INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad -500 043

MECHANICAL ENGINEERING

TUTORIAL QUESTION BANK

Course Name	**:**	**Mathematical Transform Techniques**
Course Code	**:**	**AHS011**
Class	**:**	**II B. Tech IV Semester**
Branch	**:**	**Mechanical Engineering**
Year	**:**	**2018 - 2019**
Course Coordinator	**:**	**Ms. B Praveena, Assistant Professor, FE**
Course Faculty	**:**	**Dr. S Jagadha, Associate Professor, FE** **Ms.V Subba laxmi, Assistant Professor, FE**

I. COURSE OBJECTIVES (COs):

The course should enable the students to:

I	Express non periodic function to periodic function using Fourier series and Fourier transforms.
II	Apply Laplace transforms and Z-transforms to solve differential equations.
III	Formulate and solve partial differential equations.

II. COURSE LEARNING OUTCOMES (CLOs):

Students, who complete the course, will have demonstrated the ability to do the following:

CAHS011.01	Ability to compute the Fourier series of the function with one variable.
CAHS011.02	Understand the nature of the Fourier series that represent even and odd functions.
CAHS011.03	Determine Half- range Fourier sine and cosine expansions.
CAHS011.04	Understand the concept of Fourier series to the real-world problems of signal processing
CAHS011.05	Understand the nature of the Fourier integral.
CAHS011.06	Ability to compute the Fourier transforms of the function.
CAHS011.07	Evaluate finite and infinite Fourier transforms.
CAHS011.08	Understand the concept of Fourier transforms to the real-world problems of circuit analysis, control system design
CAHS011.09	Solving Laplace transforms using integrals.
CAHS011.10	Evaluate inverse of Laplace transforms by the method of convolution.
CAHS011.11	Solving the linear differential equations using Laplace transform.
CAHS011.12	Understand the concept of Laplace transforms to the real-world problems of electrical circuits, harmonic oscillators, optical devices, and mechanical systems
CAHS011.13	Apply Z-transforms for discrete functions.
CAHS011.14	Evaluate inverse of Z-transforms using the methods of partial fractions and convolution method.
CAHS011.15	Apply Z-transforms to solve the difference equations.
CAHS011.16	Understand the concept of Z-transforms to the real-world problems of automatic controls in telecommunication.
CAHS011.17	Understand partial differential equation for solving linear equations by Lagrange method.
CAHS011.18	Apply the partial differential equation for solving non-linear equations by Charpit’s method.

CAHS011.19	Solving the heat equation and wave equation in subject to boundary conditions.
CAHS011.20	Understand the concept of partial differential equations to the real-world problems of electromagnetic and fluid dynamics
CAHS011.21	Possess the knowledge and skills for employability and to succeed in national and international level competitive examinations.

TUTORIAL QUESTION BANK

UNIT - I			
FOURIER SERIES			
Part - A (Short Answer Questions)			
S No	**QUESTIONS**	**Blooms Taxonomy Level**	**Course Learning Outcomes (CLOs)**
1	Define a periodic function for the function f(x) and give example.	Remember	CAHS011.01
2	Define even and odd function the function f(x).	Remember	CAHS011.01
3	Find whether the following functions are even or odd (i) x sinx+cosx+x^2coshx (ii)xcoshx+x^3sinhx.	Understand	CAHS011.01
4	Find the primitive periods of the functions sin3x, tan5x, sec4x	Understand	CAHS011.01
5	Write Euler's formulae in the interval $(\alpha, \alpha+2\pi)$.	Remember	CAHS011.01
6	Write the half range Fourier sin and cosine series in $(0, l)$.	Understand	CAHS011.01
7	Write the examples of periodic function.	Understand	CAHS011.01
8	Express $f(x)=\frac{\pi^2}{12}-\frac{x^2}{4}$ as a Fourier series in the interval $-\pi < x < \pi$.	Understand	CAHS011.01
9	Write the Dirichlet's conditions for the existence of Fourier series of a function f(x) in the interval $(\alpha, \alpha+2\pi)$.	Remember	CAHS011.01
10	If f(x) = x in $(-\pi, \pi)$ then find the Fourier coefficient a_2 ?	Understand	CAHS011.01
11	What are the conditions for expansion of a function in Fourier series?	Understand	CAHS011.01
12	If f(x) is an odd function in the interval $(-l, l)$ then what are the value of a_0, a_n ?	Understand	CAHS011.01
13	If f(x) = x^2 in $(-l, l)$ then find b_1?	Understand	CAHS011.01
14	What is the Fourier sine series for f(x) = x in $(0, \pi)$?	Understand	CAHS011.01
15	What is the half range sine series for f(x) = e^x in $(0, \pi)$?	Understand	CAHS011.0
16	Define fourier series of a function f(x) in the interval (C, C +2 π)?	Remember	CAHS011.01
17	Define fourier series of a function f(x) in the interval $(-l, l)$?	Remember	CAHS011.01
18	If f(x) = x^2 - x in $(-\pi, \pi)$ then what is a_0?	Understand	CAHS011.01
19	Write the fourier series for even function?	Understand	CAHS011.01
20	Write the fourier series for odd function?	Understand	CAHS011.01
Part - B (Long Answer Questions)			
1	Obtain the Fourier series expansion of f(x) given that $f(x)=(\pi-x)^2$ in $0 < x < 2\pi$ and deduce the value of $\frac{1}{1^2}+\frac{1}{2^2}+\frac{1}{3^2}+.........=\frac{\pi^2}{6}$	Understand	CAHS011.0 CAHS011.01
2	Find the Fourier Series to represent the function $f(x)=\|\sin x\|$ in $-\pi <$ x< π .	Understand	CAHS011.01

