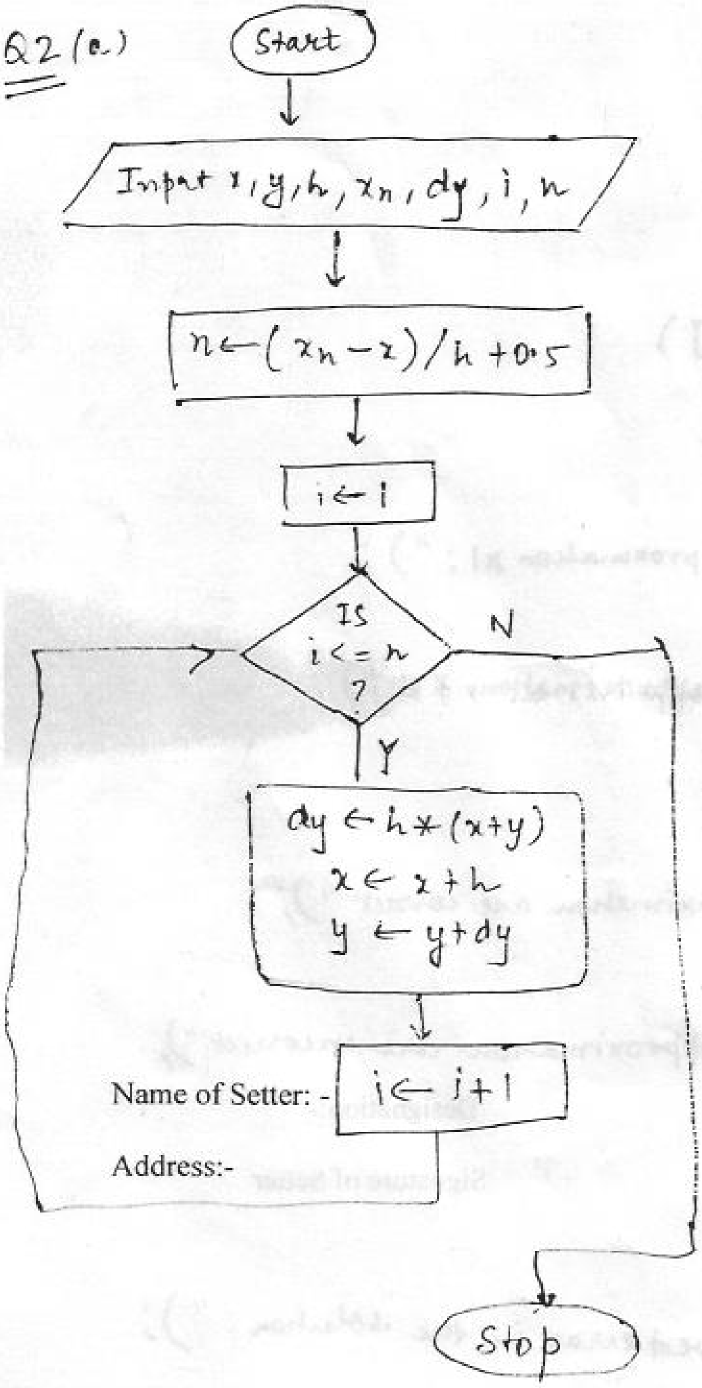
**B.Tech 4th Semester Examination, 2014**
**Model Answer**

