD and LSD.	BTL -3	Applying	PO1,PO2,PO5
29	Compare LSD and RBD. ?(Apr/May-2015)	BTL -3	Applying	PO1,PO2,PO5
30	What are the uses of Chi-Square test?	BTL -4	Analyzing	PO5
	PART - B	1		
1.(a)	The accompanying data resulted from an experiment comparing the degree of soiling for fabric copolymerized with the 3 different mixtures of met acrylic acid. Analyse the classification.Mixture 1: 0.561.120.901.070.94Mixture 2: 0.720.690.870.780.91Mixture 3: 0.621.081.070.990.93(Apr/May-2017)	BTL -1	Remembering	PO1
1. (b)	A set of data involving 4 tropical food stuffs A, B, C, D tried on 20 chicks is given below. All the 20 chicks are treated alike in all respects except the feeding treatments and each feeding treatment is given to 5 chicks. Analyze the data: A 55 49 42 21 52 B 61 112 30 89 63 C 42 97 81 95 92 D 169 137 169 85 154 (Apr/May-2016)	BTL -2	Understanding	PO2

2. (a)	The following table shows the lives in hours of four brands of electric lamps brand			
	A:1610, 1610, 1650, 1680, 1700, 1720, 1800			
	B: 1580, 1640, 1640, 1700, 1750			
	C:1460, 1550, 1600, 1620, 1640, 1660, 1740, 1820	BTL -1	Remembering	PO1
	Di1510 an 520 ys1530 van 570 and test the homogeneity			
	of the mean lives of the four brands of lamps. (Apr/May-			
	2014)			
2.(b)	A company appoints 4 salesmen A, B, C and D and			
	observes their sales in 3 seasons, summer winter and			
	SALESMEN			
	SEASON 1 2 3 4	BTL -2	Understanding	PO2
	SUMMER 45 40 28 37			
	WINTER 43 41 45 38			
	MONSOON 39 39 43 41			
3.	Carry out an Analysis of variances. (Apr/May-2013) In			
	order to determine whether there is significant difference			
	5 are selected from each make and the frequency of			
	repair during the first year of purchase is observed. The			
	results are as follows: In view of the above data, what			
	MAKES	BTL -1	Remembering	PO1
	A B C			
	5 8 7			
	6 10 3			
	8 11 5			
	9 12 4			
4.	7 4 1			
	(Apr/May-2012)			
	disease and observe the number of days each patient take			
	store cover. The results are as follows (recovery time in			
	days)			
		BTL -2	Understanding	PO2
	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$			
	B 11 15 24 17 21			
	C 9 12 20 16 19			
	D 8 13 17 17 20			
	E 12 15 19 15 22			
5.	Estimate the difference between (a) doctors and (b)			
	treatments for the above data at 5% level. (Nov/Dec-	BTL -3	Applying	
	Perform a 2-way ANOVA on the data given below:	_		1 01,1 02,1 03
	, Treatment 1			
	1 2 3			
	<u> គ្គ ្គ 1 30 26 38</u>			
1		1		

		2	24	29	28				
		3	33	24	35				
		4	36	31	30				
		5	27	35	33				
	Use the coding m	ethod sub	tractin	g 30 fro	om the	given no.			
	(Nov/Dec-2016)			0		0			
6.	The following dat	a represei	nt a cer	tain pe	rson to	o work			
	from Monday to	Friday by 4	4 differ	ent rou	ites.				
				DAYS					
		MON	TUE	WED	THU	J FRI			
	1	22	26	25	25	31			
	S 2	25	27	28	26	29	BTL -2	Understanding	PO2
		26	29	33	30	33	012 2		
	Test at 5% levelo	of sig2tofica	nc@8wh	eth267 ti	hed3f00	erences			
	among the mean	s obtained	for th	e differ	ent ro	utes are			
	significant and als	so whethe	r the di	ifferenc	es am	ong the			
	means obtained	for the dif	ferent o	days of	the we	eek are			
-	Applyze the vari	Dec-2015)	ha fall	owing	Latin	squara of			
/.	vields of paddy	where A.	B. C. I	D denc	te the	different			
	methods of cultiv	ation	2, 2,						
	D	122 A12	21 C1	.23 B	122				
	В	124 C12	23 A1	.22 D	125			A	205
	Δ	120 B11	19 D1	20 C	121		BIL-4	Analyzing	P05
		122 012	)2 P1	21 A	122				
	Examine whether	the differ	ent me	thods of	of culti	vation have			
	given significantly	v different	vields.	(Nov/E	Dec- 20	)14)			
0 (1)	The following dat	, ta resulted	, I from a	an expe	rimen	t to compare			
8. (a)	three burners A,	B, C. A Lat	in squa	ire desi	gn was	s used as the			
	tests were made	on 3 engir	nes and	were s	pread	over 3 days.			
		A16	B17	C20	_				
		B16	C21	A15			BTL -1	Remembering	PO1
		C15	A12	B13					
	(Nov/Dec-2013)				_				
	A variable	trial was c	conduct	ed on v	wheat	with 4			
8.(b)	varieties in	a Latin squ	uare de	esign. T	he plar	n of the			
	experiment	and the pe	er plot y	yield ar	e giver	n below.			
		C25 B23	AZU L	JZU ΑΙ Β10 Λ1	9 1				
		-D17 C21	$\frac{0}{0}$ D10	$\frac{1}{7}$	- 0		BTL-5	Evaluating	PO5
		B21 A	15						
		(Nov	/Dec-20	012)					

9.	A farmer wishes to test the effects of four different fertilizers A, B, C, D on the 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 per unit area. <u>A18 C21 D25 B11</u> <u>D22 B12 A15 C19</u> <u>B15 A20 C23 D24</u> <u>Design an applysis of variance to determine if there is a significant difference between the fertilizers at <math>\alpha</math>=0.05 and <math>\alpha</math>=0.01 levels of significance.</u>	BTL -1	Remembering	PO1
10.	$\begin{tabular}{ c c c c c c } \hline Set up the analysis of variance for the following results of a Latin Square Design(use $\alpha$ = 0.01$) level of significance \\ \hline $A12$ C19$ B10$ D8$ \\ \hline $C18$ B12$ D6$ A7$ \\ \hline $B22$ D10$ A5$ C21$ \\ \hline $D12$ A7$ C27$ B17$ \\ \hline \end{tabular}$	BTL -4	Analyzing	PO5
11.	In a 5x5 Latin square experiment, the data collected is given in the matrix below Yield per plot is given in quintals for the five different cultivation treatments A, B, C,D and E. Perform the analysis of variance. A48 E66 D56 C52 B61 D64 B62 A50 E64 C63 B69 A53 C60 D61 E67 C57 D58 E67 B65 A55 E67 C57 B66 A60 D57	BTL -6	Creating	PO1,PO2,PO5
12	In a Latin square experiment given below are the yields in quintals per acre on the paddy crop carried out for testing the effect of five fertilizers A, B, C, D, E. Analyze the data for variations. B25 A18 E27 D30 C27 A19 D31 C29 E26 B23 C28 B22 D33 A18 E27 E28 C26 A20 B25 D33 D32 E25 B23 C28 A20	BTL -3	Applying	PO1,PO2,PO5
13.	Find out the main effects and interaction effects in the following 2² factorial experiment and write down the analysis of variance tableBLOCKS1ABAB010111I64253060II75145033III76124117IV75332510	BTL -3	Applying	PO1,PO2,PO5

14.	An experime of potash ar All the comb two levels o with 4 replic the followin The yields o Analyze the 1%)	ent was and supe bination f sulph cation f g table btained e data a	s planne er phosp ns of 2 l ate (k) o or each d are giv and giv	ed to so bhate levels of pota . The ven in re you	on the of supe ash we yields o the fol r concl	the effect of sulphate yields of potatoes. r phosphate (p) and re studied in a RBD btained are given in lowing table. usion (with $\alpha$ =	BTL -3	Applying	PO1,PO2,PO1 2
	BLOCKS	Yi	elds (Pe	er Plot	)				
		(1)	а	b	ab				
		23	25	22	38				
	П п	Р	(1)	К	KP				
		40	26	36	38				
		(1)	К	KP	Р				
		29	20	30	20				
	IV	KP	К	Р	(1)				
		34	31	24	28				