3	Find the Fourier Series expansion for the function f(x)= x in the interval $(-\pi,\pi)$.	Understand	CAHS011.01
4	Find the Fourier Series expansion for the function $f(x)=\|\cos x\|$ in $[-\pi,\pi]$.	Understand	CAHS011.01
5	Find the Fourier series to represent the function $f(x)=e^{ax}$ in $0<x<2\pi$.	Understand	CAHS011.01
6	Find the half range Fourier sine series for the function f(x) = cos x for $0<x<\pi$	Understand	CAHS011.02
7	Obtain the Fourier cosine series for f(x) = x sin x when 0<x<π and show that $\frac{1}{1.3}-\frac{1}{3.5}+\frac{1}{5.7}-\frac{1}{7.9}+......=\frac{\pi-2}{4}$.	Understand	CAHS011.01
8	Find the Fourier series to represent the function $f(x)=x\cos x$ in $0<x<2\pi$	Understand	CAHS011.01
9	If f(x)= coshax then expand f(x) as a Fourier Series in the interval $(-\pi,\pi)$.	Understand	CAHS011.01
10	Find the Fourier cosine and sine series for the function $f(x)=\frac{1}{12}(3x^2-6x\pi+2\pi^2)$ in the interval $(0,2\pi)$.	Understand	CAHS011.02
11	Express the function $f(x)=x-\pi$ as Fourier series in the interval $-\pi<x<\pi$.	Understand	CAHS011.01
12	Find the Fourier series to represent the function $f(x)=e^{-ax}$ from $x=-\pi$ to π. And hence deduce that $\frac{\pi}{\sinh\pi}=2\left[\frac{1}{2^2+1}-\frac{1}{3^2+1}+\frac{1}{4^2+1}-----\right]$	Understand	CAHS011.01
13	Expand the function $f(x)=\left(\frac{\pi-x}{2}\right)^2$ as a Fourier series in the interval $0<x<2\pi$, hence deduce that $\frac{1}{1^2}-\frac{1}{2^2}+\frac{1}{3^2}-\frac{1}{4^2}+----=\frac{\pi^2}{12}$	Understand	CAHS011.01
14	Find the Fourier series to represent the function $f(x)=x-x^2$ in $[-\pi,\pi]$?	Understand	CAHS011.01
15	Find the half range sine series for $f(x)=x(\pi-x), in\ 0<x<\pi$ Deduce that $\frac{1}{1^3}-\frac{1}{3^3}+\frac{1}{5^3}-\frac{1}{7^3}+----=\frac{\pi^3}{32}$	Understand	CAHS011.02
16	Express $f(x)=e^{-x}$ as a Fourier series in the interval $(-l,l)$	Understand	CAHS011.01
17	Find the Fourier series of periodicity 3 for the function $f(x)=2x-x^2$ in (0,3)	Understand	CAHS011.01
18	Find the Fourier expansion of $f(x)=\frac{\pi^2}{12}-\frac{x^2}{4}$ in the interval $[-\pi,\pi]$	Understand	CAHS011.01
19	Find the half – range Fourier cosine series for the function	Understand	CAHS011.02

