May 19

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B.Tech. (Electrical Engg./ECE) (2018 Batch) (Sem.–2)

MATHEMATICS-II

Subject Code : BTAM-202-18

M.Code : 76255

Time : 3 Hrs. Max. Marks : 60

INSTRUCTIONS TO CANDIDATES :

1. SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.
2. SECTION - B & C have FOUR questions each.
3. Attempt any FIVE questions from SECTION B & C carrying EIGHT marks each.
4. Select atleast TWO questions from SECTION - B & C.

SECTION-A

I. **Answer briefly :**

a) Check whether the given equation is exact and obtain the general solution :

$$(1 + x^2)dy + 2xydx = 0$$

b) Solve the differential equation $(x - a)dy/dx + 3y = 12 (x-a)^3$; $x > a > 0$.

c) Find the solution of the differential equation $y'' + 2y' + 2y = 0$.

d) Find a differential equation of the form $ay'' + by' + cy = 0$, for which e^{-x} and xe^{-x} are solutions.

e) Solve the differential equation $y'''' + 32y'' + 256y = 0$

f) Write a short note on initial value problems.

g) Find the interval in which the root of equation $x^3 - x - 11 = 0$ lies.

h) Write a short note on Bisection method.

i) Define transcendental equation.

j) Find the polynomial which takes following data (0, 1), (1, 2) and (2, 1).

SECTION-B

2. i) Find the integrating factor and hence solve $(5x^3 + 12x^2 + 6y^2)\,dx + 6xy\,dy = 0$

   ii) Solve the differential equation $dy/dx - y = y^2 (\sin x + \cos x)$.

3. i) Find a homogeneous linear differential equation with real coefficients of lowest order which has the $xe^{-x} + e^{2x}$ as the particular solution.

   ii) Using differential operator, find general solution of $(D^2 + 9)\,y = xe^{2x} \cos x$.

4. Find the general solution of the equation $y''+16y = 32 \sec 2x$, using the method of variation of parameters.

5. Find the general solution of the equation $x^2y''+5xy' - 5y = 24x\ln x$.

SECTION-C

6. Use Newton iterative method to find the root of equation $3x - \cos(x) + 1$, by taking initial guess 0.6.

7. Solve the following equations by elimination method $2x + y + z = 10$, $3x + 2y + 3z = 18$ and $x + 4y + 9z = 16$.

8. Using Newton's forward formula, find value of $f(1.6)$, if :

x	1	1.4	1.8	2.2
$f(x)$	3.49	4.82	5.96	6.5

9. Using Runge-Kutta method of order 4, find $y(0.2)$ for the equation $y = (y - x)/(y + x)'$ $y(0) = 1$, take $h = 0.2$.

NOTE : Disclosure of Identity by writing Mobile No. or Making of passing request on any page of Answer Sheet will lead to UMC against the Student.

BTAM-20-18 Section - A (MAY 2019)

1.a) Check whether the given equation is exact and obtain the general solution.

$$(1+x^2)\,dy + 2xy\,dx = 0$$

Sol. Comparing given equation with $M\,dx + N\,dy = 0$

$M = 2xy \qquad N = 1 + x^2$

$\dfrac{\partial M}{\partial y} = 2x \,, \quad \dfrac{\partial N}{\partial x} = 2x$

$\dfrac{\partial M}{\partial y} = \dfrac{\partial N}{\partial x}$ $\quad\therefore$ given equation is exact.

Its general solution:

$$\int\limits_{y\text{ constant}} M\,dx + \int (\text{terms of } N \text{ which do not contain } x)\,dy = C$$

$$\int\limits_{y\text{ constant}} 2xy\,dx + \int 1\,dy = C$$

$x^2y + y = C$ is the required general solution

b) Solve the differential equation:

$$(x-a)\frac{dy}{dx} + 3y = 12(x-a)^3 \,, \quad x > a > 0$$

Sol. Given eq. can be written as

$$\frac{dy}{dx} + \frac{3}{x-a}\,y = 12(x-a)^2$$

which is of the form $\dfrac{dy}{dx} + Py = Q$

$P = \dfrac{3}{x-a} \,, \quad Q = 12(x-a)^2$

$$\text{I.F.} = e^{\int P\,dx} = e^{\int \frac{3}{x-a}dx} = e^{3\log(x-a)}$$

~ 3

$y(x-a)^3 = \int 12(x-a)^5\,dx + c$

$y(x-a)^3 = 12\dfrac{(x-a)^6}{6} + c$

which is the required solution.

