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#### **DEPARTMENT OF MATHEMATICS**

UNIT-V NUMERICAL SOLUTION OF ORDINARYDIFFERENTIAL EQUATIONS

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FIGURTH ORDER RUNGE KUTTA METHOD FOR SOLVING FIRST AND SECOND ORDER EQUATIONS.

SECOND ORDER RK METHOD :

21 the initial values of (a, y) for the differential 29n  $\frac{dy}{d\pi} = f(a, y)$  then the first increment in y namely  $\Delta y$  is calculated from the formula  $k_1 = \hbar f(a, y)$   $k_2 = \hbar f(a + \frac{\hbar}{2}, y + \frac{k_1}{2})$   $\Delta y = k_2$  where  $\hbar = \Delta n$ Now  $y(n+\hbar) = y(n+h) = y(n+h)$ THIRD ORDER RK METHOD:  $k_1 = \hbar f(n, y)$  $k_2 = \hbar f(n + \frac{\hbar}{2}, y + \frac{k_1}{2})$ 



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$$k_{3} = \pi_{3} [n + \hbar, y + 2k_{2} - k_{1}]$$

$$\Delta y = \frac{1}{6} [\kappa_{1} + 4 \kappa_{2} + \kappa_{3}]$$
Now  $y_{1} = y_{0} + \Delta y$ 
  
FOURTH ORDER RK METHOD:  

$$k_{1} = \hbar_{3} [n + \frac{\hbar}{2}, y + \frac{\kappa_{1}}{2}]$$

$$k_{3} = \hbar_{3} [n + \frac{\hbar}{2}, y + \frac{\kappa_{2}}{2}]$$

$$k_{4} = \hbar_{3} [n + \hbar, y + \kappa_{3}]$$

$$\Delta y = \frac{1}{6} [\kappa_{1} + 2k_{2} + 2k_{3} + k_{4}]$$
Now  $y_{1} = y_{0} + \Delta y$ .  
() Given  $\frac{dy}{dn} = x^{3} + y$ ,  $y_{0}(n) = 2$ , compute  $y(\tilde{0}, 2)$ ,  $y(n, 4) \ge y(n, 6)$   
by RK method  $q$  Jointh order.

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Soln: Gin y'=28+4 20:0; 40=2. h=0.2. and 0= (a) and to d Now Ki= h: J. (max yo;) = 0:2 [na3+yo]= 0:2(0+2)=0.4 k2 = h 2 [20+ 1/2, yot k1-] = 02 - [0+ 0:2, 2+ 0.4. ] = 0.2 = [[0.1, 2.2] = 0 2 [(0.1)34 2.27 = 0.4402.  $k_3 = h_1^2 [n_0 + \frac{h_1}{2}, y_0 + \frac{h_2}{2}] = 0.2 3 [0.1, 2.2201]$ = 0.2 [(0.1)3+ 2.22017 = 0.4442. Ky = thz [nott, yotk3] = 0.2 ] [0.2, 2.4442] = 0.2 [ (0.1)3+ 2.44427 = 0.4904 Papel in2  $Ay = \frac{1}{6} [K_1 + 2k_2 + 2k_3 + K_4]$  $= \frac{1}{6} \left[ 0.4 + (0.4402) 2 + (0.4442) 2 + 0.4904 \right]$ - 0.4432 WERL STRATE THE TRANS YI = Yo+ Ay APRIL PARTY - 28 = 2+0.4432 = 2.4432 -23MAT204-STATISTICS&NUMERICALMETHODS Dr.G.Nandini/AP/MATHS/SNSCT PAGE-30F5



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Now Rinnethod for 
$$(y_{1}, y_{1})$$
  
 $k_{1} = \frac{\hbar}{4}(y_{1}, y_{1}) = 0.4902$ .  
 $k_{2} = \frac{\hbar}{3}[x_{1} + \frac{\hbar}{2}, y_{1} + \frac{k_{1}}{2}] = 0.5430$   
 $k_{3} = \frac{\hbar}{3}[x_{1} + \frac{\hbar}{2}, y_{1} + \frac{k_{2}}{2}] = 0.5483$   
 $k_{4} = \frac{\hbar}{3}[x_{1} + \frac{\hbar}{2}, y_{1} + k_{3}] = 0.6111$   
 $\Delta y = 0.5473$ .  
 $y_{2} = y_{1} + \Delta y$   
 $= 2.4432 + 0.5473$   
 $= 2.9905$ 

Now KK niethod for (2, y2) where 2=0.4, y2 = 2.9905

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$$k_{1} = h_{1}^{2} (n_{2}, y_{2}) = 0.6108$$

$$k_{2} = h_{1}^{2} (n_{2} + \frac{h_{1}}{2}, y_{2} + \frac{k_{1}}{2}) = 0.6841$$

$$k_{3} = h_{1}^{2} (n_{2} + \frac{h_{1}}{2}, y_{2} + \frac{k_{2}}{2}) = 0.6914$$

$$k_{4} = h_{1}^{2} (n_{2} + h, y_{2} + k_{3}) = 0.7795$$

$$\Delta y = 0.6902$$

$$y_{3} = y_{2} + \Delta y = 2.9905 + 0.6902 = 3.6807$$
(2) Using kk method og 21th order solve  $y' = \frac{y^{2} - n^{2}}{y^{2} + n^{2}}$  with  $y'_{0} = 1.41 + n = 0.2$ .  
Soln: 1.1959
(3) Find  $y(0.8)$  yn that  $y' = y - n^{2}$ ,  $y(0.6) = 1.7379$  by using kk method og 4th order. Take  $h = 0.1$ .  
Soln:  $y_{1} = y(0.7) = 1.8762$ 

$$y_{2} = y(0.8) = 2.0142$$

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