	$f(x)=\sin\left(\frac{\pi x}{l}\right)$ in the range $0<x<l$		
20	Find the half- range Fourier sine series for the function $f(x)=\frac{e^{ax}-e^{-ax}}{e^{a\pi}-e^{-a\pi}} in\ (0,\pi)$	Understand	CAHS011.02
Part - C (Problem Solving and Critical Thinking Questions)			
1	If $f(x)=\begin{cases} x, 0<x<\frac{\pi}{2} \\ \pi-x, \frac{\pi}{2}<x<\pi \end{cases}$ then prove that $f(x)=\frac{4}{\pi}\left[\sin x-\frac{1}{3^2}\sin 3x+\frac{1}{5^2}\sin 5x---\right]$.	Understand	CAHS011.02
2	Find the Fourier series of the periodic function defined as $f(x)=\begin{bmatrix} -\pi, & -\pi<x<0 \\ x, & 0<x<\pi \end{bmatrix}$ Hence deduce that $\frac{1}{1^2}+\frac{1}{3^2}+\frac{1}{5^2}+------=\frac{\pi^2}{8}$	Understand	CAHS011.02
3	The intensity of an alternating current after passing through a rectifier is given by $i(x)=\begin{cases} I_0\sin x\ for\ \ 0\le x\le\pi \\ 0\qquad for\ \pi\le x\le 2\pi \end{cases}$ where I_0 is the maximum current and the period is 2π .Express $i(x)$ as a Fourier series.	Understand	CAHS011.02
4	If $f(x)=\begin{cases} 1+\frac{2x}{\pi}, & -\pi\le x\le 0 \\ 1-\frac{2x}{\pi}, & 0\le x\le\pi \end{cases}$ Then find the values of $a_0, a_n and\ b_n$?	Understand	CAHS011.02
5	If $f(x)=\begin{cases} 0\ , & -l<x<\frac{-l}{2} \\ \cos\frac{\pi x}{l}\ , & \frac{-l}{2}<x<\frac{l}{2} \\ 0\ , & \frac{l}{2}<x<l \end{cases}$ in the Fourier expansion of $f(x)$ find the value of $a_0, a_n and\ b_n$?	Understand	CAHS011.02
6	Obtain the Fourier series of $f(x)=\begin{cases} -k & for\ -\pi<x<0 \\ k & for\ \ 0<x<\pi \end{cases}$ and hence show that $1-\frac{1}{2}+\frac{1}{5}-\frac{1}{7}+........=\frac{\pi}{4}$	Understand	CAHS011.02
7	Determine the Fourier series representation of the half wave rectifier signal $x(t)=\begin{cases} \sin t\ , & 0\le t<\pi \\ 0\ , & \pi\le t<2\pi \end{cases}$	Understand	CAHS011.02

8	Let $x(t)=\begin{cases} t & , \quad 0\le t\le 1 \\ 2-t & , \quad 1\le t\le 2 \end{cases}$ be a periodic signal with fundamental period T=2, Find the Fourier coefficients $a_0, a_n and\ b_n$?	Understand	CAHS011.02
9	In the expansion of $f(x)=\left(\frac{\pi-x}{2}\right)^2, 0<x<2\pi$ find the value of $a_n and\ b_n$.?	Understand	CAHS011.01
10	Obtain the Fourier series for the function $f(x)=\begin{cases} x & in \quad -\pi<x<\pi \\ 0 & in \quad 0<x<\pi/2 \\ x-\pi/2 & in \quad \pi/2<x<\pi \end{cases}$	Understand	CAHS011.02
UNIT-II			
FOURIER TRANSFORMS			
Part – A (Short Answer Questions)			
1	Write the Fourier sine integral and cosine integral.	Remember	CAHS011.03
2	Find the Fourier sine transform of xe^{-ax}	Understand	CAHS011.03
3	Write the infinite Fourier transform of f(x).	Remember	CAHS011.03
4	Write the properties of Fourier transform of f(x)	Remember	CAHS011.03
5	Find the Fourier sine transform of f(x)=x ?	Understand	CAHS011.03
6	Find the Fourier cosine transform of $f(x)=2e^{-5x}+5e^{-2x}$?	Understand	CAHS011.03
7	What is the value of $F_C\{e^{-at}\}$?	Understand	CAHS011.03
8	State Fourier integral theorem.	Understand	CAHS011.03
9	Define Fourier transform.	Remember	CAHS011.03
10	Find the finite Fourier cosine transform of f(x)=1 in $0<x<\pi$	Understand	CAHS011.03
11	Find the inverse finite sine transform f(x) if $F_S(n)=\frac{1-\cos n\pi}{n^2\pi^2}$	Understand	CAHS011.03
12	State and prove Linear property of Fourier Transform	Understand	CAHS011.03
13	State and prove change of scale property of Fourier Transform	Understand	CAHS011.03
14	State and prove Shifting Property of Fourier Transform	Understand	CAHS011.03
15	State and prove Modulation Theorem of Fourier Transform	Understand	CAHS011.03
16	Prove that $F(x^n f(x))=(-i)^n \frac{d^n}{ds^n}[F(\text{p})]$	Understand	CAHS011.03
17	Find the Fourier Transform of f(x) defined by $f(x)=\begin{cases} e^{iqx}, & \alpha<x<\beta \\ 0, & x<\alpha\ and\ x>\beta \end{cases} or\ f(x)=\begin{cases} e^{ikx}, & a<x<b \\ 0, & x<a\ and\ x>b \end{cases}$	Understand	CAHS011.03
18	Solve $F_S\{f(x)\cos ax\}=\frac{1}{2}[F_S(p+a)+F_S(p-a)]$	Understand	CAHS011.03
19	Solve $F_c\{f(x)\sin ax\}=\frac{1}{2}[F_S(p+a)-F_S(p-a)]$	Understand	CAHS011.03