**Subject:-** NMCT **Paper Code:-** 21404

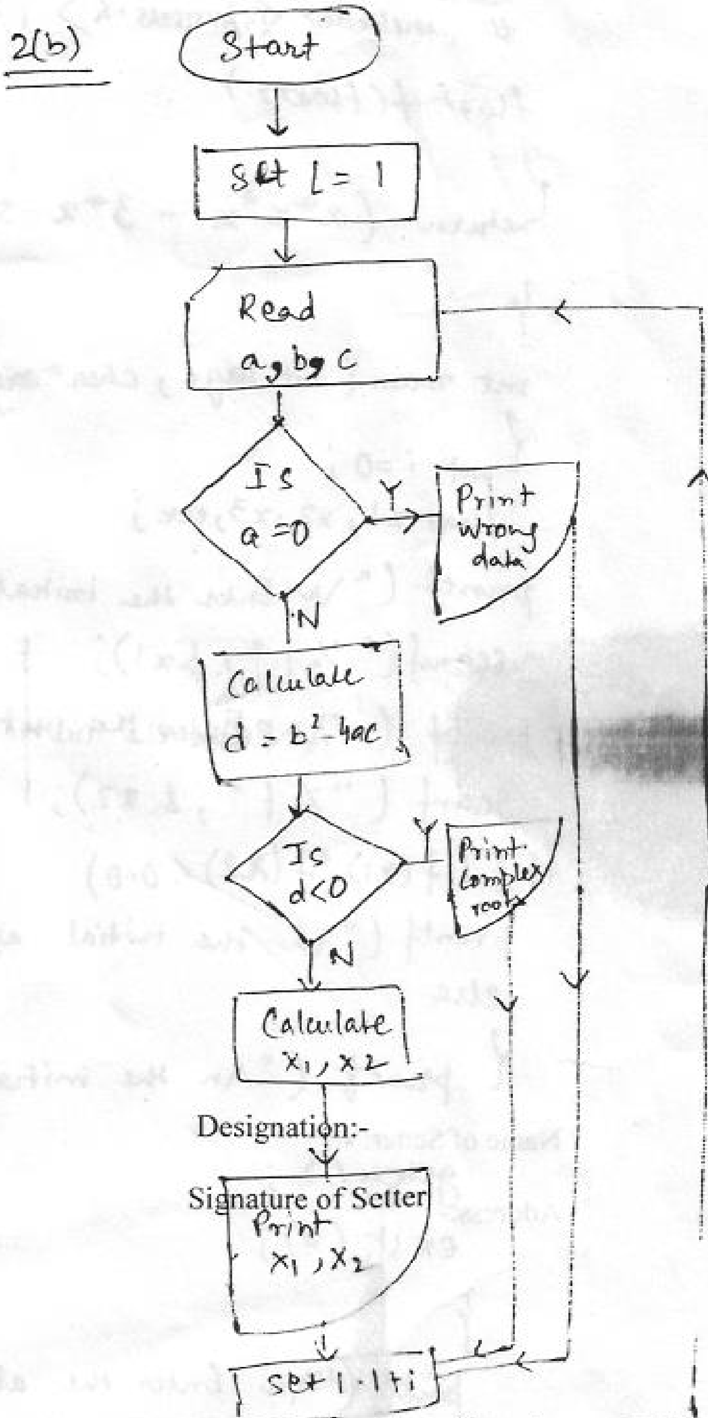
**Sets (I) / ~~(II)~~**

Q1
(i) b
(ii) c
(iii) a
(iv) a
(v) a
(vi) b
(vii) b
(viii) a
(ix) c
(x) a

Q2 (a)




2(b)

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**Sets (I) / (II)**

~~2(b)~~

3

```
# include <stdio.h>
# include <math.h>
# include <conio.h>
# include < process.h >
float f(float x)
{
return (x*x*x - 3*x-5);
}
int main ( int argc, char* argv[] )
{ int i=0 ;
 float x1, x2, x3, err ;
printf ("\n Enter the initial approximation x1: ");
 scanf(" %f ", &x1);
printf ( "\n Enter the initial approximation X2: ");
 scanf ( "%f " , & x2);
 if ( f(x1) *f (x2) < 0.0)
 printf ("\n the initial approximation are correct ");
 else
 { printf ( " \n the initial approximation are incorrect ");
   getch () ;
   exit (0);
 }
 printf ("\n Enter the allowed error in the solution : ");
```