UNIT III	SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS			
Newton Raph: methods of G matrix by pow Textbook : Edition,Khann	son method – Gauss elimination method – pivoting – Gauss Jordan methods – Iterative auss Jacobi and Gauss Seidel – Matrix inversion by Gauss Jordan method – Eigen values of a /er method. Grewal. B.S., and Grewal. J.S., "Numerical Methods in Engineering and Science", 9th a Publishers, New Delhi, 2007.			
PART – A				

Q.No	Questions	BT Level	Competence	PO
1	State the order (rate) of convergence and convergence condition for Newton Raphson method. (A.U.N/D 2017, N/D 2011,2012, M/J 2013)	BTL-4	Analyzing	PO1
2	Give Newton Raphson iterative formula. (A.U N/D 2009,M/J 2012,2014)	BTL-2	Understanding	PO1,PO2 ,PO3
3	Establish an iteration formula to find the reciprocal of a positive number N by Newton Raphson method. (A.U.N/D 2010, M/J 2012)	BTL-1	Remembering	PO1,PO2
4	State the principle used in Gauss-Jordan method. (A.U M/J 2011)	BTL-1	Remembering	PO1
5	Give the sufficient condition of convergence of Gauss Seidel method (A.U M/J 2011)	BTL-1	Remembering	PO1
6	Write the conditions for convergence in Gauss Seidel iterative technique. (or) When the method of iteration will be useful ? ( A.U M/J 2009)	BTL-3	Applying	PO1
7	State Gauss Seidel method. (A.U M/J 2011,N/D 2012)	BTL-1	Remembering	PO1,PO2
8	Gauss Seidel method always converges – True or False (A.U	BTL-1	Remembering	PO1,PO2

	M/J 2016)			
9	Write the first iteration values of x,y,z when the equations 27x+6y- z = 85, 6x+15y+2z = 72, x+y+5z = 110 are solved by Gauss Seidel method. (A.U N/D 2009,M/J 2012,2016)	BTL-3	Applying	PO1
10	Compare Gauss Elimination and Gauss Jordan methods for solving linear systems of the form AX=B. (A.U M/J 2016)	BTL-1	Remembering	PO1
11	What type of Eigen value can be obtained using power method? (A.U.N/D 2017, N/D 2011,2012, M/J 2014)	BTL-1	Remembering	PO1
12	Find the dominant eigen value of $A = \begin{bmatrix} 1 & 2 \\ 2 & 4 \end{bmatrix}$ by power method. (A.U M/J 2012)	BTL-1	Remembering	PO1
13	On what type of equations Newton's method can be applicable ? (A.U A/M 2016)	BTL-1	Remembering	PO1,PO2 ,PO5
14	By Gauss elimination method solve $x + y = 2$ and $2x + 3y = 5$ . (A.U M/J 2014)	BTL-1	Remembering	PO1
15	Why Gauss Seidel iteration is a method of successive corrections?(A.U M/J 2016)	BTL-4	Analyzing	PO1
16	What are the merits of Newton's method of iteration?	BTL-1	Remembering	PO1
17	Give two direct methods to solve a system of linear equations (A.U A/M 2013)	BTL-2	Understanding	PO2
18	Compare Gauss Elimination with Gauss Seidel method.( A.U M/J 2017)	BTL-1	Remembering	PO1
19	Find inverse of A = $\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$ by Gauss Jordan method.	BTL-1	Remembering	PO1,PO2
	(A.U M/J 2013)			
	PART-B		Γ	1
1	Solve $x \log_{10} x = 12.34$ with x <sub>0</sub> = 10 using Newton's method. (A.U.N/D 2017, N/D 2011,2012, M/J 2013)	BTL-4	Analyzing	PO1,PO2 ,PO5
2	Find the negative root of the equation $\sin x = 1 + x^3$ by using Newton Raphson method. (A.U M/J 2015)	BTL-4	Analyzing	PO1,PO2 ,PO5
3	Solve the following equation by Gauss Elimination method 10x - 2y + 3z = 23 2x + 10y - 5z = -33 (A.U.N/D 2017, N/D 3x - 4y + 10z = 41 2011,2012, M/J 2014)	BTL-5	Evaluating	PO1,PO2 ,PO5
4	Solve the equation by Gauss Jordan method : $2x_1 + x_2 + 4x_3 = 4$ $x_1 - 3x_2 - x_3 = -5$ $3x_1 - 2x_2 + 2x_3 = -1$	BTL-5	Evaluating	PO1,PO2 ,PO5

5	Find the inverse of $\begin{bmatrix} 2 & 2 & 3 \\ 2 & 1 & 1 \\ 1 & 3 & 5 \end{bmatrix}$ using Gauss Jordan method.	BTL-2	Understanding	PO1,PO2
6	Solve by Gauss Siedel method x + y + 54z = 110 27x + 6y - z = 85 6x + 15y + 2z = 72 (A.U.N/D 2017, N/D 2011,2013, M/J 2014)	BTL-2	Understanding	PO1,PO2
7	Find the dominant (largest) eigen value and the corresponding eigen vector of $A = \begin{bmatrix} 1 & -3 & 2 \\ 4 & 4 & -1 \\ 6 & 3 & 5 \end{bmatrix}$ by power method. (A.U M/J 2015)	BTL-5	Evaluating	PO1,PO2 ,PO5
8	Find the numerically largest eigen value of A = $\begin{bmatrix} 25 & 1 & 2 \\ 1 & 3 & 0 \\ 2 & 0 & -4 \end{bmatrix}$ by power method and the corresponding eigen vector. (A.U M/J 2011,N/D 2012)	BTL-5	Evaluating	PO1,PO2 ,PO5
9	Find the numerically largest eigen value of A = $\begin{bmatrix} 5 & 4 & 3 \\ 10 & 8 & 6 \\ 10 & 8 & 6 \end{bmatrix}$ by power method with the initial eigen $  \lfloor 20 - 4 \ 22 \rfloor  $ vector X <sub>0</sub> = $\begin{vmatrix} 1 \\ 1 \\ 1 \\ 1 \\ 1 \end{vmatrix}$ (A.U M/J 2016)	BTL-5	Evaluating	PO1,PO2 ,PO5

UNIT IV INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION

Lagrange's and Newton's divided difference interpolations – Newton's forward and backward difference interpolation – Approximation of derivates using interpolation polynomials – Numerical

single and double integrations using Trapezoidal and Simpson's 1/3 rules. Textbook : Grewal. B.S., and Grewal. J.S., "Numerical Methods in Engineering and Science", 9th Edition, Khanna Publishers, New Delhi, 2007.

