Problems on Particular Integral and complementary functions

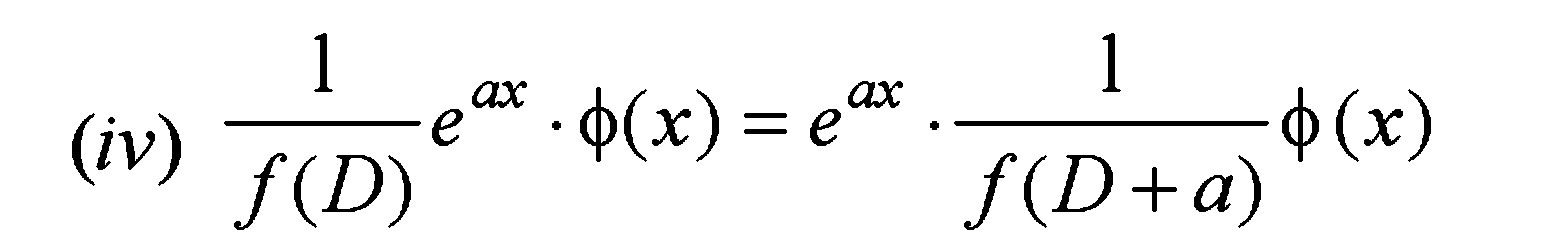
Machine generated alternative text:
RULES TO FIND PARTICULAR INTEGRAL 
If f (a) = 0 then 
f(D) 
If f'(a) = 
0 then 
f(D) 
f'(a) 
2 

Machine generated alternative text:
Expand [f(D)]- 
and then operate. 
f(D) 

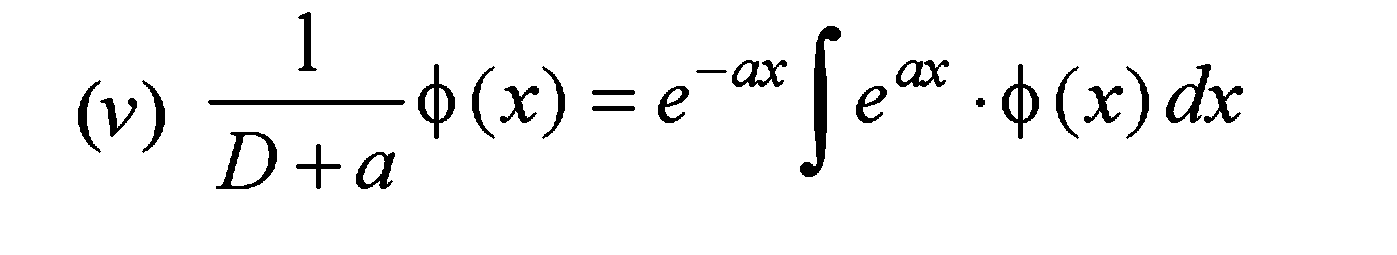
Machine generated alternative text:
Expand [f by the theorem in ascending powers of D as far as the result of 
operation on xn is zero. 

Machine generated alternative text:
sin ax = 
f(D2) 
sin ax and 
2 
f(D2) 
cosax = 
• sin ax 
2 
cos ax 
2 
Iff(— a2) = 0 then 
sin ax = x 
f(D2) 

Machine generated alternative text:
If 
If f'(-a2) = 
f (— a2) = 0 then above rule fails. 
sin ax = x 
0 then, 
f(D2) 
sin ax = x 
f(D2) 
2 
sin ax 
2 
sin ax 
2 



Machine generated alternative text:
f(D) 
f(D) 



Machine generated alternative text:
1 
x n (cos ax + i sin ax) = 
Now 
1 
1 
f(D) 
1 
•x 
1 
•x 
sin ax = 
cos ax = 
Imaginary part of ez 
Real part of ez 
1 
•x 
1 
•x 

Problems on e

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Formula of auxiliary equations and their roots.jpg Machine generated alternative text:
Nature of roots of auxiliary equation (A.E) 
No. 
l. 
2. 
3. 
4. 
Corresponding part of C.E 
(i) One real root ml 
(ii) Two real and different roots ml , 
(iii) Three real and different roots m, , 
(i) Two real and equal roots ml , ml 
(ii) Three real and equal roots mp ml , ml 
(i) One pair of complex roots ± iß 
(ii) Two pairs of complex and equal roots 
(i) One pair of surd roots a ± $ 
(ii) Two pairs of surd and equal roots 
m 
3 
Clem IX 
C em IX + C e"'2X 
'713 x 
C em I x + C em 2X + C3e 
2 ml x 
ecr (q cos ßx + sin ßx) 
Cle cr COS (ßX + % ) 
or 
or 
q ear sin (ßx + c:) 
[(q + c2x) cos ßx + + cry) sin ßxl 
eur (q cosh xo + Sinh x$) 
or 
q eur cosh (xo + % ) 
or Clear Sinh (xo + c:) 
emr [(q + % x) cosh xo + (c) + ctr) Sinh xo I 
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emr [(q + % x) cosh xo + (c) + ctr) Sinh xo I 

