CHHATTISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY

छत्तीसगढ़ स्वामी विवेकानंद तकनीकी विश्वविद्यालय

To be filled, scanned and kept at 1st page of Answer Booklet.

Nov-Dec 2021 Examination

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Enrollment No.:

B	J	4	5	9	9

Roll No.:

3	0	3	3	0	2	2	2	0	0	2	0

Course: B.Tech Semester: 3rd

Branch/Specialization: Computer Sceience & Engineering

Subject Code:

B	0	0	0	3	1	1	(	0	1	4	)

Subject Name: Mathematics - III

Regular/Backlog: Regular

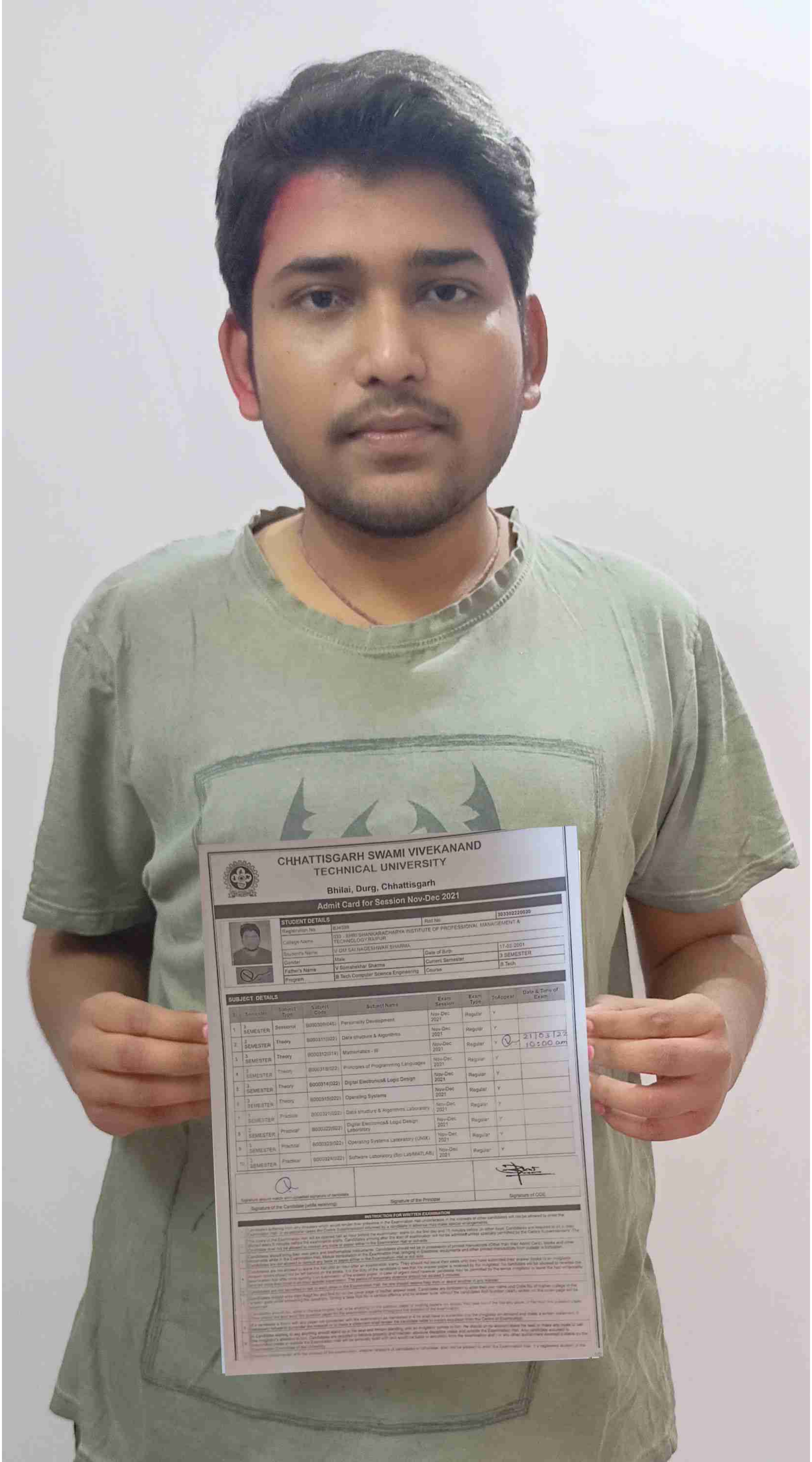
Date of Exam: 21 / 03 /2022

Note:

1) **Only above format is to be used for Nov-Dec 2021 Exams. Older/earlier format will not be accepted.**
2) **Nomenclature to be mentioned in the Answer Booklet should be Subject code_Roll No. only.**
3) **Only Roll No. generated in Admit Card must be filled (College Transfer students must take care in filling their Roll Nos,).**

I certify that above information given there in is correct and I shall be personally responsible for the same if proved wrong/false later on.

Signature: ....


CHHATTISGARH SWAMI VIVEKANAND
TECHNICAL UNIVERSITY
Bhilai, Durg, Chhattisgarh
Admit Card for Session Nov-Dec 2021
303302220030
STUDENT DETAILS
Roll No
033 - SHRI SHANKARACHARYA INSTITUTE OF PROFESSIONAL MANAGEMENT &
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Subject Name
Exam Session
Exam Type
Date & Time of Exam
Personality Development
Data structure & Algorithms
Mathematics - III
Principles of Programming Languages
Digital Electronics& Logic Design
Operating Systems
Data structure & Algorithms Laboratory
Digital Electronics& Logic Design Laboratory
Operating Systems Laboratory (UNIX)
Software Laboratory (Sci Lab/MATLAB)
B000314(022)
SEMESTER
Theory
Nov-Dec 2021
Regular
21/03/22
10:00 am
Signature of the Principal
Signature of COE
Signature of the Candidate (while receiving)
INSTRUCTION FOR WRITTEN EXAMINATION

Unit - 1

(a)

$$\text{Sol}^n \rightarrow \bar{F}(S) = \frac{4s+5}{(s-1)^2(s+2)} = \frac{A}{(s-1)} + \frac{B}{(s-1)^2} + \frac{C}{(s+2)} \quad \{\text{Applying Partial Fract}^n\}$$

$$\Rightarrow \frac{4s+5}{(s-1)^2(s+2)} = \frac{A(s-1)(s+2) + B(s+2) + C(s-1)^2}{(s-1)^2(s+2)}$$

$$\Rightarrow \frac{4s+5}{\cancel{(s-1)^2(s+2)}} = \frac{A(s-1)(s+2) + B(s+2) + C(s-1)^2}{\cancel{(s-1)^2(s+2)}}$$

$$\Rightarrow 4s+5 = A(s-1)(s+2) + B(s+2) + C(s-1)^2$$

$$\Rightarrow 0s^2+4s+5 = A(s^2+2s-s-2) + B(s+2) + C(s^2+1-2s)$$

$$\Rightarrow 0s^2+4s+5 = A(s^2+s-2) + B(s+2) + C(s^2+1-2s)$$

On comparing the coefficients of:

(i) s^2, $0 = A + C \Rightarrow \boxed{A = -C}$

(ii) s, $4 = A + B - 2C \Rightarrow \boxed{4 = 3A + B}$

(iii) constants, $5 = -2A + 2B + C$

$5 = -2A + 2B - A$

$\Rightarrow 5 = -3A + 2B$

$\Rightarrow \boxed{5 = -3A + 2B}$

On adding (ii) & (iii),

$$\begin{aligned} 5 &= -3A + 2B \\ 4 &= 3A + B \\ \hline 9 &= 3B \end{aligned} \Rightarrow \boxed{B = 3}$$

$B = 3 \Rightarrow \quad 4 = 3A + B$

$4 = 3A + (3)$

$$\boxed{A = \frac{1}{3}}$$

$\Rightarrow \quad A = -C$

$\Rightarrow \quad \boxed{C = -1/3}$

$$\therefore \; \bar{f}(s) = \frac{4s+5}{(s-1)^2(s+2)} = \frac{1}{3}\left(\frac{1}{s-1}\right) + 3\left(\frac{1}{s-1}\right)^2 - \frac{1}{3}\left(\frac{1}{s+2}\right)$$