	PART — A						
CO Ma	CO Mapping : C214.2						
Q.	Questions	BT	Competence				
No		Level					
1	Define interpolation and extrapolation?	BTL-4	Analyzing				
	(A.U.N/D 2017, N/D 2011,2012, M/J 2013)						

PO

PO1

2	State Newton's formula on interpolation. When it is used? (A.U.N/D 2017, N/D 2011,2012, M/J 2014)	BTL-1	Remembering	PO1,PO2
3	Say True or False. – Newton's divided difference formula is applicable only for equally spaced intervals. (A.U M/J 2011)	BTL-2	Understanding	PO1,PO2
4	State Newton's divided difference formula.	BTL-4	Analyzing	PO2
5	State Lagrange's interpolation formula	BTL-1	Remembering	PO1
6	Use Lagrange's formula to find the quadratic polynomial that takes these values x : 0 1 3 y : 0 1 0 Then find y(2). (A.U M/J 2011,N/D 2012)	BTL-2	Understanding	PO1
7	By differentiating Newton forward and backward difference formula, find the first derivative of the function f(x) (A.U M/J 2013)	BTL-2	Understanding	PO1,PO2
8	Write down the Newton – cotes quadrature formula.	BTL-1	Remembering	PO1
9	What is the geometrical interpretation of Trapezoidal rule? (A.U M/J 2016,N/D 2012)	BTL-1	Remembering	PO1
10	Using Trapezoidal rule evaluate $\int_{0}^{\pi} \frac{\sin x  dx}{\sin x  dx}$ by dividing the range into 6 equal parts.	BTL-1	Remembering	PO1
11	Why is Trapezoidal rule so called? (A.U N/D 2011,N/D 2014)	BTL-2	Understanding	PO1,PO2
12	What are the truncation errors in Trapezoidal and Simpson's rules of numerical integration?	BTL-4	Analyzing	PO1
13	What is the condition for Simpson's 3/8 rule and state the formula.	BTL-4	Analyzing	PO1,PO2
14	Using Simpson's rule find $\int e^{\frac{4}{x}} dx$ given $e = 1, e = 2.72, e$ = 7.39, $e^3 = 20.09, e^4 = 54.6$	BTL-4	Analyzing	P01
15	Compare Trapezoidal rule and Simpson's 1/3 <sup>rd</sup> rule for evaluating numerical integration. (A.U M/J 2015,N/D 2017)	BTL-1	Remembering	PO1
	PART — B			

	Construct Newton's forward interpolation polynomial for the			
	x: 4 6 8 10			DO1 DO2
1	y:1 3 8 16	BTL-5	Evaluating	, PO3,PO5
	Use it to find the value of y for x = 5. (A.U M/J 2011,A/M			
	2012)			
	The following data are taken from the steam table			
	Temp <sup>o</sup> c : 140 150 160 170 180 Pressure kg			PO1.PO2
2	$f/cm^2$ : 3.685 4.854 6.302 8.076 10.225 Find the pressure at temperature t = 175°	BTL-4	Analyzing	
	Using Lagrange's interpolation formula calculate the profit in the year 2000 from the following data			
	Year: 1997 1999 2001 2002			
3	Profit in lakhs	BTL-5	Evaluating	PO1,PO2, PO5,PO12
	of Rs. $\begin{cases} : 43 & 65 & 159 & 248 \end{cases}$			
	(A.O.N/D 2017, N/D 2011,2012, M/J 2013) Find the polynomial $f(x)$ by using Lagrange's formula and hence			
	find f(3) for			
4	X: 0  1  2  5	BTL-4	Analyzing	PO1,PO2,
	T(X): 2 3 12 147		, ,	P05,P012
	(A.U.N/D 2017, N/D 2011,2014, M/J 2013)			
	Using Newton divided difference formula find u(3) given u(1) = -			
5	26, u(2) = 12, u(4) = 256, u(6) = 844.	BTL-5	Evaluating	PO1,PO2, PO5,PO12
	From the given table, the values of y are consecutive terms of a			
	series of which 23.6 is the sixth term. Find the first and tenth terms of the series.			PO1.PO2.
6	x: 3 4 5 6 7 8 9	BIL-4	Analyzing	PO5,PO12
	(A.U M/J 2016)			
	The following data gives the velocity of a particle for 20 seconds			
	entire data			
7	time (sec.) : 0 5 10 15 20	BTL-5	Evaluating	PO1,PO2, PO5,PO12
	velocity (m/sec.) : 0 3 14 69 228			
	(A.U N/D			
	2015)			
	$\int \frac{dx}{dx}$		<b>Evolution</b>	PO1,PO2,
ð	Using Trapezoidal rule, evaluate $\int_{-1}^{1} 1 + x^2$ taking 8	BIL-2	Evaluating	PO5,PO12
	intervals.			

9	Find an approximate value of log e <sup>5</sup> by calculating to four decimal places by Simpson's rule the integral $\int_{4x}^{5} \frac{dx}{4x + 5}$ dividing the range into 10 equal parts. (A.U A/M 2016)	BTL-3	Applying	P01,P02, P05,P012
10	Evaluate $\int_{0}^{6} \frac{dx}{1+x^2}$ by dividing the range into 6 equal parts using Simpson's rule.	BTL-3	Applying	P01,P02, P05,P012
11.	Evaluate $\int_{0}^{1} \frac{dx}{1+x^2}$ take h = 0.125. Hence find $\pi$ using Simpson's rule. (A.U.N/D 2017, N/D 2011,2012, M/J 2014)	BTL-5	Evaluating	P01,P02, P05,P012
12.	Compute $\int_{0}^{1} \frac{x dx}{x^3 + 10}$ using Trapezoidal rule and Simpson's rule with the number of points 3,5,9. (A.U M/J 2017)	BTL-3	Applying	P01,P02, P05,P012

#### UNIT V NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS

Taylor's series method - Euler's method - Modified Euler's method - Fourth order Runge-Kutta method for solving first and second order equations - Milne's predictor-corrector methods for solving first order equations - Finite difference methods for solving second order equation.

	PART – A						
CO Map	CO Mapping :						
Q.No	Questions	BT Level	Competence	РО			
1.	State Modified Euler algorithm to solve y' = f(x, y), y(x) = y at x=x0 +h. (A.U.N/D 2017, N/D 2011,2012, M/J 2013)	BTL -1	Remembering	PO1			
2.	State the disadvantage of Taylor series method. (A.U N/D 2009,M/J 2012,2014)	BTL -1	Understanding	PO1			
3.	Write the merits and demerits of the Taylor method of solution. (A.U.N/D 2010, M/J 2012)	BTL -5	Understanding	PO1			
4.	Which is better Taylor"s method or R. K. Method?(or)	BTL -1	Remembering	PO1			

	State the special advantage of Runge-Kutta method over taylor series method. (A.U M/J 2011)			
5.	Compare Runge-Kutta methods and predictor – corrector methods for solution of initial value problem. (A.U M/J 2011)	BTL -1	Remembering	PO1
6.	What is a Predictor-corrector method of solving a differential equation?( <b>A.U M/J 2009</b> )	BTL -1	Understanding	PO2,PO 5
7.	State the third order R.K method algorithm to find the numerical solution of the first order differential equation. (A.U M/J 2011.N/D 2012)	BTL -1	Remembering	PO1
8.	Write Milne''s predictor formula and Milne''s correctorformula.(A.U M/J 2012,N/D 2014)	BTL -1	Understanding	PO1
9.	Write down Adams-Bashforth Predictor and Adams- Bashforth corrector formula.(A.U N/D 2011)	BTL -1	Understanding	PO1
10.	State Euler formula. (A.U M/J 2013)	BTL -1	Understanding	PO1
11.	Write down finite difference formula for y'(x) and y"(x) (A.U M/J 2012,N/D 2014)	BTL -1	Understanding	PO1
12.	Write down the Taylor series formula for solving first order ODE.	BTL -1	Understanding	PO1
13.	Using Taylor series method, find the value of y (0.1), from $f(x,y)=x^2 + y^2$ and $y(0) = 1$ correct to 4 decimal places	BTL -4	Analyzing	PO2
14.	Compare Taylor series method and RungeKutta method.	BTL -2	Remembering	PO5
15.	What are the advantages of R-K method over Taylor series method? (A.U N/D 2017)	BTL -2	Remembering	PO5
16.	Compare Single-step method Multi-step methods	BTL -1	Remembering	PO1
17.	Write down the error in Adam's predictor and corrector formulas	BTL -1	Understanding	PO1
18.	Write down the error in Milne's predictor and corrector formulas	BTL -1	Understanding	PO1
19.	Compare Adam's Bashforth method with RungeKutta method	BTL -1	Understanding	PO1
	PART-B			
1.	Using Taylor"s series method find y at $x = 0.1$ if $f(x,y)=x^2y-1,y(0)=1$	BTL -1	Remembering	PO1,PO2 ,PO5
2	Solve: $y'' = x + y$ ; $y(0) = 1$ , by Taylor''s series method. Find the values y at $x = 0.1$ and $x = 0.2$	BTL -3	Applying	PO1,PO2 ,PO5
3	Using Taylor"s series method find $y(1.1)$ given $y''=x + y, y(1) = 0$	BTL -1	Remembering	PO1,PO2 ,PO5

