Kafrelsheikh University
Faculty of Engineering
Physics & Engineering Mathematics Dept.
Year: 1st year Elec. Eng.
Subject: Engineering Mathematics (2)
Code: PHM1006
Date: 5/1/2020
Time allowed: 3 hours
Full mark: 100
Final Term Exam: 4pages

The following questions measure ILOs a1, b1, b7, c1 and c7.

Question 1: (40 Marks)

1. Find Taylor series of the function:

$$f(x,y) = x^2 y + 3x + y - 2$$

in terms of $(x-1)$ and $(y+1)$.

2. Prove that if $z = f(x,y)$ is homogeneous of degree k, then $xz_x + yz_y = kz$.

3. Find the solution of the following differential equation:

i) $y'' + y = \sec x$.

ii) $(x^2D^2 - 2xD + 2)y = 5 + 2x^2 \ln x$.

4. Find Laplace transform for $f(t) = u(t-\pi)e^t \sin^2 t$.

5. Find the solution of the following differential equation using Laplace transform:

$$y'' + 3y' - 4y = 2e^{-t} \quad , \quad y(0) = y'(0) = 0.$$

Question 2: (60 Marks)

1. If $u = \tan^{-1}\left(\frac{x+y}{\sqrt{x}+\sqrt{y}}\right)$ **then** $xu_x + yu_y$ **equals:**

$A)\, 2\cos 2u$ $\quad B)\, \frac{1}{4}\sin 2u$ $\quad C)\, \frac{1}{4}\tan 2u$ $\quad D)\, 2\tan u$

2. If $u = \phi\left(\frac{y}{x}\right) + x\psi\left(\frac{y}{x}\right)$ **, then** $x^2u_{xx} + 2xyu_{xy} + y^2u_{yy}$ **equals:**

$A)\, 0$ $\quad B)\, u$ $\quad C)\, 2u$ $\quad D)\, 1/u$

3. If $z = e^x \sin y,\ x = \ln t,\ y = t^2$ **then** $\frac{dz}{dt}$ **equals:**

$A)\, \frac{e^x}{t}(\sin y - 2t^2 \cos y)$ $\quad B)\, \frac{e^x}{t}(\sin y + 2t^2 \cos y)$

$C)\, \frac{e^x}{t}(\cos y - 2t^2 \sin y)$ $\quad D)\, \frac{e^x}{t}(\cos y + 2t^2 \sin y)$

4. If $u = e^{xyz}$ **then** $\frac{\partial^3 u}{\partial x\, \partial y\, \partial z}$ **is equal to:**

$A)\, e^{xyz}(1 + xyz + 3x^2y^2z^2)$ $\quad B)\, e^{xyz}(1 + xyz + x^2y^2z^2)$

$C)\, e^{xyz}(1 + 3xyz + x^2y^2z^2)$ $\quad D)\, e^{xyz}(3 + xyz + x^2y^2z^2)$

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5. If $u = x^m y^n$ **then:**

$A) du = mx^{m-1}y^n + nx^m y^{n-1}$ $B) du = mdx + ndy$ $C) udu = mxdx + nydy$ $D) \frac{du}{u} = m\frac{dx}{x} + n\frac{dy}{y}$

6. The shortest distance of the point $(0,c)$**, where** $0 < c < 5$**, from the curve** $y = x^2$ **is:**

$A) \sqrt{4c+1}$ $B) \frac{\sqrt{4c+1}}{2}$ $C) \frac{\sqrt{4c-1}}{2}$ $D) \sqrt{4c-1}$

7. If $x = r\cos\theta$, $y = r\sin\theta$**, then** $\frac{\partial(x,y)}{\partial(r,\theta)}$ **is:**

$A) r$ $B) 1/r$ $C) r^2$ $D) 1/2r$

8. If $z = f(x-y \ , y-x)$ **then**

$A) z_x - z_y = 0$ $B) z_x + z_y = 0$ $C) z_x - 2z_y = 0$ $D) 2z_x - z_y = 0$

9. The domain of definition of the function $u(x,y) = \sin^{-1}(x^2 + y^2 + 3)$ **is;**

$A) \phi$ $B) R^2$ $C) 0 < x^2 + y^2 < 2$ $D) 0 < x^2 + y^2 < 4$

10. The envelope of the family of circles $x^2 + (y-a)^2 = 4$ **is:**

$A) y = \pm 2$ $B) x = \pm a$ $C) x = \pm 2$ $D) y = \pm a$

11. If $y = A\cos(mx - \alpha)$ **, then the differential equation satisfying this relation is:**

$A) \frac{dy}{dx} = 1 - y^2$ $B) \frac{d^2y}{dx^2} = -\alpha^2 y$ $C) \frac{d^2y}{dx^2} = -m^2 y$ $D) \frac{dy}{dx} = -\alpha x$

12. The solution of the equation $y\frac{dy}{dx} = -2x$ **is a family of:**

$A)$circles $B)$ hyperbola $C)$parabola $D)$ellipses

13. The solution of $(xy^2 + 1)dx + (x^2y + 1)dy = 0$ **is:**

$A) x^2 + y^2 + 2x = c$ $B) x^2 + y^2 + 2y = c$ $C) x^2y^2 + x + y = c$ $D) x^2y^2 + 2x + 2y = c$

14. The general solution of $(1+x)ydx + (1-y)xdy = 0$ **is:**

$A) xy = ce^{x-y}$ $B) x - y = ce^{xy}$ $C) xy = ce^{y-x}$ $D) x + y = ce^{xy}$

15. In the D.E. $x\frac{dy}{dx} + my = e^{-x}$ **, if the integrating factor is** $\frac{1}{x^2}$ **then the value m is:**