Taking ILT (Inverse Laplace Transform) on both sides,

$$L^{-1}\left\{\frac{4s+5}{(s-1)^2(s+2)}\right\} = L^{-1}\left\{\frac{1}{3}\left(\frac{1}{s-1}\right)\right\} + 3L^{-1}\left\{\frac{1}{(s-1)^2}\right\} - \frac{1}{3}L\left\{\frac{1}{s+2}\right\}$$

$$= \frac{1}{3}e^{t} + 3L^{-1}\left\{\frac{1}{(s-1)^2}\right\} - \frac{1}{3}e^{-2t}$$

$$= \frac{1}{3}e^{t} + 3e^{t}L^{-1}\left\{\frac{1}{s^2}\right\} - \frac{1}{3}e^{-2t}$$

$$= \frac{1}{3}e^{t} + 3e^{t}\left(\frac{t}{1!}\right) - \frac{1}{3}e^{-2t}$$

$$= \frac{1}{3}e^{t} + 3e^{t}(t) - \frac{1}{3}e^{-2t}$$

Ans

(b)

~~Ans~~ Sol^n → $\dfrac{1-\cos t}{t^2}$

Taking Laplace Transform of $1-\cos t$

$\Rightarrow L\{1-\cos t\}$

$\Rightarrow \dfrac{1}{s} - \dfrac{s}{s^2+1}$

By using division property

$$\Rightarrow L\left\{\frac{1-\cos t}{t}\right\} = \int_s^\infty \left(\frac{1}{s} - \frac{s}{s^2+1}\right) ds$$

$$= \left[\log s - \frac{1}{2}\log(s^2+1)\right]_s^\infty$$

$$= -\log s + \frac{1}{2}\log(s^2+1)$$

$$= \frac{1}{2}\log\left(\frac{s^2+1}{s}\right)$$

Again Now $L\left(\dfrac{1-\cos t}{t^2}\right) = \dfrac{1}{2}\displaystyle\int_s^\infty 1.\log\left(\frac{s^2+1}{s^2}\right) ds$

$$= \frac{1}{2}\left[s.\log\left(\frac{s^2+1}{s^2}\right) - \int \frac{s^2}{s^2+1}\,\frac{s^2(2s)-(s^2+1).(2s)}{s^4}\, s\, ds\right]_s^\infty$$

$$= \frac{1}{2}\left[s\log\left(\frac{s^2+1}{s}\right) + 2\int \frac{ds}{s^2+1}\right]_s^\infty$$

$$= \frac{1}{2}\left[-s\log\left(\frac{s^2+1}{s^2}\right)+2\left(\frac{\pi}{2}-\tan^{-1}s\right)\right]$$

$$= \cot^{-1}s - \frac{1}{2}s\log\left(1+\frac{1}{s^2}\right) \quad \underline{Ans}$$

(D)

Sol^n → Taking Laplace transform of both sides of the eq^n and using that

$$L\{t(f(t))\} = \frac{-d}{ds}\left[L\{f(t)\}\right], \text{ we get}$$

$$-\frac{d}{ds}\left[s^2\bar{y} - s\,y(0) - y'(0)\right] + 2\left[s\bar{y} - y(0)\right] - \frac{d}{ds}(\bar{y}) = \frac{1}{s^2+1}$$

or $$-\left(s^2\frac{d\bar{y}}{ds} + 2s\bar{y}\right) + y(0) + 0 + 2s\bar{y} - 2y(0) - \frac{d}{ds}(\bar{y}) = \frac{1}{s^2+1}$$

or $$-(s^2+1)\frac{d\bar{y}}{ds} - 1 = \frac{1}{s^2+1} \qquad \boxed{\because y(0)=1}$$

$$-(s^2+1)\frac{d\bar{y}}{ds} = \frac{1}{s^2+1} + 1$$

$$\frac{d\bar{y}}{ds} = \frac{-1}{(s^2+1)^2} - \frac{1}{(s^2+1)}$$

On ~~ive~~ inversion and noting that

$L^{-1}[\bar{F}'(s)] = -t f(t)$, we get

$$-ty = -\sin t - \left(\frac{1}{2}\sin t - \frac{t\cos t}{2}\right)$$

$$= \frac{1}{2}\left(-3\sin t + t\cos t\right)$$

$$\Rightarrow y = \frac{1}{2}\left(\frac{3\sin t}{t} - \cos t\right)$$

which is the desired solut^n

Ans

Unit - 2

(a)