20	Solve $F_s\{f(x)\sin ax\} = \frac{1}{2}[F_c(p-a) - F_c(p+a)]$	Understand	CAHS011.03
Part - B (Long Answer Questions)			
1	Find the Fourier transform of f(x) defined by $f(x) = \begin{cases} 1, & \lvert x\rvert < a \\ 0, & \lvert x\rvert > a \end{cases}$ *and* *hence evaluate* $\int_0^\infty \frac{\sin p}{p} dp. and \int_{-\infty}^\infty \frac{\sin ap.\cos px}{p} dp$	Understand	CAHS011.03
2	Find the Fourier transform of f(x) defined by $f(x) = \begin{cases} 1-x^2, & \lvert x\rvert \le 1 \\ 0, & \lvert x\rvert > 1 \end{cases}$ Hence evaluate $(i)\ \int_0^\infty \frac{x\cos x - \sin x}{x^3}\cos\frac{x}{2} dx \quad (ii)\ \int_0^\infty \frac{x\cos x - \sin x}{x^3} dx$	Understand	CAHS011.03
3	Find the Fourier Transform of f(x) defined by $f(x) = e^{\frac{-x^2}{2}}, -\infty < x < \infty$ or, Show that the Fourier Transform of $e^{\frac{-x^2}{2}}$ is reciprocal.	Understand	CAHS011.03
4	Find Fourier cosine and sine transforms of $e^{-ax}, a > 0$ and hence deduce the inversion formula (or) deduce the integrals $i.\ \int_0^\infty \frac{\cos px}{a^2+p^2} dp \quad ii.\ \int_0^\infty \frac{p\sin px}{a^2+p^2} dp$	Understand	CAHS011.03
5	Find the Fourier sine Transform of $e^{-\lvert x\rvert}$ and hence evaluate $\int_0^\infty \frac{x\sin mx}{1+x^2} dx$	Understand	CAHS011.03
6	Find the Fourier cosine transform of $(a)\quad e^{-ax}\cos ax \quad (b)\quad e^{-ax}\sin ax$	Understand	CAHS011.03
7	Find the Fourier sine and cosine transform of xe^{-ax}	Understand	CAHS011.03
8	Find the Fourier sine transform of $\frac{x}{a^2+x^2}$ and Fourier cosine transform of $\frac{1}{a^2+x^2}$	Understand	CAHS011.03
9	Find the Fourier sine and cosine transform of $f(x) = \frac{e^{-ax}}{x}$ and deduce that $\int_0^\infty \frac{e^{-ax} - e^{-bx}}{x}\sin sx\, dx = Tan^{-1}\left(\frac{s}{a}\right) - Tan^{-1}\left(\frac{s}{b}\right)$	Understand	CAHS011.03

10	Find the finite Fourier sine and cosine transform of f(x), defined by f(x)= $\left(1-\frac{x}{\pi}\right)^2$, where $0 < x < \pi$	Understand	CAHS011.04
11	Find the finite Fourier sine and cosine transform of f(x), defined by f(x) =sin ax in $(0, \pi)$.	Understand	CAHS011.04
12	Find the finite Fourier sine transform of f(x), defined by $f(x) = \begin{cases} x, & 0 \le x \le \frac{\pi}{2} \\ \pi - x, & \frac{\pi}{2} \le x \le \pi \end{cases}$	Understand	CAHS011.04
13	Using Fourier integral show that $e^{-x} \cos x = \frac{2}{\pi} \int_0^{\infty} \frac{\lambda^2 + 2}{\lambda^2 + 4} \cos \lambda x dx$	Understand	CAHS011.03
14	Find the inverse Fourier transform f(x) of $F(p) = e^{-\|p\|y}$	Understand	CAHS011.03
15	Find the Fourier transform of $f(x) = \begin{cases} a^2 - x^2 & if \ \|x\| < a \\ 0 & if \ \|x\| > a \end{cases}$ hence show that $\int_0^{\infty} \frac{\sin x - \cos x}{x^3} dx = \frac{\pi}{4}$	Understand	CAHS011.03
16	Find the finite Fourier sine and cosine transforms of $f(x) = \sin ax$ in (0, π).	Understand	CAHS011.04
17	Find the inverse Fourier cosine transform f(x) of $F_c(p) = p^n e^{-ap}$ and inverse Fourier sine transform f(x) of $F_s(p) = \frac{p}{1+p^2}$	Understand	CAHS011.03
18	Using Fourier integral show that $e^{-ax} = \frac{2a}{\pi} \int_0^{\infty} \frac{\cos \lambda x}{\lambda^2 + a^2} d\lambda$ (a > 0, x≥ 0)	Understand	CAHS011.03
19	Using Fourier integral show that $e^{-ax} - e^{-bx} = \frac{2(b^2 - a^2)}{\pi} \int_0^{\infty} \frac{\lambda \sin \lambda x}{(\lambda^2 + a^2)(\lambda^2 + b^2)} d\lambda, a > 0, b > 0$	Understand	CAHS011.03
20	Using Fourier Integral, show that $\int_0^{\infty} \frac{1 - \cos \lambda \pi}{\lambda} . \sin \lambda x \, d\lambda = \begin{cases} \frac{\pi}{2} \, if \ 0 < x < \pi \\ 0, if \ x > \pi \end{cases}$	Understand	CAHS011.03

