GUJARAT UNIVERSITY

B.E. SEM – 3 (ELECT)

Question Bank

Maths – II

Each question is of equal Marks (10 Marks)

Q.1	Find the Fourier Series for $f(x)=e^{-x}$ in the interval $0<x<2\pi$.
Q.2	Expand $f(x)=x\sin x$ as a Fourier series in the interval $0<x<2\pi$.
Q.3	Find the Fourier series of $f(x)=2x-x^2$ in the interval (0,3). Hence deduce that $\frac{1}{1^2}-\frac{1}{2^2}+\frac{1}{3^2}-\ldots=\frac{\pi^2}{12}$.
Q.4	Find the Fourier series of the function $f(x)=\begin{cases} x^2 & 0\le x\le \pi \\ -x^2 & -\pi\le x\le 0 \end{cases}$.
Q.5	Find the Fourier series of the function $f(x)=\begin{cases} \pi x & 0<x<1 \\ 0 & x=1 \\ \pi(x-2) & 1<x<2 \end{cases}$. Hence show that $\frac{1}{1}-\frac{1}{3}+\frac{1}{5}-\frac{1}{7}+\ldots=\frac{\pi}{4}$.
Q.6	Find the Fourier series of $f(x)=x^2$ in the interval $0<x<a$, $f(x+a)=f(x)$.
Q.7	If $f(x)=\lvert\cos x\rvert$, expand $f(x)$ as a Fourier series in the interval $(-\pi,\pi)$, $f(x+2\pi)=f(x)$.
Q.8	For the function $f(x)$ defined by $f(x)=\lvert x\rvert$, in the interval $(-\pi,\pi)$. Obtain the Fourier series. Deduce that $\frac{1}{1^2}+\frac{1}{3^2}+\frac{1}{5^2}+\ldots=\frac{\pi^2}{8}$.
Q.9	Given $f(x)=\begin{cases} -x+1 & -\pi\le x\le 0 \\ x+1 & 0\le x\le \pi \end{cases}$. Is the function even of odd ? Find the Fourier series for $f(x)$ and deduce the value of $\frac{1}{1^2}+\frac{1}{3^2}+\frac{1}{5^2}+\ldots$.
Q.10	Find the Fourier series of the periodic function $f(x)$; $f(x)=-k$ when $-\pi<x<0$ and $f(x)=k$ when $0<x<\pi$, and $f(x+2\pi)=f(x)$.
Q.11	Half range sine and cosine series of $f(x)=x(\pi-x)$ in $(0,\pi)$
Q.12	Find the Fourier series for the function $f(x)=\begin{cases} \pi x, 0<x<1 \\ \pi\left(x-2\right), 1<x<2 \end{cases}$
Q.13	Find the Fourier series for f(x) defined by f(x) = $x+\frac{x^2}{4}$ when -π< x <π and f(x + 2π) = f(x) and hence show that $\frac{1}{1^2}-\frac{1}{2^2}+\frac{1}{3^2}-\frac{1}{4^2}+\ldots\ldots=\frac{\pi^2}{12}$

GUJARAT UNIVERSITY
B.E. SEM – 3 (ELECT)
Question Bank
Maths – II

Each question is of equal Marks (10 Marks)

Q.14	Find the Fourier series for the function $f(x)=\begin{cases} x; 0<x<1 \\ 0; 1<x<2 \end{cases}$.
Q.15	If f(x) = x in $0 < x < \frac{\pi}{2}$ $= \pi - x$ in $\frac{\pi}{2} < x < \frac{3\pi}{2}$ $= x - 2\pi$ in $\frac{3\pi}{2} < x < 2\pi$ Prove that f(x) = $\frac{4}{\pi}\left\{\frac{\sin x}{1^2}-\frac{\sin 3x}{3^2}+\frac{\sin 5x}{5^2}-\right\}$
Q.16	If f(x) = $\frac{x}{l}$ when $0 < x < l$ $= \frac{2l-x}{l}$ when $l < x < 2l$ Prove that f(x) $\frac{1}{2}-\frac{4}{\pi^2}\left(\frac{1}{I^2}\cos\frac{\pi x}{l}+\frac{1}{3^2}\cos\frac{3\pi x}{l}+\frac{1}{5^2}\cos\frac{5\pi x}{l}+\ldots\ldots\right)$
Q.17	When x lies between $\pm\pi$ and p is not an integer, prove that sin px = $\frac{2}{\pi}\sin p\pi\left(\frac{\sin x}{1^2-p^2}-\frac{2\sin 2x}{2^2-p^2}+\frac{3\sin 3x}{3^2-p^2}-\ldots\ldots\right)$
Q.18	Find the Fourier series for the function $f(x)=e^{ax}$ in $(-l,l)$
Q.19	Half range sine and cosine series of $f(x)=2x-1$ in $(0,1)$
Q.20	Half range sine and cosine series of x^2 in $(0,\pi)$
Q.21	Find Half range sine and cosine series for $f(x)=(x-1)^2$ in $(0,1)$
Q.22	Evaluate: $L\{\sin 2t\cos 3t\}$, $L\{e^{-3t}(\cos 4t+\sin 2t)\}$