Solⁿ → We have given $z = f(x^2+y^2, z-xy)$

Let $x^2+y^2 = u$, and $z - xy = v$,

so, that $f(u, v) = 0$

Differen~~tly~~tiate partially w.r.t 'x' and 'y'

we have,

$$\frac{\partial f}{\partial u}\left(\frac{\partial k}{\partial x} + \frac{\partial k}{\partial z} p\right) + \frac{\partial f}{\partial v}\left(\frac{\partial v}{\partial x} + \frac{\partial v}{\partial z} p\right) = 0$$

$$\text{or } \frac{\partial f}{\partial u}(2x) + \frac{\partial f}{\partial v}(-y+p) = 0 \quad \text{— (I)}$$

$$\text{and } \frac{\partial f}{\partial u}\left(\frac{\partial u}{\partial y} + \frac{\partial u}{\partial z} q\right) + \frac{\partial f}{\partial v}\left(\frac{\partial u}{\partial y} + \frac{\partial v}{\partial z} q\right) = 0$$

$$\text{or } \frac{\partial f}{\partial u}(2y) + \frac{\partial f}{\partial v}(-x+q) = 0 \quad \text{— (II)}$$

Eliminating $\frac{\partial f}{\partial u}$ and $\frac{\partial f}{\partial v}$ from eqⁿ (I) & (II)

we have $\begin{vmatrix} 2x & -y+p \\ 2y & -x+q \end{vmatrix} = 0$

or ⇒ $xq - yp = x^2 + y^2$

which is the required partial Differential Equation.

(b)

Sol^n $\rightarrow$ $x(y^2-z^2)p + y(z^2-x^2)q - z(x^2-y^2)=0$

Given that, the partial differential Equation

$$x(y^2-z^2)p + y(z^2-x^2)q - z(x^2-y^2)=0$$

Now the Langrange's auxilliary equation are,

$$\frac{dx}{x(y^2-z^2)} = \frac{dy}{y(z^2-x^2)} = \frac{dz}{z(x^2-y^2)}$$

Using x, y, z as multipliers, we get each fraction,

$$= \frac{x\,dx + y\,dy + z\,dz}{x^3(y^2-z^2)+y^2(z^2-x^2)+z^2(x^2-y^2)}$$

$$= \frac{x\,dx + y\,dy + z\,dz}{0}$$

$$\Rightarrow x\,dx + y\,dy + z\,dz = 0$$

On integrating we have,

$$x^2 + y^2 + z^2 = C_1 \qquad -(i)$$

similarly using $\frac{1}{x}, \frac{1}{y}, \frac{1}{z}$ as multipliers, we get

$$\frac{dx}{x} + \frac{dy}{y} + \frac{dz}{z} = 0$$

On integrating we have, $xyz = C_2$ — (II)

From eq^n (I) & (II)

$$\therefore \quad f(x^2+y^2+z^2, xyz) = 0$$

$$x^2+y^2+z^2 = f(xyz) \quad \text{Ans}$$

(D)

Sol^n → Given Eq^n $\frac{\partial u}{\partial x} = 4\frac{\partial u}{\partial y}$ — (1)

and $u(0,y) = 8e^{-3y}$ — (2)

Assume the sol^n

$$u(x,y) = XY \quad \text{— (3)}$$

substituting in the given Eq^n, we have

$$X'Y = 4Y'X$$

$$\Rightarrow \frac{X'}{X} = 4\frac{Y'}{Y} = K \text{ (Let)}$$

$$\Rightarrow \frac{X'}{X} = K \quad \text{and} \quad 4\frac{Y'}{Y} = K$$

$$\Rightarrow \log X = Kx + \log C_1$$

$$\Rightarrow \log \frac{X}{C_1} = Kx \Rightarrow X = C_1 e^{kx} \quad -(4)$$

Now $4\frac{Y'}{Y} = k$

$$\Rightarrow 4\log Y = Ky + \log C_2$$

$$\Rightarrow \log \frac{Y}{C_2} = \frac{Ky}{4}$$

$$\Rightarrow Y = C_2 e^{ky/4} \quad -(5)$$

$$\therefore \text{sol}^n \quad u(x,y) = C_1 C_2 e^{kx + \frac{ky}{4}}$$
$$= c\, e^{kx+\frac{ky}{4}} \quad -(6)$$

