Midterm 2 - Multiple Choice Questions (16334764)

Current Score: 0/50 **Due:** Wed, Apr 1, 2020 08:50 PM CDT

Question	1	2	3	4	5	6	7	8	9	10	**Total**
Points	0/5	0/5	0/5	0/5	0/5	0/5	0/5	0/5	0/5	0/5	**0/50**

1. 0/5 points Mid2-1 [4622739]

If $u=2f+3g$ and $v=-2f+g$ for some functions $f(t)$ and $g(t)$, then $W[u,v](t)=kW[f,g](t)$. What is k?

- k=8
- k=14
- None of these
- k=2
- k=-4

Solution or Explanation

We have

$$W[u,v](t)=(2f'+3g')(-2f+g)-(2f+3g)(-2f'+g')=(2\cdot 1-3\cdot(-2))(f'g-fg')=8\,W[f,g](t).$$

2. 0/5 points Mid2-2 [4625284]

The existence and uniqueness theorem guarantees that there exists a unique solution of the initial value problem

$$t(t+3)y'''+(t-3)y'+te^{-t^2}y=\ln|6-t|$$

with $y(4)=-1$, $y'(4)=2$, and $y''(4)=-1$ on an open interval

- $(0, 3)$
- $(3, 6)$
- $(0, 6)$
- None of these
- $(-3, 6)$

Solution or Explanation

After dividing by $t(t+3)$, the coefficients are continuous if $t\neq 0, -3, 6$. Since the initial conditions are given at $t=4$, the interval is $(0, 6)$.

3. 0/5 points Mid2-3 [4625509]

The motion of a certain spring-mass system is governed by

$$u'' + 8\,u' + 16\,u = 0$$

with $u(0)=-4$ and $u'(0)=20$. How many times does the mass pass through the equilibrium position $u=0$? That is, how many positive numbers t are there such that $u(t)=0$?

- 0
- 2
- None of these
- Infinitely many times
- 1

Solution or Explanation

Since the characteristic equation has the repeated roots $\lambda=-4$, the general solution is

$$u(t) = e^{-4\,t}(At+B).$$

By the initial condition, we get $A=4$ and $B=-4$. Since $u(t)=0$ if and only if $4\,t-4=0$, the answer is 1 .

4. 0/5 points Mid2-4 [4625354]

The equation $(x-4)y''-xy'+4\,y=0$ for $x>4$ has a solution $y_1(x)=e^x$. If $y_2(x)=v(x)y_1(x)$ is another solution to the equation, then the function $v(x)$ satisfies

- $v''=0$
- $(x-4)v''+(x-8)v'=0$
- $(x-4)v''-4\,v'=0$
- $v''+v'=0$
- None of these

Solution or Explanation

Since

$$(x-4)y_2''-xy_2'+4\,y_2=(x-4)(v''y_1+2v'y_1'+vy_1'')-x(v'y_1+vy_1')+4\,vy_1=e^x((x-4)v''+(x-8)v')=0,$$

the function $v(x)$ should satisfy $(x-4)v''+(x-8)v'=0$

5. 0/5 points Mid2-5 [4625365]

Identify the correct form of a particular solution for the following differential equation.

$y''+3y' = te^{3t}+8t^3.$

- $Ate^{3t}+Be^{3t}+Ct+Dt^2+Et^3+Ft^4$
- $At^2e^{3t}+Bte^{3t}+C+Dt+Et^2+Ft^3$
- $Ate^{3t}+Be^{3t}+C+Dt+Et^2+Ft^3$
- None of these
- $At^2e^{3t}+Bte^{3t}+Ct+Dt^2+Et^3+Ft^4$

Solution or Explanation

Since the homogeneous equation $y''+2y'=0$ has solutions $1, e^{-3t}$, a particular solution is of the form

$Ate^{3t}+Be^{3t}+Ct+Dt^2+Et^3+Ft^4$

6. 0/5 points Mid2-6 [4625450]

For which value of k is the following oscillator in resonance?

$3u'' + ku = 6\cos(2t)$

- 4
- 18
- None of these
- 12
- 6

Solution or Explanation

The oscillator is in resonance if $\sqrt{k/m} = \sqrt{k/3} = 2$.

7. 0/5 points mid2-7 [4625463]

The differential equation

$$u''+6\,u'+11=0$$

corresponds to an oscillator that is

- underdamped
- critically damped
- overdamped
- undamped
- None of these

Solution or Explanation

The characteristic equation has complex roots.

8. 0/5 points Mid2-8 [4625468]

The function $u(t)=-4\sqrt{3}\cos(3t)+4\sin(3t)$ can be written as $u(t)=R\cos(\omega_0 t-\delta)$ where

- $R=4$, $\omega_0=1$, $\delta=11\pi/6$
- $R=8$, $\omega_0=1$, $\delta=\pi/6$
- None of these
- $R=8$, $\omega_0=3$, $\delta=5\pi/6$
- $R=4$, $\omega_0=3$, $\delta=7\pi/6$

Solution or Explanation

We have $R=\sqrt{(-4\sqrt{3})^2+(4)^2}=8$ and $\omega_0=3$. Since $\cos(\delta)=-\sqrt{3}/2$ and $\sin(\delta)=1/2$, $\delta=5\pi/6$.

9. 0/5 points Mid2-9 [4625483]

Determine whether

$$3t-5,\ t^2+1,\ 10t^2+7t$$

are linearly dependent or linearly independent. If they are linearly dependent, find k_1, k_2, k_3 such that

$$k_1(3t-5)+k_2(t^2+1)+k_3(10t^2+7t)=0.$$

- linearly independent
- linearly dependent and $k_1=1$, $k_2=5$, $k_3=1$
- linearly dependent and $k_1=2$, $k_2=10$, $k_3=1$
- None of these

10. 0/5 points Mid2-10 [4625504]

The third order differential equation

$$y'''+py''+qy'+ry=0$$

has the characteristic equation $(\lambda+2)(\lambda^2+6\lambda+18)=0$. What is the general solution to the differential equation?

- $C_1 e^{-2t}+C_2 e^{-3t}+C_3 e^{3t}$
- $C_1 e^{-2t}+C_2 e^{-3t}\cos(3t)+C_3 e^{-3t}\sin(3t)$
- None of these
- $C_1 e^{-2t}+C_2 e^{3t}\cos(3t)+C_3 e^{3t}\sin(3t)$
- $C_1 e^{2t}+C_2 e^{-3t}\cos(3t)+C_3 e^{-3t}\sin(3t)$

Solution or Explanation

Since the roots are $\lambda=-2, -3 \pm 3i$, the general solution is

$$C_1 e^{-2t}+C_2 e^{-3t}\cos(3t)+C_3 e^{-3t}\sin(3t).$$

Assignment Details

Name (AID): **Midterm 2 - Multiple Choice Questions (16334764)**
Submissions Allowed: **3**
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