Part - C (Problem Solving and Critical Thinking Questions)			
1	Find the Fourier cosine transform of the function f(x) defined by $f(x)=\begin{cases}\cos x, & 0<x<a\\ 0, & x\geq a\end{cases}$	Understand	CAHS011.03
2	Find the Fourier sine transform of f(x) defined by $f(x)=\begin{cases}\sin x, & 0<x<a\\ 0, & x\geq a\end{cases}$	Understand	CAHS011.03
3	Find the Fourier sine and cosine transform of $2e^{-5x}+5e^{-2x}$	Understand	CAHS011.03
4	Find the Fourier sine and cosine transform of $f(x)=\begin{cases}x, & for\quad 0<x<1\\ 2-x, & for\quad 1<x<2\\ 0, & for\quad x>2\end{cases}$	Understand	CAHS011.03
5	Find the Fourier cosine transform of $f(x)$ defined by $f(x)=\begin{cases}x, & 0<x<1\\ 2-x, & 1<x<2\\ 0, & x>2\end{cases}$	Understand	CAHS011.03
6	Find the inverse finite sine transform f(x) if $F_s(n)=\frac{1-\cos n\pi}{n^2\pi^2}\, where\, 0<x<\pi$	Understand	CAHS011.04
7	Find the inverse finite cosine transform f(x), if $F_c(n)=\frac{\cos\left(\frac{2n\pi}{3}\right)}{(2n+1)^2}, where\, 0<x<4$	Understand	CAHS011.04
8	Using Fourier integral show that $e^{-ax}\cos x=\frac{2}{\pi}\int_0^\infty\frac{\lambda^2+2}{\lambda^2+4}\cos\lambda x d\lambda$	Understand	CAHS011.03
9	Find the finite Fourier sine and cosine transforms of f(x) = $x(\pi-x)$ in (0, π).	Understand	CAHS011.04
10	Find the finite Fourier sine and cosine transforms of f(x) = cosax in $(0,l)$ and $(0,\pi)$	Understand	CAHS011.04
UNIT-III			
LAPLACE TRANSFORMS			
Part - A (Short Answer Questions)			
1	Define Laplace Transform, and write the sufficient conditions for the existence of Laplace Transform.	Remember	CAHS011.05
2	Verify whether the function $f(t)=t^3$ is exponential order and find its transform.	Understand	CAHS011.05
3	Find the Laplace transform of Dirac delta function	Remember	CAHS011.05

4	Find the Laplace transform of $\lvert\sin \omega t\rvert, t \geq 0$	Understand	CAHS011.05
5	State and prove change of scale property of Laplace Transform.	Understand	CAHS011.05
6	Find the Laplace transform of $t^2 u(t-2)$	Remember	CAHS011.05
7	Find $L\{g(t)\}$ where $g(t)=\begin{cases} \cos(t-\frac{2\pi}{3}), & \text{if } t>\frac{2\pi}{3} \\ 0, & \text{if } t<\frac{2\pi}{3} \end{cases}$	Understand	CAHS011.05
8	Find the Laplace transform of $f(t)=\{\begin{matrix} \cos t, 0<t<\pi \\ \sin t, t>\pi \end{matrix}$	Understand	CAHS011.05
9	Find the Laplace transform of $\sinh t$	Remember	CAHS011.05
10	Verify the initial and final value theorem for $e^{-t}(t+1)^2$	Remember	CAHS011.05
CIE II			
11	Prove that if $L^{-1}\{f(s)\}=f(t)$ then $L^{-1}\{\bar{f}^{n}(s)\}=(-1)^n t^n f(t)$	Understand	CAHS011.05
12	Prove that if $L^{-1}\{f(s)\}=f(t)$ then $L^{-1}\{\frac{f(s)}{s}\}=\int_0^t f(u)\,du$	Understand	CAHS011.05
13	State and prove convolution theorem to find the inverse of Laplace transform	Understand	CAHS011.04
14	Find the inverse Laplace transform of $L^{-1}\left\{\frac{3s+7}{s^2-2s-3}\right\}$	Understand	CAHS011.05
15	Find the inverse Laplace transform of $L^{-1}\left\{\frac{s}{(s+1)^2(s^2+1)}\right\}$	Understand	CAHS011.05
16	Find the inverse Laplace transform of $\frac{s}{(s^2+1)(s^2+4)}$	Understand	CAHS011.05
17	Find the inverse Laplace transform of $\log\left(\frac{s+a}{s+b}\right)$	Remember	CAHS011.05
18	Find the inverse Laplace transform of $\frac{e^{-2s}}{(s+4)^3}$	Remember	CAHS011.05
19	Solve the following initial value problem by using Laplace transform $4y''+\pi^2 y=0, y(0)=0, y'(0)=0$	Understand	CAHS011.05
20	Solve the following initial value problem by using Laplace transform $y''+4y=\delta(t), y(0)=0, y'(0)=0$	Understand	CAHS011.05
Part – B (Long Answer Questions)			
1	Using Laplace transform evaluate $\int_0^\infty \frac{e^{-t}-e^{-2t}}{t}dt$	Understand	CAHS011.05
2	Find the Laplace transform of $f(t)=(t+3)^2 e^t$	Understand	CAHS011.06
3	Find $L\left\{\frac{\cos 4t \sin 2t}{t}\right\}$	Understand	CAHS011.05
4	Find $L\{\cosh at \sin bt\}$	Understand	CAHS011.05
5	Find $L\{e^{-3t}\sinh 3t\}$	Understand	CAHS011.05
6	Find $L\{t \sin 3t \cos 2t\}$	Understand	CAHS011.06