Using condition $u(0,y) = 8e^{-3y}$ in (6)

$$\Rightarrow 8e^{-3y} = C e^{ky/4} \Rightarrow c = 8,\ k = -12$$

$\therefore$ solution of Eq^n (1)

$$u(x,y) = 8e^{-12x-3y} \quad \text{Ans}$$

Unit - 3

(a)

Sol → (i) $E(x) = \frac{-3}{6} + \frac{6}{2} + \frac{9}{3}$

$= \frac{-1}{2} + 3 + 3$

$= \frac{-1+6+6}{2}$

$= \frac{12-1}{2}$

$\boxed{E(x) = \frac{11}{2}}$

(ii) $E(x^2) = \frac{9}{6} + \frac{36}{2} + \frac{81}{3}$

$= \frac{9 + 108 + 162}{6}$

$= \frac{279}{6}$

$E(x^2) = \frac{279}{6} = \frac{93}{2}$

(iii) $E(2x+1)^2 \Rightarrow E(4x^2 + 4x + 1)$

$4E(x^2) + 4E(x) + E(1)$

Substituting the values of $E(x^2)$ & $E(x) \Rightarrow 4 \times \frac{93}{2} + \cancel{4}^{2} \times \frac{11}{\cancel{2}} + 1$

$\Rightarrow 186 + 22 + 1$

$\Rightarrow 209$

(b) If x is a random variable then by the definition of probability

$$\int_0^c f(x)\,dx = 1$$

$$\Rightarrow \int_0^2 f(x)\,dx + \int_2^4 f(x)\,dx + \int_4^6 f(x)\,dx = 1$$

$$\Rightarrow \int_0^2 kx\,dx + \int_2^4 2k\,dx + \int_4^6 (-kx+6k)\,dx = 1$$

$$\Rightarrow \frac{k}{2}\left[x^2\right]_0^2 + 2k\left[x\right]_2^4 + \left[-\frac{k}{2}\left[x^2\right]_4^6 + 6k\left[x\right]_4^6\right] = 1$$

$$\Rightarrow \frac{4k}{2} + 2k(2) - \frac{k}{2}(36-16) + 6k(2) = 1$$

$$2k + 4k - 10k + 12k = 1$$

$$8k = 1$$

$$\boxed{k = \frac{1}{8}}$$

(ii) Mean value of x is

$$\int_0^6 x f(x)\,dx = \int_0^2 x f(x)\,dx + \int_2^4 x f(x)\,dx + \int_4^6 x f(x)\,dx$$

$$= \int_0^2 kx^2\,dx + \int_2^4 2kx\,dx + \int_4^6 (-kx^2 + 6kx)\,dx$$

$$\Rightarrow \frac{k}{3}\left[x^3\right]_0^2 + \frac{2k}{2}\left[x^2\right]_2^4 - \frac{k}{3}\left[x^3\right]_4^6 + \frac{6k}{2}\left[x^2\right]_4^6$$

$$\Rightarrow \frac{8k}{3} + 12k - \frac{k}{3}(216-64) + 3k\left[36-16\right]$$

$$\Rightarrow \frac{8}{3}k + 12k - \frac{k}{3}(152) + 60k$$

$$\Rightarrow \frac{8}{3}k + 12k - \frac{152k}{3} + 60k$$

$$\Rightarrow \frac{8k + 36k - 152k + 180k}{3}$$

$$\Rightarrow \frac{72k}{3}$$

$$\Rightarrow 24k$$

$$\Rightarrow 24\left(\frac{1}{8}\right)$$

$$\Rightarrow 3$$

$$\boxed{\mu = 3}$$

(d)

Sol^n → Total families = 800

Since the probability of boys & girls are equal

$$P(B) = P(G) = 1/2$$

By Binomial distributions probability of r success is given by :-

$$P(r) = {}^nC_r \, p^r \, q^{n-r}$$

(a) In case of 3 boy

Number of families

$$= 80 \times {}^5C_3 \left(\frac{1}{2}\right)^3 \times \left(\frac{1}{2}\right)^2 = 250$$