c) Find the solution of the differential equation

$y'' + 2y' + 2y = 0$

Sol. Auxilliary eq of given differential equation is

$m^2 + 2m + 2 = 0$

$m = \dfrac{-2 \pm \sqrt{4-8}}{2}$

$= \dfrac{-2 \pm 2i}{2} = 1 \pm i$

C.F is $y = e^x(c_1 \cos x + c_2 \sin x)$

which is the required solution.

d) Find a differential equation of the form $ay'' + by' + cy = 0$ for which e^{-x} and xe^{-x} are solutions.

Sol. $y = e^{-x}$ is solution of $ay'' + by' + cy = 0$ ①

$y' = -e^{-x}$, $y'' = e^{-x}$

Put in ①

$ae^{-x} - be^{-x} + ce^{-x} = 0$

$e^{-x}(a - b + c) = 0$

$a - b + c = 0$ ① $(\because e^{-x} \neq 0)$

$$\frac{dy}{dx} = -xe^{-x} + e^{-x} \Rightarrow e^{-x}(1-x)$$

$$\frac{d^2y}{dx^2} = -(1-x)e^{-x} + e^{-x}(-1) = e^{-x}(x-2)$$

Put in (1)

$$e^{-x}[a(x-2) + b(1-x) + cx] = 0$$

$$ax - 2a + b - bx + cx = 0 \quad [\because e^{-x} \neq 0]$$

$$x(a-b+c) = 2a-b$$

By (2) $\quad 2a - b = 0 \Rightarrow b = 2a$

$$a - b + c = 0$$

$$a - 2a + c = 0 \Rightarrow a = c$$

Put in (1)

$$ay'' + 2ay' + ay = 0$$

$$a(y'' + 2ay' + ay) = 0$$

$a \neq 0$

$$ay'' + 2ay' + ay = 0 \Rightarrow y'' + 2y' + y = 0$$

which is the required differential eq.

Q. Solve the differential equation

$$y'''' + 32y'' + 256y = 0$$

Sol. Given eq. can be written as

$$(D^4 + 32D^2 + 256)y = 0$$

put $D^2 = t$

$$(t^2 + 32t + 256)y = 0$$

$$t^2 + 32t + 256 = 0$$

$$(t+16)^2 = 0$$

$y = e^{0x}((c_1 + c_2 x)\cos 4x + (c_3 + c_4 x)\sin 4x)$

$y = (c_1 + c_2 x)\cos 4x + (c_3 + c_4 x)\sin 4x$

which is the required solution.

f) Write a short note on initial value problem.

Sol. An initial value problem is an ordinary differential equation together with an initial condition which specifies the value of the unknown function at a given point in the domain.

g) Find the interval in which the root of equation $x^3 - x - 11 = 0$ lies.

Sol. The given equation is $x^3 - x - 11 = 0$

Let $f(x) = x^3 - x - 11$

$f(1) = -11 < 0$

$f(2) = -5 < 0$

$f(3) = 13 > 0$

$\therefore$ root of equation $x^3 - x - 11 = 0$ lies in the interval $(2, 3)$

h) Write a short note on Bisection method.

Sol. Bisection method for finding the root of the equation $f(x) = 0$ is based on the repeated application of intermediate value theorem which states that if f is a continuous function on the interval $[a, b]$ and $f(a)$ and $f(b)$ have

If the equation $f(x) = 0$ involves transcendental function such as e^x, $\sin x$, $\log x$ etc then it is called transcendental equation. eg → $x^2 - \cos x = 0$

j) Find the polynomial which takes following data $(0,1)$, $(1,2)$, $(2,1)$

Sol

x	y	Δy	$\Delta^2 y$
0	1		
		1	
1	2		-2
		-1	
2	1		

Here $x_0 = 0$, $y_0 = 1$, $\Delta y_0 = 1$, $\Delta^2 y_0 = -2$

$h = 1$

$p = \frac{x - x_0}{h} = \frac{x - 0}{1} = x$

By Newton's forward difference formula

$$y(x) = y_0 + p\,\Delta y_0 + \frac{p(p-1)}{\lfloor 2}\,\Delta^2 y_0$$

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

$$y(x) = 1 + x - x^2 + x$$

$$y(x) = -x^2 + 2x + 1$$

Find the integrating factor and hence solve

$$(5x^3 + 12x^2 + 6y^2)\,dx + 6xy\,dy = 0$$

A. $M = 5x^3 + 12x^2 + 6y^2$

$N = 6xy$

$$\frac{\partial M}{\partial y} = 12y \quad , \quad \frac{\partial N}{\partial x} = 6y$$