7	Find the Laplace transform of $\frac{\cos 2t - \cos 3t}{t}$	Understand	CAHS011.06
8	Find the Laplace transform of $te^{2t}\sin 3t$	Understand	CAHS011.06
9	Find the Laplace transform of $\left\{\frac{1-\cos at}{t}\right\}$	Understand	CAHS011.06
10	Find the Laplace transform of $\cos t\cos 2t\cos 3t$	Understand	CAHS011.05
CIE II			
11	Find the inverse Laplace transform of $\frac{2S^2-6S+5}{S^3-6S^2+11S-6}$	Understand	CAHS011.05
12	Find the inverse Laplace transform $\frac{e^{-2s}}{s^2+4s+5}$	Understand	CAHS011.05
13	Find the inverse Laplace transform $\frac{s}{(s^2+1)(s^2+9)(s^2+25)}$	Understand	CAHS011.05
14	Find the inverse Laplace transform of $\log\left(\frac{s^2+4}{s^2+9}\right)$	Understand	CAHS011.05
15	Find the inverse Laplace transform $\frac{s^2+2s-4}{(s^2+9)(s-5)}$	Understand	CAHS011.05
16	Solve the following initial value problem by using Laplace transform $(D^2+2D+5)t = e^{-t}\sin t, y(0)=0, y'(0)=1$	Understand	CAHS011.06
17	Solve the following initial value problem by using Laplace transform $y''+9y=\cos 2t, y(0)=1, y(\frac{\pi}{2})=-1$	Understand	CAHS011.06
18	Solve the following initial value problem by using Laplace transform $y'''-2y''+5y'=0, y(0)=1, y'(0)=0, y''(0)=1$	Understand	CAHS011.06
19	Solve the following initial value problem by using Laplace transform $(D^3-D^2+4D-4)t = 68e^x\sin 2x, y=1, Dy=-19, D^2y=-37$ at x=0	Understand	CAHS011.06
20	Solve the following initial value problem by using Laplace transform $\frac{dy}{dt}+2y+\int_0^t y\,dt = \sin t, y(0)=1$	Understand	CAHS011.06
Part – C (Problem Solving and Critical Thinking)			
1	Using the theorem on transforms of derivatives, find the Laplace Transform of the following functions. (a). e^{at} (b). cosat (c). t sin at	Understand	CAHS011.05
2	Find the Laplace transform of (a) $e^{-3t}\cosh 4t\sin 3t$ (b) $(t+1)^2e^t$	Understand	CAHS011.05
3	Find the Laplace transform of (a) $t^2e^t\sin 4t$ (b) $t\cos^2 t$	Understand	CAHS011.05