$A) 2$ $B) -2$ $C) 1$ $D) -1$

16. The solution of the D.E. $\frac{dy}{dx} = e^{x-y} + x^2e^{-y}$ **is**

$A) e^y = e^x + \frac{x^3}{3} + c$ $B) e^{-y} = e^x + \frac{x^3}{3} + c$ $C) e^y = e^{-x} + \frac{x^3}{3} + c$ $D) e^y = e^x + x^3 + c$

17. The solution of the D.E. $\frac{dy}{dx}+2xy=2xy^2$ **is**

$A)\ y=\frac{cx}{1+e^{x^2}}$ $B)\ y=\frac{1}{1+ce^{x}}$ $C)\ y=\frac{1}{1+ce^{x^2}}$ $D)\ y=\frac{cx}{1-e^{x^2}}$

18. If I_1, I_2 **are integrating factors for the equations** $xy'+2y=1$ **and** $xy'-2y=1$**, then:**

$A)\ I_1=I_2$ $B)\ I_1I_2=x$ $C)\ I_1=xI_2$ $D)\ I_1I_2=1$

19. $(x^2-\cos y)dx+pdy=0$ **is exact, then p can be:**

$A)\ y^2+x\sin y$ $B)\ \sin y$ $C)\ xy^2-x\sin y$ $D)\ xy-\sin y$

20. If the roots of the auxiliary equation are $-2,-2,2\pm i\sqrt{3}$ **for the D.E.** $L(D)y=0$**, then the general solution is :**

$A)\ y=c_1e^{x}+c_2e^{-2x}+c_3\cos\sqrt{3}x+c_4\sin\sqrt{3}x$ $B)\ y=(c_1+c_2x)e^{2x}+c_3\cos\sqrt{3}x+c_4\sin\sqrt{3}x$

$C)\ y=(c_1+c_2x)e^{-2x}+e^{2x}(c_3\cos\sqrt{3}x+c_4\sin\sqrt{3}x)$ $D)\ y=c_1e^{\sqrt{3}x}+c_2xe^{\sqrt{3}x}+c_3\cos 2x+c_4\sin 2x$

21. The particular solution for the D.E. $\frac{d^2y}{dx^2}+4\frac{dy}{dx}+3y=e^{-3x}$ **is :**

$A)\ y_p=\frac{xe^{-3x}}{-2}$ $B)\ y_p=\frac{xe^{-3x}}{2}$ $C)\ y_p=\frac{e^{-3x}}{-2}$ $D)\ y_p=xe^{-3x}$

22. The particular solution for the D.E. $(D^2+2D+1)y=4\sin 2x$ **is :**

$A)\ y_p=\frac{-4}{25}(2\cos 2x+\sin 2x)$ $B)\ y_p=\frac{-4}{25}(-2\cos 2x-\sin 2x)$

$C)\ y_p=\frac{-4}{25}(4\cos 2x+3\sin 2x)$ $D)\ y_p=\frac{4}{25}(2\cos 2x-\sin 2x)$

23. The particular solution for the D.E. $(D^5-D)y=3^x$ **is :**

$A)\ y_p=\frac{3^x}{(\ln 3)^5-\ln 3}$ $B)\ y_p=\frac{3^x}{\ln 3^5-\ln 3}$ $C)\ y_p=\frac{3^x}{(\ln 3)^5+\ln 3}$ $D)\ y_p=\frac{3^x}{\ln 3^5+\ln 3}$

24. The particular solution for the D.E. $(D^2-1)y=x^3$ **is :**

$A)\ y_p=x^3+6x$ $B)\ y_p=x^3-6x$ $C)\ y_p=-x^3+6x$ $D)\ y_p=-x^3-6x$

25. Laplace Transform of the function $f(t)=\frac{\cos 10t}{t}$ **is :**

$A)\ \frac{s}{s^2+100}$ $B)\ \frac{10}{s^2+100}$ $C)\ \frac{\pi}{2}-\tan^{-1}s$ $D)$ does not exist

26. Laplace Transform of the unit step function $u(t-a)$ **is :**

$A)\ \frac{e^{-as}}{s}$ $B)\ \frac{e^{as}}{s}$ $C)\ \frac{e^{-as}}{s+a}$ $D)\ \frac{e^{as}}{s+a}$

27. Laplace Transform of the function $f(t)=e^{10t}\cos 2t$ is :

$A)\ \dfrac{s-10}{(s-10)^2+4}$ $B)\ \dfrac{s+10}{(s+10)^2+4}$ $C)\ \dfrac{s-10}{(s-10)^2-4}$ $D)\ \dfrac{s+10}{(s+10)^2-4}$

28. Inverse Laplace Transform of $\dfrac{1}{s^n}$ is :

$A)\ \dfrac{t^{n-1}}{(n-1)!}$ $B)\ \dfrac{t^{n-1}}{n!}$ $C)\ \dfrac{t^{n}}{(n-1)!}$ $D)\ \dfrac{t^{n+1}}{n!}$

29. Inverse Laplace Transform of $\dfrac{1}{s(s+1)}$ is :

$A)\ f(t)=\sin t$ $B)\ f(t)=e^{-t}\sin t$ $C)\ f(t)=e^{-t}$ $D)\ f(t)=1-e^{-t}$

30. Inverse Laplace Transform of $\dfrac{s+9}{s^2+6s+13}$ is :

$A)\ \cos 2t+9\sin 2t$ $B)\ e^{-3t}(\cos 2t+9\sin 2t)$ $C)\ e^{-3t}(3\cos 2t+\sin 2t)$ $D)\ e^{-3t}(\cos 2t+3\sin 2t)$

Good Luck

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