4	Using Euler's method find $y(0.2)$ and $y(0.4)$ from	BTL -1	Remembering	PO1,PO2 PO5
	$y^{**} = x + y, y(0) = 1$ with $h = 0.2$			,105
5	Consider the initial value problem $y'' = y - x^2 + 1$ , $y(0) = 0.5$ using the modified Euler's method, find $y(0.2)$	BTL -2	Understanding	PO1,PO2 ,PO5
6	Using R.K method of fourth order, Solve $\frac{dy}{dx} = \frac{y_2 - x_2}{\frac{y_1 + x_2}{2}}$	B <u>TL -1</u>	Remembering	PO1,PO2 ,PO5
	with $y(0) = 1$ at $x = 0.2$ .			
7	Using Milne"s method find y(4.4) gives $5xy$ " + $y^2 - 2$ = 0 given y(4) = 1, y(4.1) = 1.0049, y(4.2) = 1.0097 and y(4.3) = 1.0143.	BTL -1	Remembering	PO1,PO2 ,PO5
8	Obtain the approximate value of y at $x = 0.1 \& 0.2$ for the differential equation $\frac{dy}{dx} = 2y + 3e^x y(0) = 0$ by Taylor's Series method. Compare the numerical solution obtained with the exact solution	BTL -3	Applying	PO1,PO2 ,PO12
9	Solve $\frac{dy}{dx} = \sin x + \cos y$ , $y(2.5) = 0$ by Modified Euler's method by choosing h = 0.5, find y(3.5)	BTL -3	Applying	PO1,PO2 ,PO12
10	Solve $(1+x)\frac{dy}{dx} = -y^2$ , $y(0) = 1$ by Modified Euler's method by choosing $h = 0.1$ , find $y(0.1)$ and $y(0.2)$	BTL -3	Applying	PO1,PO2 ,PO12
11	Apply Runge – Kutta method, to find an approximate value of y when x = 0.2 given that $\frac{dy}{dx} = x + y$ , y(0) = 1.	BTL -5	Evaluating	PO1,PO2 ,PO5
12	Given $\frac{dy}{dx} = x - y^2$ $y(0) = 0$ , $y(0.2) = 0.02$ , $y(0.4) = 0.0795$ and $y(0.6) = 0.1762$ . Compute $y(1)$ using Milne's Method.	BTL -3	Applying	PO1,PO2 ,PO12
13	Using Milne's method to find y(4.4) given that $5xy' + y^2 - 2 = 0$ given that y(4) =1, y(4.1) = 1.0049, y(4.2) = 1.0097, y(4.3) =1.0143	BTL -1	Remembering	PO1,PO2 ,PO5

## **ANSWERS FOR TWO MARK QUESTIONS**

**UNIT –I-TESTING OF HYPOTHESIS** 

#### PART-A(2 MARKS)

(1).What is statistical hypothesis?(Nov/Dec-2017)

A **statistical hypothesis** is a **hypothesis** concerning the parameters or from of the probability distribution for a designated population or populations, or, more generally, of a probabilistic mechanism which is supposed to generate the observations

(2).Define chi-square. ?(Nov/Dec-2017)

$$\chi^2 = \sum_{i=1}^n (O_i - E_i)^2 / E_i$$

(3)Write type I and type II errors.(Apr/May-2015)(Nov/Dec-2013)(May/Jun-2016)

Type I error : Rejecting  $H_0$  when is true.

Type II error : Accepting  $H_0$  when it is false.

(4) What are the assumptions in 't' distribution?(Nov/Dec-2016)(Apr/May-2015)

(i) The parent population from which the sample is drawn is normal.

(ii) The sample is random.

(5) State the important properties of the t-distribution.(Apr/May-2015)

(i) For suffiently large value of n, the t-distribution tends to the standard normal distribution

distribution.

(ii) The mean of the t-distribution is zero

(iii). The probability curve of the t-distribution is similar to the std.normal curve and is symmetric about t=0,bell-shaped.

6). Write any three applications of Chi-Square distribution.(May/Jun-2014)

(i) To test the goodness of fit.

(ii) to test the independence of attributes.

(iii) To test the homogeneity of independent estimates of population.

(7) Define null and alternative hypothesis.

For applying the tests of significance ,we first set up a hypothesis which is a definite statement about the population parameter called Null hypothesis. Any hypothesis which is complementary to null hypothesis is called an alternative hypothesis.

(8) When do we use the t-distribution?

When the sample size is 30 or less and the population standard deviation is unknown, we use the t-distribution.

(9) What is meant by level of significance?

The probability ' $\alpha$ ' that a random value of the statistic 't' belongs to the critical region is known as level of significance.

(10) Define Standard error and Critical region.

The standard deviation of the sampling distribution of a statistic is known as the standard error. A region corresponding to a statistic 't' in the sample S amounts to rejection of the null hypothesis is called critical region.

(11) Write any two applications of 't'-distribution.

The t-distribution is used to test the significance of the difference between

- (i) the mean of the small sample and mean of the population.
- (ii) The coefficient of correlation in the small sample and that in the population

assumed zero.

- (12) Write the condition for the application of  $\chi^2$  test.
  - (i) The sample observations should be independent.
  - (ii) N, the total frequency should be at least 50.
    - (iii) Theoritical cell frequency should be less 5.
- (13) Write any three applications of 'F' distribution. F-test is used to test whether
  - (i) Two independent samples have been drawn from the normal populations with the same variance  $\sigma^2$  .
  - (ii) Two independent estimate of the population variance are homogeneous are not.

(14) State the important properties of F-distribution.

(i) The square of the t-variate with n degrees of freedom follows a F-distribution with 1 and n of freedom.

15) Define sampling distribution.

Different samples from the same population will result in general in distinct estimates, will form a statistical distribution called sampling distribution.

(16) Define Chi-square test of goodness of fit.

Chi-square test of goodness of fit is a test to find if the deviation of the experiment from theory is just by chance or it is due to the inadequacy of the theory to fit the observed data.

(17) Write down the form of the 95% confidence interval for the population mean in terms of population S.D.

$$\left(\overline{X} - 1.96 \frac{\sigma}{\sqrt{n}}, \overline{X} + 1.96 \frac{\sigma}{\sqrt{n}}\right)$$

(18) What is the Standard error of the difference between the means of two large samples drawn from different populations with known SD's.

$$\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}$$

(19) What is the test statistic used to test the significance of the difference between small sample, mean and population?

$$t = \frac{\overline{x} - \mu}{\frac{\sigma}{\sqrt{n}}}$$

(20) What is the test statistic used to test the significance of the difference between the means of two small samples?

$$t = \frac{\overline{x_1 - x_2}}{\sigma \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$$

(21) Write down the formula of test stastistic 'Z' to test the significance of difference between the means (large samples).

$$Z = \frac{\overline{x_1 - x_2}}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

(22) Write down the formula of test statistic 'Z' to test the significance of difference between the proportions(large samples).

$$Z = \frac{p_1 - p_2}{\sqrt{\frac{P_1 Q_1}{n_1} + \frac{P_2 Q_2}{n_2}}}$$

(23) What is the test statistic used to test the signifiance of the difference between the means of two small samples of the same size, when the sample items are correlated?

$$t = \frac{\vec{d}}{s\sqrt{n-1}}$$
, where  $d_i = x_i - y_i$ 

(24) What are the expected frequency of 2x2 contigency table given below.

	11
(a+b)(a+c)	(a+b)(b+d)
Ν	Ν
(a+c)(d+c)	(d+b)(d+c)
N	N

(25) Write down the 1% and 5% critical values for right tailed and teo tailed Tests.