GUJARAT UNIVERSITY
B.E. SEM – 3 (ELECT)
Question Bank
Maths – II

Each question is of equal Marks (10 Marks)

Q.23	Evaluate: $L\left\{\sin^2 2t\right\}$, $L\left\{e^{-2t}\cos 3t\right\}$
Q.24	Evaluate: $L\left\{\dfrac{\sin 2t-\sin 3t}{t}\right\}$, $L\left\{t\int_0^t e^{-4t}\sin 3t\,dt\right\}$
Q.25	Evaluate: $L^{-1}\left\{\log\left(\dfrac{s+1}{s-1}\right)\right\}$, $L^{-1}\left\{\dfrac{s^2+s+2}{s^5}\right\}$
Q.26	Evaluate: $L^{-1}\left\{\cot^{-1}\dfrac{s}{a}\right\}, L^{-1}\left\{\dfrac{s-1}{(s-1)^2+4}\right\}$
Q.27	Evaluate: $L^{-1}\left\{\log\left(\dfrac{s+2}{s+3}\right)\right\}$, $L^{-1}\left\{\dfrac{s+2}{\left(s^2+4s+5\right)^2}\right\}$
Q.28	Evaluate: $L^{-1}\left\{\dfrac{1+2s}{(s+2)^2\,(s-1)^2}\right\}, L^{-1}\left\{\dfrac{s^2+s+3}{s^6}\right\}$
Q.29	Evaluate: $L^{-1}\left\{\dfrac{(s+1)^2}{s^3}\right\}$, $L^{-1}\left\{\tan^{-1}\dfrac{s}{a}\right\}$
Q.30	Find the Laplace Transform of f(t), where *(i)* $f(t) = t$ if $0 < t < \dfrac{a}{2}$, $f(t+a) = f(t)$ $= a - t$ if $\dfrac{a}{2} < t < a$
Q.31	Find the Laplace transform of the function $f(t)=\begin{cases}\sin\omega t; 0<t<\dfrac{\pi}{\omega}\\ 0; \dfrac{\pi}{\omega}<t<\dfrac{2\pi}{\omega}\end{cases}$, $f(t)=f(t+\dfrac{2\pi}{\omega})$
Q.32	Use convolution theorem to find the Laplace Inverse Transform of

GUJARAT UNIVERSITY

B.E. SEM – 3 (ELECT)

Question Bank

Maths – II

Each question is of equal Marks (10 Marks)

	(i) $\dfrac{sa}{\left(s^2 - a^2\right)^2}$ (ii) $\dfrac{s-2}{s\left(s - 4s - 13\right)}$
Q.33	Use convolution theorem to find the Laplace Inverse Transform of (i) $\dfrac{s^2}{\left(s^2 + a^2\right)\left(s^2 - b^2\right)}$ (ii) $\dfrac{1}{s^2(s-2)}$
Q.34	Find the value of the integral using Laplace Transform technique. (i) $\int_0^\infty t\, e^{-2t} \cos t\, dt$ (ii) $\int_0^t e^{-t} \dfrac{\sin t}{t}\, dt$
Q.35	Solve the initial value problem $y'' + 5y' + 2y = e^{-2t}, y(0) = 1, y'(0) = 1,$ Using Laplace transformation.
Q.36	Solve the following Differential Equations using Laplace Transform technique. $\dfrac{d^2x}{dt^2} - 2\dfrac{dx}{dt} + x = e^t$ with $x = 2$ and $\dfrac{dx}{dt} = -1$ at $t = 0$
Q.37	Solve the following Differential Equations using Laplace Transform technique. $\dfrac{d^2y}{dx^2} + y = 1$ with $y(0)=1$ and $y\left[\dfrac{\pi}{2}\right] = 0$
Q.38	Solve the following equations : (a) $(D - 2)^2 y = 8(e^{2x} + \sin 2x + x^2)$ (b) $(D^2 + D) y = x^2 + 2x + 4$
Q.39	Solve the following equations : (a) $(D^2 + 1) y = x^2 \cos x$ (b) $(D^2 + 1)y = e^{2x} + \cosh 2x + x^3$
Q.40	Solve the following equations : (a) $(D^4 + 2D^2 + 1)y = x^2 \cos^2 x$ (b) $(D^2 + 2) y = e^{-2x} + \cos 3x + x^2$
Q.41	Solve the following equations :