$$\frac{\frac{\partial M}{\partial y} - \frac{\partial N}{\partial x}}{N} = \frac{12y - 6y}{6xy} = \frac{6y}{6xy} = \frac{1}{x}$$ which is a function of x alone

$$I.F = e^{\int \frac{1}{x} dx} = e^{\log x} = x$$

Multiply x with given Differential Equation

$$(5x^4 + 12x^3 + 6xy^2)\,dx + 6x^2y\,dy = 0$$

$$\frac{\partial M}{\partial y} = 12xy \qquad \frac{\partial N}{\partial x} = 12xy$$

$$\frac{\partial M}{\partial y} = \frac{\partial N}{\partial x}$$ $\therefore$ equation is exact

$$\int_{y\ \text{constant}} M\,dx + \int \left(\text{terms of } N \text{ which do not contain } x\right) dy = c$$

$$\int_{y\ \text{constant}} (5x^4 + 12x^3 + 6xy^2)\,dx + \int 0\,dy = c$$

$x^5 + 3x^4 + 3x^2y^2 = c$ is the required general solution.

ii) Solve the differential equation

$$\frac{dy}{dx} - y = y^2(\sin x + \cos x)$$

$\frac{dy}{dx} \quad \quad y \; (\sin x + \cos x)$

Dividing both sides by y^2

$$y^{-2}\frac{dy}{dx} - y^{-1} = (\sin x + \cos x)$$

Put $y^{-1} = z$

$$-y^{-2}\frac{dy}{dx} = \frac{dz}{dx}$$

$$-\frac{dz}{dx} - z = \sin x + \cos x$$

$$\frac{dz}{dx} + z = \sin x + \cos x$$

which is of the form $\frac{dy}{dx} + Py = Q$,

i.e. Leibnitz linear equation.

$$I.F = e^{\int 1 dx} = e^x$$

$$z e^x = \int (e^x \sin x + e^x \cos x)\, dx + c$$

$$z e^x = e^x(-\cos x) + \int e^x(-\cos x)\, dx + \int e^x \cos x\, dx + c$$

$$z e^x = -e^x \cos x + C$$

$y^{-1} e^x = -e^x \cos x + c$ is the required general solution

3.i) Find a homogeneous linear differential equation with real coefficients of lowest order which has the $xe^{-x} + e^{2x}$ as the particular solution.

Sol. Particular solution is $xe^{-x} + e^{2x}$

$\therefore -1$ is repeated 2 times

roots of D are $-1, -1, 2$

$$(D^2+2D+1)(D-2) = 0$$
$$D^3 - 2D^2 + 2D^2 - 4D + D - 2 = 0$$
$$D^3 - 3D - 2 = 0$$
$$(D^3 - 3D - 2)y = 0$$
$$\frac{d^3y}{dx^3} - 3\frac{dy}{dx} - 2y = 0$$

ii) Using differential operator find general solution of $(D^2+9)y = xe^{2x}\cos x$

Sol: $D^2+9=0 \Rightarrow D = \pm 3i$

C.F. $y = c_1 \cos 3x + c_2 \sin 3x$

P.I. $\frac{1}{D^2+9} xe^{2x}\cos x$

$$\frac{1}{D^2+9} x\cos x = e^{2x}\frac{1}{D^2+4+4D+9} x\cos x$$

$$= e^{2x}\frac{1}{(D+2)^2+9} x\cos x$$

$$= e^{2x}\frac{1}{D^2+4D+13} x\cos x$$

$$= e^{2x}\left[x \cdot \frac{1}{D^2+4D+13}\cos x + \frac{d}{dD}\left(\frac{1}{D^2+4D+13}\right)\cos x\right]$$

$$= e^{2x}\left[x \cdot \frac{1}{D^2+4D+13}\cos x + \frac{-(2D+4)}{(D^2+4D+13)^2}\cos x\right]$$