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**Sets (I) / (II)**

```
while(fabs (x2-x1) > err)
{
  i++;
  x3 = (x1+x2)/2
  printf ("\n Iteration = %d has f (x3)= %f and x = %f ", i, f(x3), x3);
  if ( f(x3) == 0.0)
  {
    printf ("\n Solution converges");
    printf ("\n The solution is %f " x3);
    exit(0);
  }
  if( f(x2)*f(x3)<0))
    X1 = x3 ;
  else
    x2 = x3;
}
printf ("\n Solution converges in iteration %d ", i);
printf ("\n The solution is %f ", x3);
getch ();
return 0;
}
```

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**Sets (I) / (II)**

(4) The various types of control statements should be mentioned with their syntax and should be explained elaborately like

Various types of control statements are

(a) if statement - if statement tests a condition if condition is true the statements are executed otherwise ignored
Syntax should be mentioned with example.

(b) if else statement - Working to be mentioned with syntax and example

(c) Nested if else statement - Working with syntax and example

(d) The switch statement - "

(e) Loops - The different types of loop - for loop, while loop & do while loop should be mentioned with details and example

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**Sets (I) / (II)**

5(a) let $f(x) = x^3 + x^2 - 1$

$f(0) = -1$, $f(1) = 1$ Thus real root lies between 0 and 1

taking $x_0 = 0.5$

$f(0.5) = 0.5)^3 + (0.5)^2 - 1 = -0.625$

This shows that root lies between 0.5 & 1

we get $x_1 = \frac{1+0.5}{2} = 0.75$

Thus $f(x_1) = (0.75)^3 + (0.75)^2 - 1 = -0.015625$

Hence root lies between 0.75 & 1

we get $x_2 = \frac{1+0.75}{2} = 0.875$

and then

$f(x_2) = 0.66992 + 0.5625 - 1 = 0.23242$ (+ve)

Hence root lies between 0.75 & 0.8125

So $x_4 = \frac{0.75 + 0.8125}{2} = 0.781$

which yields $f(x_4) = (0.781)^3 + (0.781)^2 - 1 = 0.086$ +ve

thus root lies between 0.75 & 0.781

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we take $x_5 = \frac{0.75+0.781}{2} = 0.765$

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& note that $f(0.765) = 0.0335$ (+ve

Hence root lies between 0.75 and 0.765

∴ let $x_6 = 0.75 + 0.76\ldots$

(6)

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Sets (I) / (II)

$f(0.7575) = 0.0084$ (+ve)

Hence root lies between 0.75 and 0.7575

Proceeding in same way we shall get $x_7 = \ldots$ $x_8 = \ldots$

$x_9 = \ldots$, $x_{10} = \ldots \rightarrow x$ close to $0.75486$ Ans

5(b) Let $f(x) = x^3 - 5x - 7 = 0$

$f(2) = -9$

$f(3) = 5$ $\therefore$ One root lies between 2 & 3

By Regula Falsi method $x_{n+1} = \dfrac{x_n f(x_{n-1}) - x_{n-1} f(x_n)}{f(x_{n-1}) - f(x_n)}$, $n = 1, 2, 3$

We start with $x_0 = 2$ & $x_1 = 3$ Then

$$x_2 = \frac{3(-9) - 2(5)}{-9-5} = \frac{37}{14} \simeq 2.6$$

But $f(2.6) = -2.424$ & $f(3) = 5$

Thus $x_3 = \dfrac{(2.6)5 + 3(2.424)}{5 + 2.424} = 2.73$

Now $f(2.73) = -0.30583$ Since we are getting close to root we find $f(2.75) = 0.046875$

Thus $x_4 = \dfrac{2.75(-0.303583) - 2.73(0.0468675)}{-0.303583 - 0.0468675} = 2.7473$

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Now $f(2.747) = -0.0062$ 6

Therefore $x_5 = \dfrac{2.75(-0.0062) - 2.747(0.046875)}{-0.0062 - 0.046875} = 2.74721$

