	ALPHA COLLEGE OF ENGINEERING AND TECHNOLOGY
	ADVANCED ENGINEERING MATHEMATICS (2130002)
	FOURIER SERIES & FOURIER INTEGRALS
	ASSIGNMENT - 1
1	Find Fourier series of f(x) = $\frac{\pi-x}{2}$ in the interval (0, 2π). Hence deduce that $\frac{\pi}{4} = 1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \cdots$
2	Find Fourier series of f(x) = $\left(\frac{\pi-x}{2}\right)^2$ in the interval 0 ≤ x ≤ 2π. Hence deduce that $\frac{\pi^2}{12} = \frac{1}{1^2} - \frac{1}{2^2} + \frac{1}{3^2} - \cdots$
3	Find the Fourier sine series for f(x) = e^x $\quad 0 < x < \pi$
4	Find the Fourier series for f(x) = $\begin{cases} \pi + x & -\pi < x < 0 \\ \pi - x \;, & 0 < x < \pi \end{cases}$
5	Find Fourier series of f(x) = $x + x^2 \quad , -\pi < x < \pi.$ Hence deduce that $\frac{\pi^2}{6} = 1 + \frac{1}{2^2} + \frac{1}{3^2} + \frac{1}{4^2} + \cdots$
6	Find Fourier series for f(x) = $x - x^2 \quad , -\pi \le x \le \pi$ and hence show that $\frac{\pi^2}{12} = \frac{1}{1^2} - \frac{1}{2^2} + \frac{1}{3^2} - \frac{1}{4^2} + \cdots$
7	Express f(x) = $\|x\| \quad , -\pi < x < \pi$ as Fourier series.
8	Find the Fourier series of the function f(x) = $\begin{cases} 1 + \frac{2x}{\pi} \;; & -\pi \le x \le 0 \\ 1 - \frac{2x}{\pi} \;; & 0 \le x \le \pi \end{cases}$ Hence deduce that $\frac{\pi^2}{8} = \frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \cdots$
9	Expand f(x) in Fourier series in the interval (0 , 2π) if f(x) = $\begin{cases} -\pi \;; & 0 < x < \pi \\ x - \pi \;; & \pi < x < 2\pi \end{cases}$ And hence show that $\sum_{r=0}^{\infty} \frac{1}{(2r+1)^2} = \frac{\pi^2}{8}$
10	Obtain Fourier series of f(x) = $x^2 \quad , -\pi < x < \pi.$ Deduce that $\sum_{n=1}^{\infty} \frac{1}{n^2} = \frac{\pi^2}{6}$
11	Find Fourier series for f(x) = $\begin{cases} -\pi & -\pi < x < 0 \\ x - \pi & 0 < x < \pi \end{cases}$
12	Find Fourier series expansion of f(x) = $\begin{cases} -\pi \,, & -\pi < x < 0 \\ x \,, & 0 < x < \pi \end{cases}$
13	Find Fourier series of the function f(x) = $2x - x^2 \quad in \;\; 0 < x < 3$
14	For the function f(x) = $\begin{cases} x & 0 \le x \le 2 \\ 4 - x & 2 \le x \le 4 \end{cases}$, find its Fourier series. Hence show that $\frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \cdots = \frac{\pi^2}{8}$
15	Obtain Fourier series of the periodic function f(x) = $2x \quad , -1 < x < 1$