put $D^2 = -1$

$$= e^{2x}\left[x \cdot \frac{1}{4D+12}\cos x - \frac{2D+4}{(4D+12)^2}\cos x\right]$$

$$\Big[x \cdot \frac{\cdots}{16D^2-144} \cos\cdots - \frac{\cdots}{16D^2+144+96D}\Big]$$

$$= e^{2x}\left[x \cdot \frac{(4D-12)}{-160}\cos x - \frac{(2D+4)}{128+96D}\cos x\right]$$

$$= e^{2x}\left[-\frac{x}{160}(4D-12)\cos x - \frac{(2D+4)(96D-128)}{9216D^2-16384}\cos x\right]$$

$$= e^{2x}\left[-\frac{x}{160}\left[4D\cos x - 12\cos x\right] - \frac{(192D^2-256D+384D-512)\cos x}{26050}\right]$$

$$= e^{2x}\left[\frac{-x}{160}\left[-4\sin x - 12\cos x\right] - \frac{(192D^2+128D-512)}{26050}\cos x\right]$$

$$= e^{2x}\left[\frac{-x}{160}\left[-4\sin x - 12\cos x\right] - \frac{(-192\cos x - 128\sin x - 512\cos x)}{26050}\right]$$

Complete solution is C.F + P.I.

$$y = c_1\cos 3x + c_2\sin 3x + e^{2x}\left[\frac{-x}{160}(-4\sin x - 12\cos x) + \frac{192\cos x + 128\sin x + 512\cos x}{26050}\right]$$

4. Find the general solution of equation $y'' + 16y = 32\sec 2x$ using the method of variation of parameters.

Sol. Given equation in symbolic form

$$(D^2+16)\,y = 32\sec 2x$$

A.E $\quad D^2+16 = 0 \Rightarrow D = \pm 4i$

C.F. $\quad y = c_1\cos 4x + c_2\sin 4x$

$$W = \begin{vmatrix} y_1 & y_2 \\ y_1' & y_2' \end{vmatrix} = \begin{vmatrix} \cos 4x & \sin 4x \\ -4\sin 4x & 4\cos 4x \end{vmatrix} = 4$$

$P.I. = uy_1 + vy_2$ where $u = -\int \frac{y_2 X}{W} dx$ and

$v = \int \frac{y_1 X}{W}$

$$P.I. = -\cos 4x \int \frac{\sin 4x . 32 \sec 2x}{4} dx + \sin 4x \int \frac{\cos 4x . 32 \sec 2x}{4} dx$$

$$= -8\cos 4x \int 2 \sin 2x \cos 2x . \frac{1}{\cos 2x} dx +$$
$$\sin 4x \int \frac{2\cos^2 2x - 1}{\cos 2x} dx$$

$$= -16 \cos 4x \int \sin 2x \, dx + \sin 4x \int (2\cos 2x - \sec 2x) dx$$

$$= -16 \cos 4x \left[-\frac{\cos 2x}{2} \right] + 8 \sin 4x \left[\frac{2\sin 2x}{2} - \frac{\log \sec 2x + \tan 2x}{2} \right]$$

$$= 8\cos 4x \cos 2x + 8 \sin 4x \sin 2x - 4 \sin 4x \log(\sec 2x + \tan 2x)$$

$$= 8\cos(4x - 2x) - 4\sin 4x \log(\sec 2x + \tan 2x)$$

$$= 8\cos 2x - 4 \sin 4x \log(\sec 2x + \tan 2x)$$

$C.S = C.F + P.I.$

$$y = c_1 \cos 4x + c_2 \sin 4x + 8\cos 2x - 4\sin 4x \log(\sec 2x + \tan 2x)$$

. Find the general solution of $x^2y'' + 5xy' - 5y = \frac{24x}{\log x}$

1. Symbolic form of given equation is

$\theta^2 = \theta(\theta-1)$, $xD = \theta$

$[\theta(\theta-1) + 5\theta - 5]y = 24ze^z$

$[\theta^2 - \theta + 5\theta - 5]y = 24ze^z$

$(\theta^2 + 4\theta - 5)y = 24ze^z$

AE is $\theta^2 + 4\theta - 5 = 0$

$\theta^2 - \theta + 5\theta - 5 = 0 \Rightarrow \theta(\theta-1) + 5(\theta-1) = 0$

