Find a real root of the equation x= e ^ (-x) using newton Raphson method.(R.G.P.V May 2019)

Solution

Let,

F(x) = x – e ^ (-x)

Now put x=0: 0 – e ^ (-0) = -1

Now put x=1: 1 – e^ (-1) = 0.6321

Thus the roots lie between 0 and 1.

Then,

x0 = 0+1/2= 0.5

x0 = 0.5

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By Newton Raphson Formula:
  Xn+1 = Xn – f(Xn)/ f’(Xn)
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Here from given equation f(Xn) = x – e ^ (-x), f’(Xn)= 1 + e^(-x)

So,

Xn+1 = Xn – f(Xn)/ f’(Xn)

Now put n=0;

X0+1= X0 – X0 – e ^ (-X0)/ 1 + e ^ (- X0)

Now put the value of X0= 0.5

X1= 0.5 – 0.5 – e ^ (-0.5)/ 1 + e ^ (-0.5)

X1= 0.5 – 0.5 – 0.60653/ 1 + 0.60653

X1= 0.5 – (- 0.10653)/ 1.60653

X1= 0.56631.

Xn+1 = Xn – f(Xn)/ f’(Xn)

Now put n=1;
X1+1= X1 – X1 – e ^ (-X1)/ 1 + e ^ (- X1)

Now put the value of X1= 0.56631
X2 = 0.56631 – 0.56631 – e ^ (-0.56631)/ 1 + e ^ (-0.56631)
X2 = 0.56631 – (-0.001306)/ 1.567616
X2 = 0.56714
Xn+1 = Xn – f(Xn)/ f'(Xn)

Now put n=2;
X2+1= X2 – X2 – e ^ (-X2)/ 1 + e ^ (- X2)

Now put the value of X2 = 0.56714
X3= 0.56714 – (- 0.56714) – e ^ (-0.56714)/ 1+ e ^ (- 0.56714)
X3= 0.56714- (- 0.00000516)/ 1.56714
X3= 0.56714.

Hence, the required root is 0.56714

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