4	Find the Laplace transform of $\int_0^t \frac{e^t \sin t}{t} dt$	Understand	CAHS011.06
5	Find the L{f(t)} and L{ f′(t) } for the function (a) $\frac{\sin t}{t}$ (b) $e^{-5t}\sin t$	Understand	CAHS011.06
CIE II			
6	Find the inverse Laplace transform $\frac{s+3}{s^2-10s+29}$	Understand	CAHS011.06
7	Find the inverse transform of $\frac{s+2}{s^2-4s+13}$	Understand	CAHS011.06
8	Find the inverse Laplace transform $\frac{s^2+s-2}{s(s+3)(s-2)}$	Understand	CAHS011.06
9	Apply convolution theorem to evaluate $L^{-1}\left\{\frac{s^2}{(s^2+a^2)(s^2+b^2)}\right\}$	Understand	CAHS011.06
10	Apply convolution theorem to evaluate $L^{-1}\left\{\frac{1}{s(s^2+4)^2}\right\}$	Understand	CAHS011.06
UNIT-IV			
Z –TRANSFORMS			
Part – A (Short Answer Questions)			
1	Prove that $z(a^n) = \frac{z}{z-a}$	Understand	CAHS011.07
2	Evaluate $z\left[\frac{1}{(n+1)!}\right]$	Understand	CAHS011.07
3	Find the z- transform of $e^{-\alpha n}$ where $\alpha > 0$	Understand	CAHS011.07
4	Find the z-transform of the sequence defined by $u_n = 2^n \quad n \le 0$	Understand	CAHS011.07
5	State and prove Linear Properties of z- transforms	Understand	CAHS011.07
6	Find the z- transform of $\frac{a^n}{n!}e^{-a}$	Understand	CAHS011.07
7	Find the z- transform of cos(n+1)θ	Understand	CAHS011.07
8	State and prove shifting property to the right.	Understand	CAHS011.07
9	Prove that $z\left[(\frac{1}{2})^n\right] = \frac{2z}{2z-1}$	Understand	CAHS011.07
10	State and prove shifting property to the left.	Understand	CAHS011.07
11	Find $z(n-1)^2$	Understand	CAHS011.07
12	Define convolution theorem of Z-Transform	Remember	CAHS011.07
13	Find $z(n\cos n\theta)$	Understand	CAHS011.07
14	Show that $z(\frac{1}{n+1}) = z\log\frac{z}{z-1}$	Understand	CAHS011.07

15	Evaluate the inverse z-transform of $\frac{4z}{z-1}$	Understand	CAHS011.07
16	Evaluate Inverse z-transform of $\frac{3z(z+1)}{(z-1)^3}$	Understand	CAHS011.07
17	Evaluate the inverse z-transform of $\frac{1}{1-az^{-1}}$ with |z|>a	Understand	CAHS011.07
18	Obtain the z-transform of the cosine function $x(t)=\begin{cases}\cos\omega t & 0\le t\\ 0 & t<0\end{cases}$	Understand	CAHS011.07
19	Prove that $z(n^2) = \frac{z^2+z}{(z-1)^3}$	Understand	CAHS011.07
20	Find the z-Transform of $\frac{1}{n(n+1)}$	Understand	CAHS011.07
Part – B (Long Answer Questions)			
1	Evaluate $z(\cos\theta+i\sin\theta)^n$ hence prove that $z(\cos n\theta)=\frac{z(z-\cos\theta)}{z^2-2z\cos\theta+1}$ and $z(\sin n\theta)=\frac{z\sin\theta}{z^2-2z\cos\theta+1}$	Understand	CAHS011.07
2	Find the inverse z-transform of $\frac{8z-z^3}{(4-z)^3}$	Understand	CAHS011.07
3	Use convolution theorem to evaluate $z^{-1}\left(\frac{z^2}{z^2-4z+3}\right)$	Understand	CAHS011.07
4	State and prove convolution theorem of z- transforms.	Understand	CAHS011.07
5	Obtain the inverse z-transform of $\frac{z^3}{(z+1)(z-1)^2}$	Understand	CAHS011.07
6	Obtain the inverse z-transform of $\frac{z-1}{(z-2)^3}$	Understand	CAHS011.07
7	Use convolution theorem to evaluate the inverse of $\frac{z^2}{z^2-5z+6}$	Understand	CAHS011.07
8	Solve the difference equation using z-transform $y_{n+2}-3y_{n+1}+2y_n=4^n$ with $y_0=0,\ y_1=1$	Understand	CAHS011.07
9	Solve difference equation using z-transform $u_{n+2}-4u_{n+1}+4u_n=2^n$ given $u_0=0,\ u_1=1$	Understand	CAHS011.07
10	Solve the difference equation using z- transform $u_{n+2}-2u_{n+1}u_n=3n+5$	Understand	CAHS011.07
11	Solve the difference equation using z- transform $u_{n+2}-8u_{n+1}+16u_n=4^n$ given $u_0=0$ and $u_1=1$	Understand	CAHS011.07
12	Solve the difference equation using z- transform $y_{n+2}-2y_{n+1}+y_n=2^n$ with $y_0=2$ and $y_1=1$	Understand	CAHS011.07
13	Solve the difference equation using z- transform $y_{n+2}-2y_{n+1}+y_n=3n+5$ with $y_0=1$ and $y_1=3$	Understand	CAHS011.07
14	Solve the difference equation using z- transform $u_{n+2}-6u_{n+1}+9u_n=0$	Understand	CAHS011.07
15	Solve the difference equation using z- transform	Understand	CAHS011.07

