Advanced Engineering Mathematics, by Erwin Kreyszig 10th. Ed.

**Problem Set 2.5**

No. 1

Double root 

The differential equation becomes  (1)















Put y, y’ and y” into (1)













No. 2



Auxiliary equation:







General sol.: 

No. 3



Auxiliary equation:



double root



General sol.: 

No. 4



Multiply the original equation by x



Auxiliary equation:







General sol.: 

No. 5



Auxiliary equation:

 (double root)



General sol.: 

No. 6



Auxiliary equation:







General sol.: 

No. 7



Auxiliary equation:





General sol.:

No. 7



Auxiliary equation:









General sol.: 

No. 8



Auxiliary equation:





(double root)



General sol.: 

No. 9



Auxiliary equation: 



 double root



General sol.: 

No. 10



Auxiliary equation:







General sol.: 

No. 11



Auxiliary equation:









General sol.: 

No. 12



Auxiliary equation:







General sol.: 



As the initial values are 





And 

Particular sol.: 

No. 13



Auxiliary equation:





General sol.: 



As the initial values are 





And 

Particular sol.: 

No. 14



Auxiliary equation:





General sol.: 



As the initial values are 







Particular sol.: 

No. 15



Auxiliary equation:





 (double root)



General sol.: 



Since the initial values 







Particular sol.: 

No. 16



Auxiliary equation:



 double root



General sol.: 



Then the initial values  are inserted





And 

Particular sol.: 

No. 17



Auxiliary equation:





General sol.: 



Then the initial values  are inserted





Particular sol.: 

No. 18



Auxiliary equation:



 (double root)



General sol.: 





Then the initial values  are inserted





And 

Particular sol.: 

No. 19



Auxiliary equation:







General sol.: 



Then the initial values  are inserted





And 

Particular sol.: 

No. 20

(b)The Euler-Cauchy eqution 

Its auxiliary equation 

And the roots are  respectively.

In case of double root,  and 

If  then the linear combination  is also a solution



Then apply de’Hospital’ Rule

Remark: 



In case of double root (s=0), is a solution.

(c)  Its auxiliary equation is 

In case of double root  and 

The equation becoms  (1)











Put y, y’ and y” into (1)









(d)The Euler-Cauchy eqution 

Set 

It means 













 This is a homogeneous linear ODEs with constant coefficients.

Its auxiliary equation  

Then 

 are the roots  which is of the auxiliary equation of 

(e)   (1)

In the critical case  and 



, , 

Put y, y’ and y” into (1)