			1%		5%
Two tailed test		:	2.58		1.96
Right tailed test	:			2.33	1.645

(26) What is the difference between confidence limits and tolerance limits

Confidence limits: To estimate a parameter of a population

Tolerance limits: To indicate between what limits one can find a certain proportion of a population.

(27) What are the assumptions of large sample?

(i) it should be normal

(ii) values given by the samples are suffienctly close to the populatio parameters.

(28) What is test of goodness of fit?

To determine whether the actual sample distribution matches a known theoretical distribution.

(29) Define hypothesis

Hypothesis is a statement about the population parameter.it is tested on the basis of the outcome of the random sample.

There are 2 types (i) null hypothesis and (ii) alternate hypothesis

(30) What is meant by population?

A population in statistics means a set of objects which are measurement or observations pertaining to the objects.

#### UNIT —II-DESIGN OF EXPERIMENTS PART-A(2 MARKS)

1).Write the advantages of Latin Square design.(Nov/Dec-2017)

Advantages of latin square designs. Controls more variation than CR or RCB designs because of 2- way stratification.

(2). What are the conditions to be followed in one way classification? (Nov/Dec-2017)

In <u>statistics</u>, **one-way** <u>**analysis** of variance</u> (abbreviated **one-way ANOVA**) is a technique that can be used to compare means of two or more samples (using the <u>F distribution</u>). This technique can be used only for numerical response data, the "Y", usually one variable, and numerical or (usually) categorical input data, the "X", always one variable, hence "one-way"

(3).What is meant by analysis of variance?(May/Jun-2016) Analysis of Variance is a technique that will enable us to test for the significance of the difference among more than two sample means.

4).Why a 2x2 Latin square is not possible?Explain.(May/Jun-2016)(May/Jun-2014). Consider a nxn latin Square design ,then the degrees of freedom for SSE

$$= (n^{2} - 1) - (n - 1) - (n - 1) - (n - 1)$$

$$=(n-1)(n-2)$$

For n=2 ,degrees of freedom of SSE=0 and hence MSE id not defined.Comparision is not possible.Hence 2x2 Latin Square is not possible.

(5)Define Replication and Randomization.(Nov/Dec-2016)

**Replication** is the repetition of an <u>experimental</u> condition so that the variability associated with the phenomenon can be estimated. In other words replication as "the repetition of the set of all the treatment combinations to be compared in an experiment. Each of the repetitions is called a **replicate**."

A method based on chance alone by which study participants are assigned to a treatment group. **Randomization** minimizes the differences among groups by equally distributing people with particular characteristics among all the trial arms.

(6) What is the advantage of factorial experiment?(Nov/Dec-2016)

(i) Factorial designs allow additional factors to be examined at no additional cost

(ii) Factorial designs allow the effects of a factor to be estimated at several levels of the other factors, yielding conclusions that are valid over a range of experimental conditions.

(7)What is the aim of design of experiment?(Apr/May-2015)(May/Jun-2014)

The **design of experiments** (DOE, DOX, or **experimental design**) is the **design** of any task that **aims** to describe or explain the variation of information under conditions that are hypothesized to reflect the variation.

(8) What are the basic principles of experimental design?(Apr/May-2015)(i) Replication

(ii) Randomization and Local control.
<ul> <li>(9) Write the advantages and disadvantages of RBD?(Apr/May-2015) Advantages :</li> <li>(i). Accuracy (ii) Flexibility (iii) Easy to analyze Disadvantage : It is not suitable for large number of treatment</li> </ul>
(10) What is Latin Square design ?
A useful method of eliminating fertility variations consist in an experimental layout which will control in 2
perpendicular directions such a layout is a LSD.
(11)Define Raw Sum of Squares and Correction factor.
The expression $\sum \sum x^2_{ij}$ is known as RSS and the expression $\frac{G^2}{N}$ , where $G^2 = \sum \sum x^2_{ij}$ is called
the correction factor.
(12) Write any 3 applications of LSD.
(i) The statistical analysis is simple.
(ii) Even with the missing data analysis remains relatively simple.
(iii) More than one factor can be investigated simultaneously.
(13) How do you calculate the Correction factor in LSD?
By squaring the grand total and dividing it by the number of observations ,we
calculate the correction factor.
(14) What do you mean by design of experiments?(Nov/Dec-2014)
It is defined as the logical construction of the experiment in which the degree of uncertainty
with which the inference is drawn ,may be well defined.
(15) What are the subject matters included in the design of experiment?
(i) Planning of the experiment
(ii) Obtaining relevant information from it regarding the statiscal hypothesis
under study.
(16) What are the assumptions in ANOVA?
Each of samples is drawn from a normal population and the variances for the
population from which samples have been drawn are equal.
(17) What are the three essential steps to plan an experiment?
(i) A statement of the objective.
(ii) Statement should clearly mention the hypothesis to be tested.
(iii) Description should include the type of experimental material, size of the experiment and the
number of replications.
(18) What are the basic steps in ANOVA?
(i) Estimate the population variance among the sample means.
(ii) Estimate the population variance from the variance within the sample means.
(19) Write the steps to find F-ratio.
$S^2$ Variance betweensamples
$F = \frac{S_1}{S^2} = \frac{Variance within samples}{Variance within samples}$
$\frac{1}{2}$

(20) Discuss the advantages of Completely Randomized block design.

(i) easy to lay out

(ii) allows flexibility (iii)simple

statiscal information

(iv). The lot of information due to missing data is smaller than with any other design

(21) State the uses of ANOVA.

(i) The effects of some fertilizer on the yields are significantly different.

(ii) The mean qualities of outputs of various machines differ significantly.

(22) Explain the word treatment in ANOVA.

The word treatment in ANOVA is used to refer to any factor in experiment is controlled at different levels or values.

(23) What do you mean by 2-way classification?

In two way classification , the datas are classified according to different criteria or factors.

(24) Indicate the characteristics of a good experimental design.

- (i) Absolute (ii) Comparative.
- (25) What are the important designs of experiments?
  - (i) Completely Randomized design(or) One-Way classification
  - (ii) Randomized Block Design (or) Two-Way classification
  - (iii) Latin Square Design (or) Threee-Way classification.

(26) What is an experimental error ?

The variation from plot to plot caused by uncontrolled factors is known as

experimental error.

(27) What is meant by CRD?

It is defined as a type of experimental design where the experimental units are allocated to the treatments in a completely random fashion. This is used to study the effects of one primary factor without the need to take other nuisance variables into account.

(28)Compare RBD and LSD.

RBD is more efficient than CRD for most types of experiment work.

In CRD, grouping of the experiments sixe so as to allocate the treatments at random to the experimental units is not done. But in RBD, treatments are allocated at random within the units of each stratum.

RBD is more flexible than CRD, since no restrictions are placed on the number or treatments or the number if replicatins.

(29) Compare LSD and RBD.

In LSD, the number of treatments is equal to the number of replications , whereas there are no such restrictions on treatments and replications in RBD.

(30) What are the uses of Chi-Square test?

- (i) To test significance difference between experimental values and theoretical values.
- (ii) To find whether two or more attributes are associated or not.

#### UNIT III SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS

Newton Raphson method – Gauss elimination method – pivoting – Gauss Jordan methods – Iterative

methods of Gauss Jacobi and Gauss Seidel – Matrix inversion by Gauss Jordan method – Eigen values of a matrix by power method.

Textbook : Grewal. B.S., and Grewal. J.S., "Numerical Methods in Engineering and Science", 9th Edition, Khanna Publishers, New Delhi, 2007.

**1.State the order (rate) of convergence and convergence condition for Newton Raphson method. Sol.** The order of convergence of Newton Raphson method is 2

(quadratic) and convergence condition is  $|f(x)f''(x)| < [f'(x)]^2$ .