16	Is the function f(x) = $x + \lvert x\rvert$, $-\pi \le x \le \pi$ even or odd? Find its Fourier series over the interval mentioned.
17	Find Fourier cosine series for f(x) = x^2 $0 < x < \pi$
18	Find the Fourier sine series for f(x) = 2x 0 < x < 1
19	Find Fourier sine series over $[0,\pi]$ for the function f(x) = $\cos 2x$
20	Find Fourier cosine series of f(x) = e^{-x} , $0 \le x \le \pi$
21	Find the cosine series for f(x) = $\pi - x$ $0 < x < \pi$
22	Find half range cosine series for f(x) = $(x-1)^2$ $0 < x < 1$
23	Find half range sine series of f(x) = x^3 $0 \le x \le \pi$
24	Find half range cosine series for f(x) = $\begin{cases} kx\ , & 0 \le x \le \frac{l}{2} \\ k(l-x)\ , & \frac{l}{2} \le x \le l \end{cases}$ Also prove that $\sum_{n=1}^{\infty} \frac{1}{(2n-1)^2} = \frac{\pi^2}{8}$
25	Find Fourier integral representation of the function f(x) = $\begin{cases} 2\ , & \lvert x\rvert < 2 \\ 0\ , & \lvert x\rvert > 2 \end{cases}$
26	Find the Fourier cosine integral f(x) = e^{-kx} $, x > 0\ , k > 0$
27	Find the Fourier cosine integral for f(x) = $\frac{\pi}{2} e^{-x}$, x ≥ 0
28	Show that $\int_0^{\infty} \frac{\lambda^3 \sin \lambda x}{\lambda^4 + 4} d\lambda = \frac{\pi}{2} e^{-x} \cos x$, $x > 0$
29	Express f(x) = $\begin{cases} 1 & 0 \le x \le \pi \\ 0 & x > \pi \end{cases}$ as a Fourier sine integral and hence Evaluate $\int_0^{\infty} \frac{1-\cos(\pi\lambda)}{\lambda} \sin(x\lambda)\, d\lambda$
30	Show that $\int_0^{\infty} \frac{\sin \lambda \cos \lambda}{\lambda}\, d\lambda = 0\ , if\ x > 1$
31	Find the Fourier transform of the function f(x) = e^{-ax^2}

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	ADVANCED ENGINEERING MATHEMATICS (2130002)
	ORDINARY DIFFERENTIAL EQUATIONS
	ASSIGNMENT - 2
1	What are the order and the degree of the differential equation $y'' + 3y^2 = 3\cos x$
2	Solve : $9yy' + 4x = 0$
3	Solve : $\frac{dy}{dx} + \frac{y\cos x + \sin y + y}{\sin x + x\cos y + x} = 0$
4	Solve : $\frac{dy}{dx} + y\cot x = 2\cos x$
5	Check whether the given DE is exact or not $(x^4 - 2xy^2 + y^4)dx - (2x^2y - 4xy^3 + \sin y)dy = 0$ Hence find general solution.
6	What is the integrating factor of the linear differential equation: $y' - \left(\frac{1}{x}\right)y = x^2$
7	Solve: $ye^x dx + (2y + e^x)dy = 0$
8	Solve: $(x^2 + y^2 + 3)dx - 2xy\,dy = 0$
9	Solve : $\frac{dy}{dx} = e^{3x-2y} + x^2e^{-2y}$
10	Solve the following Bernoulli's equation $\frac{dy}{dx} + \frac{y}{x} = \frac{y^2}{x^2}$
11	Solve: $(x+1)\frac{dy}{dx} - y = e^{3x}(x+1)^2$
12	Solve : $\frac{dy}{dx} = \frac{x^2 - x - y^2}{2xy}$
13	Solve: $\frac{dy}{dx} + \left(\frac{1}{x}\right)y = x^3y^3$
14	If $y = (c_1 + c_2x)e^x$ is a complementary function of a second order differential equation, find the Wronskian $W\,(y_1, y_2)$
15	Find the Wronskian of the two function $\sin 2x \;\; and \;\; \cos 2x$
17	Find the orthogonal trajectories of cardioids: $r = a(1 - \cos\theta)$
18	Give the differential equation of the orthogonal trajectory of the family of circles $x^2 + y^2 = a^2$
19	Solve following DE using the method of undetermined coefficient $\frac{d^2y}{dx^2} + 2\frac{dy}{dx} + 4y = 2x^2 + 3e^{-x}$
20	Solve following DE using the method of undetermined coefficient $y'' + 9y = 2x^2$
21	Solve following DE using the method of undetermined coefficient $y'' + 4y' = 8x^2$
22	Solve following DE using the method of variation of parameter $y'' + 9y = \sec 3x$