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**Sets (I) / (II)**

6(a) The augmented matrix is

$$\left[\begin{array}{cccc|c} 10 & -7 & 3 & 5 & 6 \\ -6 & 8 & -1 & -4 & 5 \\ 3 & 1 & 4 & 11 & 2 \\ 5 & -9 & -2 & 4 & 7 \end{array}\right]$$

First elimination yields

$$\left[\begin{array}{cccc|c} 10 & -7 & 3 & 5 & 6 \\ 0 & 3.8 & 0.8 & -1 & 8.6 \\ 0 & 3.1 & 3.1 & 9.5 & 0.2 \\ 0 & -5.5 & -3.5 & 1.5 & 4 \end{array}\right]$$

Result after second elimination

$$\left[\begin{array}{cccc|c} 10 & -7 & 3 & 5 & 6 \\ 0 & 3.8 & 0.8 & -1 & 8.6 \\ 0 & 0 & 2.4474 & 10.3158 & -6.8158 \\ 0 & 0 & -2.3421 & 0.0526 & 16.44764 \end{array}\right]$$

Result after 3rd elimination

$$\left[\begin{array}{cccc|c} 10 & -7 & 3 & 5 & 6 \\ 0 & 3.8 & 0.8 & -1 & 8.6 \\ 0 & 0 & 2.4474 & 10.3158 & -6.8158 \\ 0 & 0 & 0 & 9.9248 & 9.9249 \end{array}\right]$$

Therefore backward substitution yields

$9.9248u = 9.9249$ and so $u = 1$

$2.4474z + 10.3158u = -6.8158$ & so $z = -6.9999 = -7$

$3.8y + 0.8z - u = 8.6$ and so $y = 4$

$10x - 7y + 3z + 5u = 6$ & so $x = 5$

Name of Setter: - Hence solution is

$$\left.\begin{aligned} x &= 5 \\ y &= 4 \\ z &= -7 \\ u &= +1 \end{aligned}\right\} \text{Ans}$$

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**Sets (I) / (II)**

6(b) From given eqns $x = \frac{100-y-z}{54}$, $y = \frac{72-2x-6z}{15}$ & $z = \frac{85+x-6y}{27}$

we take initial approximation $x_0 = y_0 = z_0 = 0$ Then by 1st approximation

$x_1 = \frac{110}{54} = 2.0370$ $y_1 = \frac{72-2x_1-6z_0}{15} = 4.5284$ $z_1 = \frac{85+x_1-6y_1}{27} = 2.247$

second approximation

$x_2 = \frac{110-y_1-z_1}{54} = 1.9122$ $y_2 = \frac{72-2x_2-6z_1}{15} = 3.6581$, $z_2 = \frac{85+x_2-6y_2}{27} = 2.4$

3rd approximation

$x_3 = \frac{110-y_2-z_2}{54} = 1.9247$ $y_3 = \frac{72-2x_3-6z_2}{15} = 3.5809$, $z_3 = \frac{85+x_3-6y_3}{27} =$

4th approximation

$x_4 = \frac{110-y_3-z_3}{54} = 1.9258$ $y_4 = \frac{72-2x_4-6z_3}{15} = 3.5738$, $z_4 = \frac{85+x_4-6y_4}{27}$ $= 2.$

5th approximation

$x_5 = \frac{100-y_4-z_4}{54} = 1.9259$ $y_5 = \frac{72-2x_5-6z_4}{15} = 3.5732$, $z_5 = \frac{85+x_5-6y}{27}$ $= 2.04$

Thus solution $x = 1.926$, $y = 3.573$, $z = 2.425$ Ans

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**Sets (I) / (II)**

Q7(a)

The difference table is

| $x$ | $y=f(x)$ | $\Delta y$ | $\Delta^2 y$ |
|---|---|---|---|
| 0 | 1 | | |
| | | 0.5 | |
| 1 | 1.5 | | 0.2 |
| | | 0.7 | |
| 2 | 2.2 | | 0.2 |
| | | 0.9 | |
| 3 | 3.1 | | 0.3 |
| | | 1.2 | |
| 4 | 4.3 | | |