2. Give Newton Raphson iterative formula. Sol.  $x_{n+1} = x_n - \frac{f(x_n)}{f'(x)_n}, n = 0, 1, 2, \dots$ 

**3.** Establish an iteration formula to find the reciprocal of a positive number N by Newton Raphson method.

**Sol.** Let x = 1/N

$$\Rightarrow N = \frac{1}{x} \Rightarrow \frac{1}{x} - N = 0$$
  
(*i.e.*)  $f(x) = \frac{1}{x} - N \Rightarrow f(x) = \frac{1}{x_n} - N, f'(x) = -\frac{1}{x_n^2}$ 

By Newton Raphson method,

$$x_{n+1} = x_{n} - \frac{f(x_{n})}{f'(x_{n})} = x_{n} - \frac{\frac{1}{x_{n}} - N}{-\frac{1}{x_{n}^{2}}} = x_{n} + x_{n}^{2} \left(\frac{1}{x_{n}} - N\right)$$
$$= x_{n} \left(2 - Nx_{n}\right).$$

4. State the principle used in Gauss-Jordan method.

**Sol.** In the equation AX = B, the matrix A is transformed into an identity matrix.

5. Give the sufficient condition of convergence of Gauss Seidel method.

**Sol.** The absolute value of the leading diagonal element is greater than the sum of the absolute values of the other elements in that row, which is called diagonally dominant.

6. Write the conditions for convergence in Gauss Seidel iterative technique. (or) When the method of iteration will be useful?

Sol. The coefficient matrix should be diagonally dominant.

7. State Gauss Seidel method.

**Sol.** As soon as a new value for a variable is found by iteration it is used immediately in the following equations. This method is called Gauss Seidel method.

**8. Gauss Seidel method always converges – True or False.** Sol. False.

9. Write the first iteration values of x,y,z when the equations 27x+6y-z = 85, 6x+15y+2z = 72, x+y+5z = 110 are solved by Gauss Seidel method.

Sol. Here the coefficient matrix is diagonally dominant. Then

 $\mathbf{x} = \frac{1}{27} (85 - 6y + z) \dots \dots \dots (1)$  $y = \frac{1}{15} (72 - 6x - 2z)....(2)$  $z = \frac{1}{5} (110 - x - y)...(3)$ First Iteration Put y = 0, z = 0 in (1), we get x = 3.148Put x = 3.148, z = 0 in (2), we get y = 3.451Put x = 3.148, y = 3.451 in (3), we get z = 20.66210. Compare Gauss Elimination and Gauss Jordan methods for solving linear systems of the form AX=B. Sol. In Gauss Elimination method, the coefficient matrix reduced to upper triangular matrix and we get the solution by back substitution whereas in Gauss Jordan method, the coefficient matrix reduces to an unit or identity matrix and we get the solution without using back substitution. 11.What type of Eigen value can be obtained using power method? Sol. Dominant eigen value. 2 **12.Find the dominant eigen value of**  $A = \begin{bmatrix} 3 & 4 \end{bmatrix}$  **by power method.** Sol. Dominant eigen value = 5.372213. On what type of equations Newton's method can be applicable ? Sol. Newton's method can be applicable to the solution of both algebraic and transcendental equation and can be also used when the roots are complex. 14. By Gauss elimination method solve x + y = 2 and 2x + 3y = 5. The augmented matrix is Sol. 1 1 2  $\begin{bmatrix} A,B \end{bmatrix} = \begin{bmatrix} 2 & 3 & 5 \\ 1 & 1 & 2 \end{bmatrix}$  $= \begin{vmatrix} 0 & 1 & 1 \end{vmatrix} R_2 = R_2 - 2R_1$ By back substitution, x + y = 2 - (1)v = 1(1) becomes, x + 1 = 2x = 1Hence x = 1, y = 1. 15. Why Gauss Seidel iteration is a method of successive corrections? Sol. Because we replace approximations by corresponding new ones as soon the latter have been computed. 16. What are the merits of Newton's method of iteration? Sol. Newton's method is successfully used to improve the result obtained by other methods. It is

applicable to the solution of equations involving algebraical functions as well as transcendental functions.

17. Give two direct methods to solve a system of linear equations.

Sol.	Sol. Gauss Elimination method and Gauss Jordan method.			
18. C	18. Compare Gauss Elimination with Gauss Seidel method.			
Sol.	Gauss Elimination	Gauss Seidel		
	i.Direct method	i. Indirect method		
	ii. Used to find inverse of	ii. Used to solve system of		
	the matrix also.	equations only		
	iii. Diagonally dominant condition	iii. Diagonally dominant condition		
	is not insisted.	is insisted.		

## UNIT IV INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION

Lagrange's and Newton's divided difference interpolations – Newton's forward and backward difference interpolation – Approximation of derivates using interpolation polynomials – Numerical single and double integrations using Trapezoidal and Simpson's 1/3 rules.

Textbook : Grewal. B.S., and Grewal. J.S., "Numerical Methods in Engineering and Science", 9th Edition, Khanna Publishers, New Delhi, 2007.

1. Define interpolation and extrapolation?

**Sol.** The process of computing the value of a function inside the given range is called interpolation. The process of computing the value of a function outside the given range is called extrapolation.

#### 2. State Newton's formula on interpolation. When it is used?

Sol. Newton's forward interpolation formula is  

$$y = y_0 + u\Delta y_0 + \frac{u(u-1)}{2!}\Delta^2 y_0 + \frac{u(u-1)(u-2)}{3!}\Delta^3 y_0 + \dots$$
where  $u = \frac{x - x_0}{h}$ 

This formula is used mainly for interpolating the values of y near the beginning of a set of tabular values.

Newton's backward interpolation formula is  

$$y = y_{n} + u\nabla y_{n} + \frac{u(u+1)}{2!}\nabla^{2} y_{n} + \frac{u(u+1)(u+2)}{3!}\nabla^{3} y_{n} + \dots$$
where  $u = \frac{x - x_{n}}{h}$ 

This formula is used mainly for interpolating the values of y near the end of a set of tabular values.

# 3. Say True or False. – Newton's divided difference formula is applicable only for equally spaced intervals.

Sol. False.

4. State Newton's divided difference formula.

Sol.  $y = y_0 + (x - x_0)\Delta y_0 + (x - x_0)(x - x_1)\Delta^2 y_0 + (x - x_0)(x - x_1)(x - x_0)\Delta^3 y_0 + (x - x_0)(x - x_0)\Delta y_0 + (x - x_0)\Delta y_0 +$ 

#### 5. State Lagrange's interpolation formula

Sol.

$$y = f(x) = \frac{(x - x_1)(x - x_2)(x - x_3).....(x - x_n)}{(x_0 - x_1)(x_0 - x_2)(x_0 - x_3).....(x - x_n)} y_0 + \frac{(x - x_0)(x - x_2)(x - x_3).....(x - x_n)}{(x_1 - x_0)(x_1 - x_2)(x_1 - x_3).....(x_1 - x_n)} y_1 + \frac{(x - x_0)(x - x_1)(x - x_3).....(x - x_n)}{(x_2 - x_0)(x_2 - x_1)(x_2 - x_3).....(x_2 - x_n)} y_2 + \dots + \frac{(x - x_0)(x - x_1)(x - x_2)(x - x_3).....(x - x_{n-1})}{(x_n - x_0)(x_n - x_1)(x_n - x_2)(x_n - x_3).....(x_n - x_{n-1})} y_n$$
6. Use Lagrange's formula to find the quadratic polynomial that takes these values
$$x : 0 \quad 1 \quad 3 \\ y : 0 \quad 1 \quad 0$$
Then find y(2).
Sol. By Lagrange's formula
$$y = f(x) = \frac{(x - x_1)(x - x_2)}{(x_0 - x_1)(x_0 - x_2)} y_0 + \frac{(x - x_0)(x - x_2)}{(x_1 - x_0)(x_1 - x_2)} y_1 + \frac{(x - x_0)(x - x_1)}{(x_2 - x_0)(x_2 - x_1)} y_2$$

$$y = f(x) = \frac{(x - 1)(x - 3)}{(0 - 1)(0 - 3)} 0 + \frac{(x - 0)(x - 3)}{(1 - 0)(1 - 3)} 1 + \frac{(x - 0)(x - 1)}{(3 - 0)(3 - 1)} 0$$

$$y(x) = \frac{x^2 - 3x}{-2}$$
Hence y(2) = 1.
7. By differentiating Newton forward and backward difference formula, find the first derivative

of the function f(x).