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	(a) $(D^2 + 2D+1)\, y = x\, e^x \sin x$ (b) $(D^2 - 9)\, y = e^{3x} \cos 2x$
Q.42	Solve the following equations : (a) $(D - 2)^2\, y = 8(e^{2x} + \sin 2x + x^2)$ (b) $(D^3 + 8)\, y = x^4 + 2x + 1$
Q.43	Solve the following equations : (a) $(D^2 - 1)\, y = x \sin 3x + \cos x$ (b) $(D^2 - 4D + 4)\, y = 2e^x + \cos 2x + x^3$
Q.44	Solve: $x^2 \frac{d^2y}{dx^2} - 3x\frac{dy}{dx} + 5y = x^2 \sin(\log x)$.
Q.45	Solve: $x^2 \frac{d^2y}{dx^2} - 3x\frac{dy}{dx} + y = ((\log x)\sin(\log x) + 1)/x$
Q.46	Solve: $(3x+2)\frac{d^2y}{dx^2} + 3(3x+2)\frac{dy}{dx} - 36y = 3x^2 + 4x + 1$.
Q.47	Solve: $x^2 \frac{d^2y}{dx^2} - 3x\frac{dy}{dx} + 5y = x^2 \sin(\log x)$.
Q.48	Solve: $x^2 \frac{d^2y}{dx^2} - 2x\frac{dy}{dx} - 4y = x^2 + 2\log x$.
Q.49	Solve by using method of variation of parameters: $\frac{d^2y}{dx^2} + y = \sec x$.
Q.50	Solve by using method of variation of parameters: $\frac{d^2y}{dx^2} + y = \tan x$.
Q.51	Solve by using method of variation of parameters: $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} = e^x \sin x$
Q.52	The charge q on a plate of a condenser C is given by $L\frac{d^2q}{dt^2} + R\frac{dq}{dt} + \frac{q}{c} = E \sin pt$ the circuit is tuned to resonance so that $p^2 = \frac{1}{LC}$ if initially the current i and charge q

Each question is of equal Marks (10 Marks)

	be zero show that for small value of $\frac{R}{L}$,the current in the circuit at time t is given by $\left(\frac{Et}{2L}\right)\sin pt$.
Q.53	Solve the following simultaneous equations: $\begin{matrix} Dx+y=\sin t \\ Dy+x=\cos t \end{matrix}$; where D = $\frac{d}{dt}$ given that when t =0 ,x =1 and y = 0.
Q.54	Solve the following simultaneous equations: $\begin{matrix} Dx+y=e^{t} \\ Dy+x=e^{-t} \end{matrix}$; where D = $\frac{d}{dt}$
Q.55	Form the partial differential equation of following: (a) $2z=\frac{x^2}{a^2}+\frac{y^2}{b^2}$ (b) $z=f(x+ct)+g(x-ct)$
Q.56	Form the partial differential equation of following: (a) $2z=a^2x^2+b^2y^2$ (b) $z=x+y+f(xy)$
Q.57	Form the partial differential equation of following: (a) $z=(x^2+a)(y^2+b)$ (b) F(xy+z^2 , x + y+ z) = 0
Q.58	Solve following partial differential equations : (a) $x(y^2-z^2)p+y(z^2-x^2)q=z(x^2-y^2)$ (b) $x(y-z)p+y(z-x)q=z(x-y)$
Q.59	Solve following partial differential equations : (a) $py+qx=pq$ (b) $z=px+qy+2\sqrt{pq}$
Q.60	Solve following partial differential equations : (a) $\frac{\partial^2 z}{\partial x^2}-\frac{\partial^2 z}{\partial x\partial y}=\sin x\cos y+xy$ (b) $\frac{\partial^2 z}{\partial x^2}-\frac{\partial^2 z}{\partial x\partial y}=\cos x\cos 2y$
Q.61	Solve following partial differential equations :