23	Solve following DE using the method of variation of parameter $\frac{d^2y}{dx^2} + y = \sin x$
24	Solve following DE using the method of variation of parameter $y'' - 3y' + 2y = e^x$
25	Solve following DE using the method of variation of parameter $y'' + a^2y' = \tan ax$
26	Solve following DE using the method of variation of parameter $\frac{d^2y}{dx^2} + 9y = \tan 3x$
27	Solve : $(D^2 + 6D + 9)x = 0 \quad , where\ D = \frac{d}{dx}$
28	Solve: $(D^3 - 3D^2 + 9D - 27)y = \cos 3x$
30	Solve : $x^2 \frac{d^2y}{dx^2} + 4x \frac{dy}{dx} + 2y = x^2 \sin(\ln x)$
31	Solve : $(D^3 - D)y = x^3$
32	Solve : $(D^2 + 9)y = 2 \sin 3x + \cos 3x$
33	Find the complete solution of $\frac{d^3y}{dx^3} + 8y = \cosh(2x)$
34	Solve : $\frac{d^2y}{dx^2} - 6\frac{dy}{dx} + 9y = \cos(2x) \sin x$
35	Solve : $x^2 \frac{d^2y}{dx^2} - 6x \frac{dy}{dx} + 6y = x^{-3} \log x$
36	Solve: $(D^2 - 2D + 1)y = 10e^x$
37	Solve: $\frac{dy}{dx} + (\tan x)y = \sin 2x \quad , \quad y(0) = 0$
38	Solve: $(D^4 - 16)y = e^{2x} + x^4 \quad , \ where\ D = \frac{d}{dx}$
39	Solve: $y'' + 11y' + 10y = 0$
40	Solve: $(D^2 - 1)y = xe^x \quad , where\ D = \frac{d}{dx}$
41	Solve : $x^2 \frac{d^2y}{dx^2} - x\frac{dy}{dx} + y = \sin(\ln x)$
42	Solve the following Cauchy Euler equation $x^2 \frac{d^2y}{dx^2} + x \frac{dy}{dx} + y = \log x \sin(\log x)$
43	Find the general solutions of the following differential equations : $\frac{d^3y}{dx^3} - 2\frac{dy}{dx} + 4y = e^x \cos x$

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	SERIES SOLUTION OF DIFFERENTIAL EQUATION
	ASSIGNMENT - 3
1	Find the power series solution of $(1-x^2)y''-2xy'+2y=0$ about the ordinary point $x=0$
2	Find the power series solution of $3x\frac{d^2y}{dx^2}+2\frac{dy}{dx}+y=0$ about the point $x=0$ using frobenius method.
3	Discuss about ordinary point, singular point, regular singular point and irregular singular point for the differential equation: $x^3(x-1)y''+3(x-1)y'+7xy=0$
4	Find the series solution of $(x^2+1)y''+xy'-xy=0$ $\quad about\ x_0=0$
5	Find the series solution of $\frac{d^2y}{dx^2}+xy=0$
6	Find the general solution of $2x^2y''+xy'+(x^2-1)y=0$ by using frobenius method.
7	Explain regular-singular point of a second order differential equation and find the roots of the indicial equation to $x^2y''+xy'-(2-x)y=0$
8	Find the series solution of $(x-2)y''-x^2y'+9y=0$ $\quad about\ x_0=0$
9	Find the series solution of $(1+x^2)y''+xy'-9y=0$
10	Find the series solution of $2x(x-1)y''-(x+1)y'+y=0$