Sol. Newton forward interpolation formula is

$$y = y_{0} + u\Delta y_{0} + \frac{u(u-1)}{2!}\Delta^{2}y_{0} + \frac{u(u-1)(u-2)}{3!}\Delta^{3}y_{0} + \dots$$
  
where  $u = \frac{x - x_{0}}{h}$   
$$\frac{dy}{dx} = \frac{dy}{du} \cdot \frac{du}{dx}$$
$$= \frac{1}{\Delta} \int_{\Delta}^{\Delta} \frac{1}{4!} + \frac{2u - 1}{\Delta^{2}} + \frac{3u_{2} - 6u + 2}{6} \Delta_{3}$$
$$h \begin{bmatrix} y_{0} & 2 & y_{0} \end{bmatrix} = \frac{3u_{2} - 6u + 2}{6} \Delta_{3}$$

$$+ \frac{2u_{3}^{-9}u_{2} + 11u - 5}{12} \Delta_{4} y_{0}^{+} + \dots ]$$
Newton backward interpolation formula is  

$$y = y_{n} + u\nabla y_{n} + \frac{u(u+1)}{2!} \nabla^{2} y_{n} + \frac{u(u+1)(u+2)}{3!} \nabla^{3} y_{n} + \dots \\ where u = \frac{x - x_{n}}{h}$$

$$\frac{dy}{dx} = \frac{dy}{du} \frac{du}{dx} \frac{2u + 1}{2!} + 2 \frac{3u_{2} + 6u + 2}{6} \nabla^{3} y_{n} + \frac{2u_{3} + 9u_{2} + \frac{1}{1!} 1u + 3}{12} \nabla^{2} y_{n} + \frac{3u_{2} + 6u + 2}{6} \nabla^{3} y_{n} + \frac{2u_{3} + 9u_{2} + \frac{1}{1!} 1u + 3}{12} \nabla^{4} y_{n} + \dots ]$$
8. Write down the Newton - cotes quadrature formula.  
Sol.  

$$\int_{a_{0}^{n}}^{x} f(x) dx = h \left\{ ny_{0} + \frac{n^{2}}{2} \Delta y_{0} + \frac{1}{2} \left( \frac{n^{3}}{3} - \frac{n^{2}}{2} \right) \Delta^{2} y_{0} + \frac{1}{6} \left( \frac{n^{4}}{4} - n^{3} + n^{2} \right) \Delta^{3} y_{0} + \dots \right\}$$
9. What is the geometrical interpretation of Trapezoidal rule?  
Sol. We are finding the area of the curve enclosed by  $y = f(x)$ , the X-axis, the ordinates  $x = a$  and  $x = b$  by using the area of trapezium.  
10. Using Trapezoidal rule evaluate  $\int_{0}^{x} \sin x dx$  by dividing the range into 6 equal parts.  
Sol.  

$$h = \frac{\pi - 0}{6} = \frac{\pi}{6}$$
When  $h = \frac{\pi}{6}$ , the values of  $y = \sin x$  are  

$$\frac{x: 0}{6} = \frac{\pi}{6} \frac{2\pi}{6} = \frac{3\pi}{6} \frac{4\pi}{6} \frac{5\pi}{6} \frac{5\pi}{6} \pi \frac{\pi}{3} \frac{1}{9} \left[ (y_{0} + y_{n}) + 2(y_{1} + y_{2} + y_{3} + \dots y_{n-1}) \right]$$

$$= \frac{\pi}{6} [(0 + 0) + 2(0.5 + 0.8660 + 1 + 0.8660 + 0.5)] = 0.9770$$
11. Why is Trapezoidal rule so called?

Sol. The Trapezoidal rule is so called, because it approximates the integral by the sum of n

trapezoids.  
12. What are the truncation errors in Trapezoidal and Simpson's rules of numerical integration?  
Sol. Error in the Trapezoidal rule is 
$$-\frac{h}{12}f'(\theta)$$
. Error in the Trapezoidal rule is of the order  $h^2$ .  
Error in the Simpson's one-third rule is  $-\frac{h^5}{90}f''(\theta)$ . Error in Simpson's one-third rule is of the order  $h^4$ .  
Error in the Simpson's three eighth rule is  $-\frac{3h^5}{80}f''(\theta)$ . Error in the Simpson's three eighth rule is of the order  $h^4$ .  
Error in the Simpson's three eighth rule is  $-\frac{3h^5}{80}f''(\theta)$ . Error in the Simpson's three eighth rule is of the order  $h^4$ .  
13. What is the condition for Simpson's 3/8 rule and state the formula.  
Sol. The condition for Simpson's 3/8 rule is the number of sub-intervals should be a multiple of 3.  
Simpson's 3/8 rule is  $\int_{x_0}^{x_1} f(x) dx = \frac{3h}{8} [(y_0 + y_n) + 3(y_1 + y_2 + y_4 + y_5 + y_7 + ......) + 2(y_3 + y_6 + y_9 + .....)]$   
14. Using Simpson's rule find  $\int_{x_1}^{\theta} e_x dx$  given  $e^0 = 1$ ,  $e^1 = 2.72$ ,  $e^2 = 7.39$ ,  $e^3 = 20.09$ ,  $e^4 = 54.6$   
Soln The following data is  $\sum_{x_1:0}^{x_1} f(x) dx = \frac{h}{3} [(y_0 + y_n) + 4(y_1 + y_3 + y_5 + .....) + 2(y_2 + y_4 + y_6 + .....)]$   
 $+ 2(y_2 + y_4 + y_6 + ....)$   
 $+ 2(y_2 + y_4 + y_6 + ....)]$   
 $\int_{0}^{4} e^x dx = \frac{1}{3} [(1 + 54.6) + 4(2.72 + 20.09) + 2(7.39)]$   
 $= 53.8733$ 

# 15. Compare Trapezoidal rule and Simpson's 1/3<sup>rd</sup> rule for evaluating numerical integration. Sol. i) In Newton Cotes Quadrature formula, if we put n = 1 we get Trapezoidal rule whereas if we put n = 2, we get Simpson's 1/3<sup>rd</sup> rule. ii) In Trapezoidal rule, the interpolating polynomial is linear whereas in Simpson's 1/3<sup>rd</sup> rule, the interpolating polynomial is of degree 2. iii) In Trapezoidal rule, there is no restriction on the number of intervals whereas in Simpson's 1/3<sup>rd</sup> rule, the number of intervals should be

even.

#### UNIT V NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS

Taylor's series method - Euler's method - Modified Euler's method - Fourth order Runge-Kutta method for solving first and second order equations - Milne's predictor-corrector methods for solving first order equations - Finite difference methods for solving second order equation.

1.State Modified Euler algorithm to solve y' = f(x, y), y(x) = y at x=x0 + h. (A.U.N/D 2017, N/D

2011,2012, M/J 2013)  $y_{n+1} = y_n + hf \left[ x_n + \frac{h}{2}y_n + \frac{h}{2}f(x_n, y_n) \right]$ 

 $y_1 = y_0 + hf \left[ x_0 + \frac{h}{2}y_0 + \frac{h}{2}f(x_0, y_0) \right]$ 

2. State the disadvantage of Taylor series method.

#### Solution:

#### (A.U N/D 2009,M/J 2012,2014)

In the differential equation f(x, y),  $\frac{dy}{dx} = f(x, y)$  the function f(x, y), may have a complicated

algebraical structure. Then the evaluation of higher order derivatives may become tedious. This is the demerit of this method.