Newton forward interpolation formula is

$$f(x) = y_0 + u\Delta y_0 + \frac{u(u-1)}{\lfloor 2}\Delta^2 y_0 + \frac{u(u-1)(u-2)}{\lfloor 3}\Delta^3 y_0 + \dots$$

where $u = \dfrac{x-x_0}{h}$

Here $x = 1.3$, $x_0 = 1$, $h = 1$ $\therefore$ $u = \dfrac{1.3-1}{1} = 0.3$

$$f(1.3) = 1.5 + 0.3 \times 0.7 + \frac{0.3(0.3-1)}{2} \times 0.2$$

($\because$ 1.3 lies in interval $[1,2]$ So we take $y_0 = 1.5$)

$$= 1.5 + 0.21 + 0.03(-0.7)$$

$$= 1.5 + 0.21 - 0.021 = 1.5 + 0.189 = 1.689 = 1.07$$

Ans

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**Sets (I) / (II)**

7(b) Let $x$ ~~deno~~ denote ~~avg~~ age in years and $y$ denote no of days of absence

If $y = a_0 + a_1 x$ is line of best fit, then we have normal equations

$$\Sigma y = na_0 + a_1 \Sigma x$$

$$\Sigma xy = a_0 \Sigma x + a_1 \Sigma x^2$$

To evaluate $a_0$ & $a_1$, we now construct the following table

| $x$ | $y$ | $xy$ | $x^2$ |
|---|---|---|---|
| 21 | 4 | 84 | 441 |
| 42 | 14 | 588 | 1764 |
| 38 | 10 | 380 | 1444 |
| 64 | 38 | 2432 | 4096 |
| 53 | 19 9 | 1007 477 | 2809 |
| 61 | 34 | 2074 | 3721 |
| 47 | 17 | 799 | 2209 |
| $\Sigma x = 326$ | $\Sigma y = 136$ 126 | $\Sigma xy = 7364$ 6834 | $\Sigma x^2 = 16484$ |

Here $n = 7$ and the normal eqn are

126 $136 = 7a_0 + 326a_1$

$7364 = 326a_0 + 16484a_1$

6834

Solving we get $a_0 = -17.41$ ($-16.5606$) $a_1 = 0.791$ (0.7420)

Hence the relation is $y = -17.41 + 0$ ($-16.5606$)

when $x = 40$, $y = -17.41 + 0.791 \times 40$

$-16.5606 + 0.7420984 \times 40$

$= 14$ (approx) } Ans

$13.12 \simeq 13$

8a) Here $f(x) = 4x - 3x^2$ & $h = \frac{1-0}{10} = 0.1$

The value of $x$ & $f(x)$ are tabulated below

| $x$ | 0 | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 | 1 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| $f(x)$ | 0 | 0.37 | 0.68 | 0.93 | 1.12 | 1.25 | 1.32 | 1.33 | 1.28 | 1.17 | 1.0 |

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**Sets (I) / (II)**

From the Trapezoidal rule

$$\int_0^1 f(x)\,dx = \frac{h}{2}\left[(y_0+y_n) + 2(y_1+y_2+\cdots y_{n-1})\right] \text{ where } n=10$$

$$= \frac{0.1}{2}\left[(0+1) + 2(0.37+0.68+0.93+1.12+1.25+1.32+1.33+1.28+1.17\right]$$

$$= 0.05\,[1+18.90] = 0.995$$

$$\text{Exact value} = \int_0^1 (4x-3x^2)\,dx = \left[2x^2-x^3\right]_0^1 = 2-1 = 1$$

$\therefore$ absolute error = Exact value − Approx value $= 1-0.995 = 0.005$ Ans

$$\text{Relative error} = \frac{\text{Absolute error}}{\text{exact value}} = \frac{0.005}{1} = 0.005 \quad \text{Ans}$$