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	LAPLACE TRANSFORM
	ASSIGNMENT - 4
1	Find the Laplace transform $t\, sin^2(3t)$
2	Find the Laplace transform of (i) $e^{-3t}\, u(t-2)$ (ii) $\frac{1-\cos 2t}{t}$
3	Find inverse Laplace transform of : (i) $\tan^{-1}\left(\frac{2}{s}\right)$ (ii) $\frac{s^3}{s^4-a^4}$
4	Find the Laplace transform of the periodic function of the waveform $f(t) = \frac{2t}{3} \quad , \quad 0 \le t \le 3 \quad , \; f(t+3) = f(t)$
5	Solve the following initial value problem using the method of Laplace transforms $y''' + 2y'' - y' - 2y = 0 \quad given\ that\ y(0) = 1\ , y'(0) = 2\ \ , y''(0) = 2$
6	Using the convolution theorem, find $L^{-1}\left\{\frac{s^2}{(s^2+a^2)(s^2+b^2)}\right\} \quad , \quad a \neq b$
7	Find $L\,\{e^{3t+3}\}$
8	Find $L^{-1}\left(\frac{4}{s^2} - \frac{1}{s^2+9}\right)$
9	Use Laplace Transform to solve the following initial value problem: $y'' - 3y' + 2y = 12e^{-2t} \qquad , y(0) = 2 \quad , \quad y'(0) = 6$
10	Obtain $L\{e^{2t} sin^2 t\}$
11	Find $L^{-1}\left[\frac{s+7}{s^2+8s+25}\right]$
13	Find the Laplace Transform of $t\, e^{4t} \cos 2t$
14	Define Laplace transform of $f(t)$, $t \ge 0$ Find Laplace transform of $t^{-\frac{1}{2}}$ Find $L\left\{\frac{\sin at}{t}\right\}$
15	Find $L\left\{\int_0^t e^t \frac{\sin t}{t}\, dt\right\}$
16	Find $L^{-1}\left\{\frac{2s^2-1}{(s^2+1)(s^2+4)}\right\}$
17	Use Laplace Transform to solve the following initial value problem:

	$y'' - 3y' + 2y = 4t + e^{3t}$, $y(0) = 1$, $y'(0) = -1$
18	Find $L\{t\ \sin 3t\ \cos 2t\}$
19	Find $L^{-1}\left\{\frac{e^{-3s}}{s^2+8s+25}\right\}$
20	State the convolution theorem and apply it to evaluate $L^{-1}\left\{\frac{s}{(s^2+a^2)^2}\right\}$
21	Find $L^{-1}\left\{\frac{1}{s^4-81}\right\}$
22	Find $L\{t^2\ \cosh(3t)\}$
23	Find Laplace transform of (i) $\frac{\cos at - \cos bt}{t}$ (ii) $t\ \sin at$
24	Find $L^{-1}\left\{\frac{1}{(s+\sqrt{2})(s-\sqrt{3})}\right\}$
25	Find $L^{-1}\left(\frac{1}{(s+a)^2}\right)$
26	For a periodic function f with fundamental period p, state the formula to find Laplace transform of f
27	State the convolution theorem and verify it for $f(t) = t$ and $g(t) = e^{2t}$
28	Find $L^{-1}\left\{\frac{e^{-2s}}{(s^2+2)(s^2-3)}\right\}$
29	Find $L\{t(\sin t - t\cos t)\}$
30	Use Laplace Transform to solve the following initial value problem: $y'' - 2y' = e^t \sin t$, $y(0) = y'(0) = 0$
31	Find $L^{-1}\left\{\frac{1}{s(s^2-3s+3)}\right\}$
32	Find $L\left\{\int_0^t e^u(u + \sin u)du\right\}$
33	Find Laplace transform of $f(t) = \begin{cases} 0 & 0 < t < \pi \\ \sin t & t \geq \pi \end{cases}$
34	Evaluate : $t * e^t$
35	Use Laplace Transform to solve the following initial value problem: $y'' + 3y' + 2y = e^t$ $y(0) = 1$, $y'(0) = 0$

36	Find $L^{-1}\left\{\frac{1}{(s-2)(s+3)}\right\}$
37	Using convolution theorem, obtain the value of $L^{-1}\left\{\frac{1}{s(s^2+4)}\right\}$
38	Prove that : (i) $L(e^{at})=\frac{1}{s-a}\ ,s>a$ (ii) $L(\sinh at)=\frac{a}{s^2-a^2}$