## 3. Write the merits and demerits of the Taylor method of solution. (A.U.N/D 2010, M/J 2012) Solution:

The method gives a straight forward adaptation of classic to develop the solution as an infinite series. It is a powerful single step method if we are able to find the successive derivatives easily.

If f(x,y) involves some complicated algebraic structures then the calculation of higher derivatives becomes tedious and the method fails. This is the major drawback of this method.

However the method will be very useful for finding the starting values for powerful methods like Runge - Kutta method, Milne"s method etc.,

4. Which is better Taylor's method or R. K. Method?(or) State the special advantage of Runge-Kutta method over taylor series method (A.U M/J 2011) Solution:

- R.K Methods do not require prior calculation of higher derivatives of y(x) ,as the Taylor method does. Since the differential equations using in applications are often complicated, the calculation of derivatives may be difficult.
- > Also the R.K formulas involve the computation of f(x, y) at various positions, instead of derivatives and this function occurs in the given equation.

5. Compare Runge-Kutta methods and predictor – corrector methods for solution of initial value problem. (A.U M/J 2011)

#### Solution:

Runge-Kutta methods

- Runge-methods are self starting, since they do not use information from previously calculated points.
- As mesne are self starting, an easy change in the step size can be made at any stage.
   3.Since these methods require several evaluations of the function f (x, y), they are time consuming.
- > In these methods, it is not possible to get any information about truncation error. Predictor Corrector methods
  - > These methods require information about prior points and so they are not self starting.
  - $\succ$  In these methods it is not possible to get easily a good estimate of the truncation error.

6. What is a Predictor-corrector method of solving a differential equation? (A.U M/J 2009) Solution:

- > Predictor-corrector methods are methods which require the values of y at  $x_n, x_{n-1}, x_{n-2}, ...$  for computing the value of y at . x  $_{n+1}$
- We first use a formula to find the value of y at x n+1 and this is known as a predictor formula.

The value of y so got is improved or corrected by another formula known as corrector formula

7. State the third order R.K method algorithm to find the numerical solution of thefirst order differential equation. (A.U M/J 2011,N/D 2012)

**Solution:** To solve the differential equation y' = f(x, y) by the third order R.K method, we use the following algorithm.

$$k_{1} = hf(x, y)$$

$$k_{2} = hf\left(x + \frac{h}{2}, y + \frac{k_{1}}{2}\right)$$

$$k_{3} = hf(x + h, y + 2k_{2} - k_{1})$$
and  $\Delta y = \frac{1}{6}(k_{1} + 4k_{2} + k_{3})$ 

 8. Write Milne<sup>ss</sup> predictor formula and Milne<sup>ss</sup> corrector formula. (A.U M/J 2012,N/D 2014) Solution:

➢ Milne"s predictor formula is

$$y_{4,p} = y_0 + \frac{4h}{3} [2y_1' - y_2' + 2y_3']$$

➢ Milne"s corrector formula is

$$y_{4,c} = y_2 + \frac{h}{3} [y_2' + 4y_3' + y_4']$$

9. Write down Adams-Bashforth Predictor and Adams-Bashforth corrector formula. (A.U N/D 2011)

#### Solution

Adams-Bashforthpredictor formula is

$$y_{4,p} = y_3 + \frac{h}{24} [55y_3' - 59y_2' + 37y_1' - 9y_0']$$

Adams-Bashforthcorrector formula is

$$y_{4,c} = y_3 + \frac{h}{24} [9y_4' + 19y_3' - 5y_2' + y_1']$$

10.State Euler formula **Solution:** 

$$y_{n+1} = y_n + hf[x_n, y_n]$$
 when  $n = 0, 1, 2, \dots$ 

11.Write down finite difference formula for y'(x) and y"(x) (A.U M/J 2012,N/D 2014) Solution:

$$y'(x) = \frac{y_{i+1} - y_i}{h}, \quad y''(x) = \frac{y_{i-1} - 2y_i + y_{i+1}}{h^2}$$

$$n+1$$
  $y_n$   $\frac{1}{1!}y_n$   $\frac{2}{2!}y_n$   $\frac{3}{3!}y_n$  ....

13.Using Taylor series method, find the value of y (0.1), from dy  $= x^2 + y^2$  and y(0) = 1 correct to 4decimal places

Solution:

$$\begin{array}{ccccc} y'=x^2 + y^2 & x = 0 \\ y'=2x+2yy' & y=1 \\ y'=2+2yy'+2(y')^2 & y'=1 \\ y^{iv}=2yy'+6y'y' & y'=2; y'=8; y^{iv}=28 \\ & & & & & & & & \\ & & & & & & & & \\ & & & & & & & & \\ & & & & & & & & \\ & & & & & & & & \\ & & & & & & & & & \\ & & & & & & & & & \\ & & & & & & & & & \\ & & & & & & & & & \\ & & & & & & & & & \\ & & & & & & & & & \\ & & & & & & & & & \\ & & & & & & & & & \\ & & & & & & & & & \\ & & & & & & & & & \\ & & & & & & & & \\ & & & & & & & & \\ & & & & & & & & \\ & & & & & & & & \\ & & & & & & & & \\ & & & & & & & & \\ & & & & & & & \\ & & & & & & & \\ & & & & & & & \\ & & & & & & & & \\ & & & & & & & \\ & & & & & & & \\ & & & & & & & & \\ & & & & & & \\ & & & & & & \\ & & & & & & \\ & & & & & & \\ & & & & & & \\ & & & & & & \\ & & & & & & \\ & & & & & & \\ & & & & & & \\ & & & & & & \\ & & & & & & \\ & & & & & & & \\ & & & & & & \\ & & & & & & & \\ & & & & & & & \\ & & & & & & & \\ & & & & & & & \\ & & & & & & & \\ & & & & & & & \\ & & & & & & & \\ & & & & & & & \\ & & & & & & & \\ & & & & & & & \\ & & & & & & & \\ & & & & & & & \\ & & & & & & & & \\ & & & & & & & & \\ & & & & & & & \\ & & & & & & & & \\ & & & & &$$

14. Compare Taylor series method and Runge Kutta method. **Solution:** 

- The use of R-K method gives quick convergence to the solutions of the differential equations than Taylor's series method.
- > The labour involved in R-K method is comparatively lesser.
- In R-K method, the derivatives of higher order are not required for calculation as in Taylor series method.

# 15. What are the advantages of R-K method over Taylor series method? **Solution:**

The Rungekutta methods are designed to give greater accuracy and they possess the advantage of requiring only the function values at some selected points on the sub interval.

16. Compare Single-step method Multi-step methods. (A.U N/D 2017) Solution:

S.No	Single-step method	Multi-step method

(A.U M/J 2013)

1	It requires only the numerical value $y_i$ in order to compute the next value $y_{i+1}$	It requires not only the numerical valuey <sub>i</sub> but also atleast four of the past valuesy <sub>i</sub> -1,y <sub>i</sub> -2,,	
2	Taylor series, Euler's and R-K methodsare single step methods	Milne's, Adam's methods are multi stepmethods	

17. Write down the error in Adam's predictor and corrector formulas. **Solution:** 

Order of error is  $h^5$ 

Error in predictor  $h^5 \frac{251}{720} y^{\nu}$ Error in corrector  $h^5 \frac{19}{120} y^{\nu} \xi$ 

## 18. Write down the error in Milne's predictor and corrector formulas. **Solution:**

Order of error is  $h^5$ 

Error in predictor 
$$h^5 \frac{14}{45} y^{\nu} \xi$$
  
Error in corrector  $h^5 \frac{1}{90} y^{\nu} \xi$ 

19.Compare Adam's Bashforth method with RungeKutta method **Solution:** 

S. No	Adam's Bashforth Method	Runge-Kutta Method
1	Multi step method	Single step method
2	Need four prior values of y <sub>i</sub> 's	Need only the last prior value
3	Does not permits changes in the step size	Permits changes in the step size