8 (b) Here $f(x) = \frac{1}{1+x}$, $n=6$ $\therefore h = \frac{3-0}{6} = \frac{1}{2} = 0.5$

Value of $x$ & $f(x)$ are tabulated below

| $x$ | 0 | 0.5 | 1 | 1.5 | 2 | 2.5 | 3 |
|---|---|---|---|---|---|---|---|
| $f(x)$ | 1 | 0.6667 | 0.5000 | 0.4000 | 0.3333 | 0.2857 | 0.2500 |

From Simpson's 1/3rd rule we get

$$I = \int_0^3 \frac{dx}{1+x} = \frac{h}{3}\left[(y_0+y_6) + 4(y_1+y_3+y_5) + 2(y_2+y_4)\right]$$

$$= \frac{0.5}{3}\left[(1+0.2500 + 4(0.6667+0.4000+0.2857) + 2(0.5000+0.3333)\right]$$

$$= \frac{0.5}{3}\times(8.3262) = 1.3877 \quad \text{— (1)}$$

$$\text{Now} \int_0^3 \frac{dx}{1+x} = \left[\log_e(1+x)\right]_0^3 = \log_e 4 = 2\log_e 2 \quad \text{— (2)}$$

From (1) & (2) the estimated value of $\log_e 2$ is

$$\log_e 2 = \frac{1}{2}(1.3877) = 0.6938 \quad \text{Ans}$$

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**Sets (I) / (II)**

Q9(a) Here $f(x,y) = x - y$, $x_0 = 0$, $y_0 = 1$ & $h = 0.2$

$f(x_0, y_0) = x_0 - y_0 = 0 - 1 = -1$

By Euler's method the successive approximations are

$y_1 = y(x_1) = y(0.2) = y_0 + hf(x_0, y_0) = 1 + 0.2(-1) = 1 - 0.2 = 0.8$

$f(x_1, y_1) = x_1 - y_1 = 0.2 - 0.8 = -0.6$

$y_2 = y(x_2) = y(0.4) = y_1 + hf(x_1, y_1) = 0.8 + (0.2)(-0.6) = 0.68$

$\therefore y(0.4) = 0.68$ Ans

Q9(b) Here $f(x,y) = 1 + y^2$, $x_0 = y_0 = 0$ & $h = 0.2$

$k_1 = hf(x_0 y_0) = 0.2(1 + 0^2) = 0.2$

$k_2 = hf(x_0 + \frac{1}{2}h, y_0 + \frac{1}{2}k_1) = (0.2)[f(0.1, 0.1)] = 0.2[1 + (0.1)^2] =$

$k_3 = hf(x_0 + \frac{h}{2}, y_0 + \frac{k_2}{2}) = (0.2) f(0.1, 0.101) = 0.2[1 + 0.101)^2] = 0.$

$k_4 = hf(x_0 + h, y_0 + k_3 = (0.2) f(0.2, 0.20204) = 0.2[1 + 0.20204^2$

$= 0.20816$

$\therefore y(0.2) = y_0 + \frac{1}{6}(k_1 + 2k_2 + 2k_3 + k_4)$

$= 0 + \frac{1}{6}(0.2 + 2 \times 0.202 + 2 \times 0.20204 + 0.20816]$

$= 0.2027$, correct to 4 decimal places.

Now to compute $y(0.4)$ we take $x_0 = 2$, $y_0 = 0.2027$, $h = 0.2$

Name of Setter: - Then $k_1 = 0.2[1 + 0.2027^2) = 0.2082$

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$k_2 = 0.2[1 + 0.3068^2] = 0.2188$

$k_3 = 0.2[1 + 0.3121^2] = 0.2195$

$k_4 = 0.2[1 + 0.4222^2] = 0.2356$

$y(0.4) = y_0 + k = 0.2$