Untitled picture.png Machine generated alternative text:
RULES TO FIND PARTICULAR INTEGRAL 
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f(D) 
If f'(a) = 
0 then 
f(D) 
f'(a) 
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sin ax = 
f(D2) 
sin ax and 
2 
f(D2) 
cosax = 
• sin ax 
2 
cos ax 
2 
Iff(— a2) = 0 then 
sin ax = x 
f(D2) 
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Untitled picture.png Machine generated alternative text:
RULES TO FIND PARTICULAR INTEGRAL 
If f (a) = 0 then 
f(D) 
If f'(a) = 
0 then 
f(D) 
f'(a) 
2 
Untitled picture.png Machine generated alternative text:
sin ax = 
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sin ax = 
f(D2) 
sin ax and 
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f(D2) 
cosax = 
• sin ax 
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cos ax 
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Iff(— a2) = 0 then 
sin ax = x 
f(D2) 
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Application

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The linear differential equations with constant coefficients find their most important applications in the 
study of electrical, mechanical and other linear systems. In fact such equations play a dominant role in unifring 
the theory of electrical and mechanical oscillatory systems. 
We shall begin by explaining the types of oscillations of the mechanical systems and the equivalent elec- 
trical circuits. Then we shall study at some length the slightly less striking applications such as deflection of 
beams and whirling of shafts. At the end, we'll take up some of the applications of simultaneous linear differen- 
tial equations. 


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Untitled picture.png Machine generated alternative text:
When the acceleration of a particle is proportional to its 
displacement from a fixed point and is always directed towards it, then 
the motion is said to be simple harmonic. 

If the displacement of the particle at any time t, from fixed point O is x, then,


Untitled picture.png Machine generated alternative text:
its solution is 
its velocity at 
= —g2x or (D2+ g2)x = O, 
dt2 
x = cos pt + sin pt 
= sin pt + C2 cos gt) 
dt 



Untitled picture.png Machine generated alternative text:
If the particle starts from rest at A, where OA = 
a, 
then from (2), 
and from (3), 
Thus 
(at t = O, x = a) 
(at t = O, dx/dt = O) 
x = a cos gt 
dt 
which give the displacement and the velocity of the particle at any time t. 


Untitled picture.png Machine generated alternative text:
If the particle starts from rest at A, where OA = 
a, 
then from (2), 
and from (3), 
Thus 
(at t = O, x = a) 
(at t = O, dx/dt = O) 
x = a cos gt 
dt 
which give the displacement and the velocity of the particle at any time t. 

Untitled picture.png Machine generated alternative text:
Nature of motion. The particle starts from A towards O under acceleration directed towards O which 
gradually decreases until it vanishes at O, when the particle has acquired the maximum velocity. On passing 

Untitled picture.png Machine generated alternative text:
through O, retardation begins and the particle comes to an instantaneous rest at A', where ()A' = OA. It then 
retraces its path and goes on oscillating between A and A'. 


Untitled picture.png Machine generated alternative text:
The amplitude or maximum displacement from the centre is a. 
The periodic time, i.e., the time ofcomplete oscillation is h/ g, for when t is increased by the values 
of x and dx/dt remain unaltered. 
The frequency or the number of oscillations per second is 
1 'periodic time, i.e., g/ 2m 




Untitled picture.png Machine generated alternative text:
Frequency: The number of complete oscillations per second is called the frequency of 
motion. If is the frequency and T is the time period. 
Time period = T = 4 
1 
Frequency = n = 
= —OX 
(1) 
(ii) 
(iii) 
(iv) 
(v) 
d2x 
The of S.H.M. is 
dt2 
The velocity v at a distance x from the centre at time t is 
2 
2 
2 
2 
x = a cos at, where a is the amplitude and o is the angular velocity. 
Maximum acceleration = o a 
Maximum velocity = o a 
2 It 
Time period = T 
(At the extreme point) 
(at the centre) 
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Untitled picture.png Machine generated alternative text:
Frequency: The number of complete oscillations per second is called the frequency of 
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