GUJARAT UNIVERSITY
B.E. SEM – 3 (ELECT)
Question Bank
Maths – II

Each question is of equal Marks (10 Marks)

	(a) $\frac{\partial^2 z}{\partial x^2} - 2\frac{\partial^2 z}{\partial x \partial y} + \frac{\partial^2 z}{\partial y^2} = e^{x+4y}$ (b) $\frac{\partial^2 z}{\partial x^2} - 2\frac{\partial^2 z}{\partial x \partial y} + \frac{\partial^2 z}{\partial y^2} = x^3 + e^{x+2y}$
Q.62	(a) Solve: $\frac{\partial^2 z}{\partial x \partial y} = e^{-y}\cos x$,given that z = 0 when y = 0 and $\frac{\partial z}{\partial y} = 0$ when x = 0 (b) Solve: $\frac{\partial^2 z}{\partial x^2} = z$ given that $z = e^y$ and $\frac{\partial z}{\partial x} = e^{-y}$ when *x = 0*
Q.63	Solve: $\frac{\partial z}{\partial x} = 2\frac{\partial z}{\partial y} + z$ where z (x , 0) = 8 e^{-5x} using method of separation of variables.
Q.64	Solve: $3\frac{\partial z}{\partial x} + 2\frac{\partial z}{\partial y}$ *= 0,* where *z (x , 0) = 4* e^{-x} by using method of separation of variables.
Q.65	Solve: $\frac{\partial z}{\partial x} = 4\frac{\partial z}{\partial y}$ where z*(0 , y) = 8* e^{-3y} using method of separation of variables.
Q.66	Find the series solution of the differential equation $x\frac{d^2y}{dx^2} + \frac{dy}{dx} + xy = 0$
Q.67	Attempt following. 1) Express $f(x) = 4x^3 + 6x^2 + 7x + 2$ in terms of Legendre polynomial. 2) Prove that $J_{\frac{-1}{2}}(x) = \sqrt{\frac{2}{\pi x}}\cos x$
Q.68	Solve the following equation in power series $(1+x^2)\frac{d^2y}{dx^2} + x\frac{dy}{dx} - y = 0$
Q.69	Attempt the following. (ii) Evaluate $J_{\frac{3}{2}}(x)$ (iii) Prove that $J_{\frac{-1}{2}}(x) = \sqrt{\frac{2}{\pi x}}\cos x$
Q.70	Attempt the following. (i) StateRodrigue's formula for Legendre's polynomials. Show that $P_4(x) = \frac{1}{8}\left(35x^4 - 30x^2 + 3\right)$ (ii) Express J_4 in terms of J_0 and J_1.

GUJARAT UNIVERSITY

B.E. SEM – 3 (ELECT)

Question Bank

Maths – II

Each question is of equal Marks (10 Marks)

Q.71	Solve in series in differential equation $\frac{d^2y}{dx^2}+xy=0$
Q.72	Solve in series in differential equation $x\frac{d^2y}{dx^2}+\frac{dy}{dx}-y=0$
Q.73	solve in series the differential equation $\frac{d^2y}{dx^2}+4y=0$
Q.74	(a) Find real root of the equation $x^3+x^2+1=0$ by using method of direct iteration correct up to three decimal places. (b) By using Newton –Raphson's get the real root of the equation $xe^x-2=0$ correct up to two decimal places
Q.75	(a) Find the real root of the equation $x\log_{10}x-1.2=0$ by false position method. (b) By using Newton –Raphson's get the real root of the equation $x=e^{-x}$ near x = 0.5 correct up to two decimal places.
Q.76	(a) Using the method of iteration, find the roots of the equation $x^4-3x+1=0$ $x_0=1.5$ correct to four decimal places. (b) Find a root of the equation $x^3-x-1=0$ correct to three decimal places, using the bisection method.
Q.77	(a) Find root of the equation $xe^x=\cos x$ correct to three decimal places using method of False-position. (b) Find root of the equation $x^3-3x+5=0$ correct to three decimal places using method of Newton-Raphson.