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	PARTIAL DIFFERENTIAL EQUATIONS
	ASSIGNMENT - 5
1	Form the partial differential equations by eliminating the arbitrary function from $f(x^2+y^2\,,z-xy)=0$
2	Solve the following Lagrange's linear differential equation: $(x^2-yz)p+(y^2-zx)q=z^2-xy$
3	Find the complete solution of the following partial differential equations: (i) $\frac{\partial^3 z}{\partial x^3}-3\frac{\partial^3 z}{\partial x^2\partial y}+4\frac{\partial^3 z}{\partial y^3}=e^{x+2y}$ (ii) $\frac{\partial^2 z}{\partial x^2}+3\frac{\partial^2 z}{\partial x\partial y}+2\frac{\partial^2 z}{\partial y^2}=x+y$
4	Using the method of separation of variables solve: $\frac{\partial^2 z}{\partial x^2}-2\frac{\partial z}{\partial x}+\frac{\partial z}{\partial y}=0$
5	Form the partial differential equation from the following: (i) $z=ax+by+ct$ (ii) $z=f\left(\frac{x}{y}\right)$
6	Using the method of separation of variables solve: $\frac{\partial u}{\partial x}=2\frac{\partial u}{\partial t}+u \quad where \;\; u(x\,,0)=6e^{-3x}$
9	Obtain the solution of the partial differential equation: $p^2-q^2=x-y\;\;,\;\; where\ p=\frac{\partial z}{\partial x}\;\;,q=\frac{\partial z}{\partial y}$
10	Solve: $y^2p-xyq=x(z-2y)$
11	Find the solution of the wave equation $u_{tt}=c^2u_{xx}\;\;,\;0\le x\le L$ satisfying the conditions $u(0,t)=u(L,t)=0\;,\qquad u_t(x,0)=0\qquad,\qquad u(x,0)=\frac{\pi x}{L}\quad,0\le x\le L$
12	Form the partial differential equations from $z=f(x+at)+g(x-at)$
13	find the general solution to the partial differential equation $(x^2-y^2-z^2)p+2xyq=2xz$
14	Solve: $\frac{\partial^3 z}{\partial x^3}-2\frac{\partial^3 z}{\partial x^2\partial y}=2e^{2x}$
15	Using the method of separation of variables solve: $x\frac{\partial u}{\partial x}-2y\frac{\partial u}{\partial y}=0$
16	Solve : $x^2p+y^2q=z^2$

17	Solve using charpit method : $px + qy = pq$
18	Using the method of separation of variables solve: $u_x = 2u_t + u \qquad given\ \ u(x,0) = 4e^{-4x}$
19	Find the general solution to the partial differential equation: $xp + yq = x - y$
20	Form the partial differential equation for the equation: $(x-a)(y-b) - z^2 = x^2 + y^2$
21	Using separable variable technique find the acceptable general solution to the one-dimensional heat equation $u_t = c^2 u_{xx}$ and find the solution satisfying the conditions $u(0,t) = u(\pi,t) = 0 \ \ for\ \ t > 0 \quad and\ u(x,0) = \pi - x \quad , 0 < x < \pi$
22	Form the partial differential equation by eliminating the arbitrary functions from $f(x+y+z\,, x^2+y^2+z^2) = 0$
23	Solve the following partial differential equation: $(z-y)p + (x-z)q = y - x$
24	Solve : $p - x^2 = q + y^2$

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	SOME SPECIAL FUNCTIONS
	ASSIGNMENT - 6
1	Define rectangle function and saw-tooth wave function. Also sketch the graphs
2	Find the value of $\Gamma\left(\frac{7}{2}\right)$
3	State the relationship between beta and gamma function.
4	Find the value of $\Gamma\left(\frac{1}{2}\right)$
5	Define Heaviside's unit step functions
6	State Duplication (Legendre) formula
7	Find $B\left(\frac{9}{2},\frac{7}{2}\right)$
8	Find the value of $\Gamma\left(\frac{13}{2}\right)$
9	Represent graphically the given saw-tooth function $f(x) = 2x \quad , \qquad 0 \le x < 2 \quad and\ f(x+2) = f(x)\ \ for\ all\ x$
10	Define Rectangle function