$(\theta-1)(\theta+5) = 0 \Rightarrow \theta = 1, \theta = -5$

$y = c_1e^z + c_2e^{-5z} = c_1x + c_2x^{-5}$

P.I. $\frac{1}{\theta^2+4\theta-5} \cdot 24ze^z$

$\cdot z = 24e^z \frac{1}{\theta^2+1+2\theta+4\theta+4-5} \cdot z$

$= 24e^z \frac{1}{(\theta+1)^2+4(\theta+1)-5} \cdot z$

$= 24e^z \frac{1}{\theta^2+6\theta} \cdot z = 24e^z \frac{1}{6\theta(1+\frac{\theta}{6})}$

$= 4e^z \frac{1}{\theta}(1+\frac{\theta}{6})^{-1} z$

$= 4e^z \frac{1}{\theta}(1 - \frac{\theta}{6} + \cdots) z$

$= 4e^z \frac{1}{\theta}(z - \frac{1}{6}) = 4e^z[\frac{z^2}{2} - \frac{1}{6}z]$

$= 4x\left[\frac{(\log x)^2}{2} - \frac{1}{6}\log x\right]$

C.S. $=$ C.F $+$ P.I.

$y = c_1x + c_2x^{-5} + 4x\left[\frac{(\log(x))^2}{2} - \frac{1}{6}\log x\right]$

Use Newton iterative method to find the root of equation $3x - \cos x + 1$ by taking initial guess 0.6

Sol. Let $f(x) = 3x - \cos x + 1$

$$f'(x) = 3 + \sin x$$

$$x_0 = 0.6$$

Iteration 1 $\rightarrow$ $x_1 = x_0 - \frac{f(x_0)}{f'(x_0)}$

$$x_1 = 0.6 - \frac{3(0.6) - \cos(0.6) + 1}{3 + \sin(0.6)}$$

$$= 0.6 - \frac{1.8 - 0.82533 + 1}{3 + 0.56464}$$

$$= 0.6 - \frac{1.97467}{3.56464} = 0.6 - 0.55396$$

$$x_1 = 0.04604$$

Iteration 2 $\rightarrow$ $x_2 = x_1 - \frac{f(x_1)}{f'(x_1)}$

$$x_2 = 0.04604 - \frac{3(0.04604) - \cos(0.04604) + 1}{3 + \sin(0.04604)}$$

$$= 0.04604 - \frac{0.13812 - 0.99894 + 1}{3 + 0.04602}$$

$$= 0.04604 - \frac{0.13918}{3.04602} = 0.04604 - 0.04569$$

$$x_2 = 0.00035$$

$$f'(x_2)$$

$$x_3 = 0.00035 - \frac{0.00105}{3.00035} = 0.00035 - 0.00035$$

$$= 0$$

root of given equation is $x = 0$

7. Solve the following equations by elimination method $2x + y + z = 10$, $3x + 2y + 2z = 18$ and $x + 4y + 9z = 16$

Sol. $$[A|B] = \left[\begin{array}{ccc|c} 2 & 1 & 1 & 10 \\ 3 & 2 & 3 & 18 \\ 1 & 4 & 9 & 16 \end{array}\right]$$

$R_1 \leftrightarrow R_3$

$$\sim \left[\begin{array}{ccc|c} 1 & 4 & 9 & 16 \\ 3 & 2 & 3 & 18 \\ 2 & 1 & 1 & 10 \end{array}\right]$$

$R_2 \to R_2 - 3R_1$, $R_3 \to R_3 - 2R_1$

$$\sim \left[\begin{array}{ccc|c} 1 & 4 & 9 & 16 \\ 0 & -10 & -24 & -30 \\ 0 & -7 & -17 & -22 \end{array}\right]$$

$R_2 \to -\frac{1}{10} R_2$

$$\sim \left[\begin{array}{ccc|c} 1 & 4 & 9 & 16 \\ 0 & 1 & \frac{24}{10} & 3 \\ 0 & -7 & -17 & -22 \end{array}\right]$$