(b) In case of 5 girls

Number of families

$$= 800 \times {}^5C_5 \times \left(1/2\right)^5 \times \left(\frac{1}{2}\right) = 25$$

(c) In case of 2 or 3 boys

Number of families

$$= 800\left[{}^5C_2 \times \left(\frac{1}{2}\right)^2 \left(\frac{1}{2}\right)^3 + {}^5C_3 \times \left(\frac{1}{2}\right)^3 \left(\frac{1}{2}\right)^2\right]$$

$$= 800\left[\frac{5}{16} + \frac{5}{16}\right] = 500$$

Unit = 4

(a)

Sol^n →

x	y	Δy	$\Delta^2 y$	$\Delta^3 y$	$\Delta^4 y$
0	6				
		4			
5	10		$a-14$		
		$a-10$		$41-3a$	
10	a		$27-2a$		$b+6a-102$
		$17-a$		$b+3a-61$	
15	17		$b+a-34$		$143-4b-4a$
		$b-17$		$82-3b-a$	
20	b		$48-2b$		
		$31-b$			
25	31				

∵ Only four entries are given, hence the function. $f(x)$ can be represented by 3rd degree polynomial.

$$\therefore \Delta^4 y_0 = 0 \quad \& \quad \Delta^4 y_1 = 0$$

$$\Rightarrow b + 6a - 102 = 0 \quad \& \quad 143 - 4b - 4a = 0$$

$$\Rightarrow (b + 6a = 102) \times 4 \quad \& \quad 4a + 4b = 143$$

Now, On solving these eq^n

$$\begin{aligned} 24a + \cancel{4b} &= 408 \\ -\ 4a \pm \cancel{4b} &= 143 \\ \hline 20a &= 265 \end{aligned}$$

$a = 13.25$

$b = 22.5$

So, values of a & b are 13.25 & 22.5 respectively.

(C)

Sol^n → Given,

x →	20	30	40	50
$f(x)$ →	512	439	346	243

Taking $x_0 = 30$, $h = 10$, $P = \frac{35-30}{10}$

$P = 1/2$

or $P = 0.5$

The difference table is

x	P	$f(x)$	$\Delta f(x)$	$\Delta^2 f(x)$	$\Delta^3 f(x)$
20	-1	512	-73	-23	13
30	0	439	-93	-10	
40	1	346	-103		
50	2	243			

Now using stirling's formula to find f(35).

$$y_p = y_0 + p\left(\frac{\Delta y_0 + \Delta y_{-1}}{2}\right) + \frac{p^2}{2!} \cdot \Delta^2 y_{-1}$$

$$+ \frac{p(p^2-1)}{3!} \frac{(\Delta^3 y_{-1} + \Delta^2 y_{-2})}{2}$$

$$+ \text{-----}$$

$$y_{0.5} = 439 + (0.5)(-93) + \frac{(0.5)\cancel{(0.5)}(-0.5)}{2} \cdot \left(\frac{-23-10}{2}\right)$$

$$+ \frac{(0.5)(0)(-0.5)}{6} \times 13$$

$$y_{0.5} = 439 + (-46.50) + 2.06 + 0$$

$$y_{0.5} = \cancel{399.56}\ 394.56$$

$$y_{0.5} = 395 \text{ (approx)}$$

Hence,

$$y(35) = 395 \quad \text{Ans}$$

(D)

Sol^n →

x	$f(x)$	I	II	III	IV
4	48				
		52			
5	100		15		
		97		1	
7	294		21		0
		202		1	
10	900		27		0
		310		1	
11	1210		33		
		409			
13	2028				

Now, by newton's divide difference formula →

$$f(x) = y_0 + (x - x_0)[x_0, x_1] + (x - x_0)(x - x_1)[x_0, x_1, x_2] + \cdots$$