$R_3 \to R_3 + 7R_2$

$$\sim \left[\begin{array}{ccc|c} 1 & 4 & 9 & 16 \\ 0 & 1 & 24/10 & 3 \end{array}\right]$$

$$\left[\begin{array}{ccc|c} 1 & 4 & 9 & 16 \\ 0 & 1 & 24/10 & 3 \\ 0 & 0 & 1 & 5 \end{array}\right]$$

$$z = 5$$

$$y + \frac{24}{10} z = 3$$

$$y + 12 = 3 \Rightarrow y = -9$$

$$x + 4y + 9z = 16$$

$$x - 36 + 45 = 16$$

$$x = 7$$

- $x = 7, \ y = -9, \ z = 5$

8. Use Newton's forward formula, find value of $f(1.6)$ if

x	1	1.4	1.8	2.2
$f(x)$	3.49	4.82	5.96	6.5

Sol.

x	$f(x)$	$\Delta f(x)$	$\Delta^2 f(x)$	$\Delta^3 f(x)$
1	3.49			
		1.33		
1.4	4.82		-0.19	
		1.14		-0.41
1.8	5.96		-0.6	
		0.54		
2.2	6.5			

$x_0 = 1, \ y_0 = 3.49, \ \Delta y_0 = 1.33, \ \Delta^2 y_0 = -0.19,$
$\Delta^3 y_0 = -0.41, \quad h = 0.4, \ p = \frac{x - x_0}{h}$

$$p = \frac{x-1}{0.4}$$

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

$$= 3.49 + \frac{(x-1)}{0.4}(1.33) + \frac{\frac{(x-1)}{0.4}\left(\frac{x-1}{0.4}-1\right)}{2}(-0.19)$$

$$+ \frac{\frac{(x-1)}{0.4}\left(\frac{x-1}{0.4}-1\right)\left(\frac{x-1}{0.4}-2\right)}{6}(-0.41)$$

$$f(1.6) = 3.49 + \frac{(1.6-1)}{0.4}(1.33) + \frac{\left(\frac{1.6-1}{0.4}-\cancel{2}\right)\left(\frac{1.6-1}{0.4}\right)}{2}(-0.19)$$

$$+ \frac{\frac{(1.6-1)}{0.4}\left(\frac{1.6-1}{0.4}-1\right)\left(\frac{1.6-1}{0.4}-2\right)}{6}(-0.41)$$

$$= 3.49 + 1.995 - 0.071 + 0.026 = 5.44$$

9. Using Runge-Kutta method of order 4, find $y(0.2)$ for the equation $y = \frac{y-x}{(y+x)'}$, $y(0) = 1$, take $h = 0.2$

Sol. $y = \frac{y-x}{\frac{dy}{dx}+1} \Rightarrow 1 + \frac{dy}{dx} = \frac{y-x}{y}$

$$\frac{dy}{dx} = \frac{y-x}{y} - 1 \Rightarrow \frac{dy}{dx} = \frac{y-x-y}{y}$$

$$\frac{dy}{\cdot} = -\frac{x}{\cdot}$$

$$= h f(x_0, y_0) = 0.2\left(-\frac{0}{1}\right) = 0$$

$$k_2 = h f\left(x_0 + \frac{h}{2}, y_0 + \frac{k_1}{2}\right)$$

$$= 0.2 f\left(0 + \frac{0.2}{2}, 1 + \frac{0}{2}\right) = 0.2 f(0.1, 1)$$

$$= 0.2 \times -\frac{0.1}{1} = -0.02$$

$$k_3 = h f\left(x_0 + \frac{h}{2}, y_0 + \frac{k_2}{2}\right)$$

$$= 0.2 f\left(0 + \frac{0.2}{2}, 1 - \frac{0.02}{2}\right) = 0.2 f(0.1, 0.99)$$

$$= 0.2 \times -\frac{0.1}{0.99} = -0.0202$$

$$k_4 = h f(x_0 + h, y_0 + k_3)$$

$$= 0.2 f(0 + 0.2, 1 + (-0.0202))$$

$$= 0.2 f(0.2, 0.9798)$$

$$= 0.2 \times -\frac{0.2}{0.9798} = -0.0408$$

$$y_1 = y_0 + \frac{1}{6}(k_1 + 2k_2 + 2k_3 + k_4)$$

$$= 1 + \frac{1}{6}(0 + 2(-0.02) + 2(-0.0202) + (-0.0408))$$

$$= 1 + \frac{1}{6}(-0.04 - 0.0404 - 0.0408)$$

$$= 1 - \frac{0.1212}{6} = 1 - 0.0202 = 0.9798$$

$$\therefore y(0.2) = 0.9798$$