∴ for $x = 9$,

$$f(9) = 48 + (5)(52) + (5)(4)(15) + (5)(4)(2)(1)$$

$$f(9) = 48 + 260 + 300 + 90$$

$$\boxed{f(9) = 648}$$ Ans

for $x = 15$,

$$f(15) = 48 + (15-4)(52) + (15-4)(15-5)(15) +$$
$$(15-4)(15-5)(15-7)\cdot(1)$$

$$f(15) = 48 + (11)(52) + (11)(10)(15) +$$
$$(11)(10)(8)(1)$$

$$f(15) = 48 + 572 + 1650 + 850$$

$$\boxed{f(15) = 3150}$$ Ans

Unit - 5

(a)

Ans => Here, $\frac{dy}{dx} = x - y$

$$f(x, y) = x - y$$

$$x_0 = 0, \quad y_0 = 1$$

Firstly approximation by Picard's Method

$$y(1) = y_0 + \int_{x_0}^{x} f(x, y_0)\, dx$$

$$y'(x) = 1 + \int_{0}^{x} (x - y_0)\, dx$$

$$= 1 + \int_{0}^{x} (x-1)\, dx$$

$$= 1 + \int_{0}^{x} (x-1)\, dx$$

$$= 1 + \frac{x^2}{2} - x$$

$$y'(1) = 1 + \frac{1}{2} - 1$$

$$y'(1) = \frac{1}{2}$$

$$\boxed{y'(1) = 0.5}$$

(b)

Ans:⇒ Here,

$$\frac{dy}{dx} = x + y$$

$y' = x + y$ $\qquad$ $y'(0) = 1$

$y'' = 1 + y'$ $\qquad$ $y''(0) = 2$

$y''' = y''$ $\qquad$ $y'''(0) = 2$

$y^{iv} = y'''$ $\qquad$ $y^{iv}(0) = 2$

By Taylor's Series –

$$y = y_0 + (x - x_0)(y')_0 + \frac{(x-x_0)^2}{2!}(y'')_0 + \frac{(x-x_0)^3}{3!}(y''')_0 + \frac{(x-x_0)^4}{4!}(y^{iv})_0 + \text{------}$$

Here, $x_0 = 0$, $y_0 = 1$

$$y(x) = 1 + x(1) + \frac{x^2(2)}{2!} + \frac{x^3}{3!}(2) + \frac{x^4}{4!}(2) + \text{-----}$$

at $x = 0.1$

$$y(0.1) = 1 + 0.1 + \frac{(0.1)^2}{2!} + \frac{(0.1)^3 \times 2}{3!} + \frac{(0.1)^4 \times 2}{4!} + \cdots$$

$$y(0.1) = 1.1103$$

at $x = 0.2$

$$y(0.2) = 1 + 0.2 + \frac{(0.2)^2}{2!} + \frac{(0.2)^3 \times 2}{3!} + \frac{(0.2)^4 \times 2}{4!} + \cdots$$

$$y(0.2) = 1.2427.$$

$\boxed{(C)}$

Ans => We have

$$f(x, y) = \frac{y^2 - x^2}{y^2 + x^2}$$

$x_0 = 0, \quad y_0 = 1, \quad h = 0.2$

$K_1 = h\, f(x_0, y_0) = 0.2\, f(0, 1) = 0.2000$

$K_2 = h f\left(x_0 + \frac{h}{2}, y_0 + \frac{k_1}{2}\right) = 0.19672$

$K_3 = h f\left(x_0 + \frac{h}{2}, y_0 + \frac{k_2}{2}\right) = 0.1967$

$K_4 = h f(x_0 + h, y_0 + k_3) = 0.1891$

$K = \frac{1}{6}(K_1 + 2k_2 + 2K_3 + K_4) = 0.19599$

Hence $y(0.2) = y_0 + k = 1.196$

Now we find $y(0.4)$

$x_1 = 0.2,\ y_1 = 1.196,\ h = 0.2$

$K_1 = h\, f(x_1, y_1) = 0.1891$

$K_2 = h\, f(x_1 + h/2, y_1 + \frac{K_1}{2}) = 0.1795$

$K_3 = h f(x_1 + h/2, y_1 + k_2/2) = 0.1793$

$K_4 = h f(x_1 + h, y_1 + k_3) = 0.1688$

$k = \frac{1}{6}(K_1 + 2K_2 + 2K_3 + K_4) = 0.1792$

$\boxed{y(0.4) = y_1 + k = 1.3752}$ Ans