	$y_{n+2} - 2y_{n+1} + y_n = 3n+5$ with $y_0 = y_1 = 0$		
16	Evaluate $z^{-1}\left(\frac{4z^2 - 2z}{z^3 - 5z^2 + 8z - 4}\right)$	Understand	CAHS011.07
17	Using $z(n^2) = \frac{z^2 + z}{(z-1)^3}$ prove that $z(n+1)^2 = \frac{z^3 + z^2}{(z-1)^3}$	Understand	CAHS011.07
18	Evaluation of inverse z-Transforms by using standard Formulae. $z^{-1}\left(\frac{az}{(z-a)^2}\right) = na^n$	Understand	CAHS011.07
19	Prove that $z(a^n \sin n\theta) = \frac{az\sin\theta}{z^2 - 2az\cos\theta + a^2}$	Understand	CAHS011.07
20	Show that $z(\sin(n+1)\theta) = \frac{z^2\sin\theta}{z^2 - 2z\cos\theta + 1}$	Understand	CAHS011.07
Part – C (Problem Solving and Critical Thinking)			
1	Using the power series method find the inverse Z –Transform of $\frac{z}{(10 + 7z + z^2)}$	Understand	CAHS011.08
2	Using the power series method find the inverse Z –Transform of $\frac{z}{(z-3)(z-2)(z-1)}$	Understand	CAHS011.08
3	Using the power series method find the inverse Z –Transform of $\frac{1 + 2z^{-1}}{(1 + 2z^{-1} + 4z^{-2})}$	Understand	CAHS011.08
4	Using convolution theorem to find the inverse Z –Transform of $\frac{10z}{(z-2)(z-1)}$	Understand	CAHS011.08
5	Using convolution theorem to find the inverse Z –Transform of $\frac{8z^2}{(4z+1)(2z-1)}$	Understand	CAHS011.08
6	Using the partial fraction method find the inverse Z –Transform of $\frac{z(2z-1)}{(z-2)^2(z-1)}$	Understand	CAHS011.08
7	Using the partial fraction method find the inverse Z –Transform of $\frac{z^2 + 2z + 1}{z^2 - \frac{3}{2}z + \frac{1}{2}}$	Understand	CAHS011.08
8	Using the partial fraction method find the inverse Z –Transform of $\frac{z^2}{(z^2 + 4)(z+2)}$	Understand	CAHS011.08
9	Using the integral method find the inverse Z –Transform of $\frac{z-4}{(z^2 + 5z + 6)}$	Understand	CAHS011.08

10	Using the partial fraction method find the inverse Z –Transform of $\frac{z(4z-2)}{(z-2)^2(z-1)}$	Understand	CAHS011.08
UNIT-V			
PARTIAL DIFFERENTIAL EQUATIONS AND APPLICATIONS			
Part - A (Short Answer Questions)			
1	Define order and degree with reference to partial differential equation	Remember	CAHS011.09
2	Form the partial differential equation by eliminate the arbitrary constants from $z = ax^3 + by^3$	Understand	CAHS011.09
3	Form the partial differential equation by eliminating arbitrary function $z=f(x^2+ y^2)$	Understand	CAHS011.09
4	Solve the partial differential equation $p\sqrt{x} + q\sqrt{y} = \sqrt{z}$	Understand	CAHS011.09
5	Define complete integral with reference to nonlinear partial differential equation	Remember	CAHS011.09
6	Define general integral with reference to nonlinear partial differential equation	Remember	CAHS011.09
7	Solve the partial differential equation $p^2+ q^2= m^2$	Understand	CAHS011.09
8	Solve the partial differential equation $z = px+qy+ p^2 q^2$	Understand	CAHS011.09
9	Write the one dimension wave equation of partial differential equation	Remember	CAHS011.09
10	Write the one dimension heat equation of partial differential equation	Remember	CAHS011.09
11	Eliminate the arbitrary constants from $z=(x^2+a)\ (y^2+b)$ to form partial differential equation	Understand	CAHS011.09
12	Form the partial differential equation by eliminating a and b from $\log(az-1) = x + ay + b$	Understand	CAHS011.09
13	Form the partial differential equation by eliminating the constants from $(x-a)^2 + (y-b)^2 = z^2 \cot^2 \alpha$ where α is a parameter.	Understand	CAHS011.09
14	Define a non-linear partial differential equation.	Remember	CAHS011.09
15	Define particular integral with reference to nonlinear partial differential equation.	Remember	CAHS011.09
16	Define singular integral with reference to nonlinear partial differential equation.	Remember	CAHS011.09
17	Solve $p- x^2=q+ y^2$	Understand	CAHS011.09
18	Solve the partial differential equation $x(y-z)p+y(z-x)q=z(x-y)$.	Understand	CAHS011.09
19	Find a complete integral of $f=xpq+yq^2-1=0$.	Understand	CAHS011.09
20	Find a complete integral of $f= (p^2+q^2)y-qz=0$	Understand	CAHS011.09
Part - B (Long Answer Questions)			
1	Form the partial differential equation by eliminating arbitrary function from $f(x^2+ y^2+ z^2, z^2-2xy)=0$	Understand	CAHS011.09
2	Solve the partial differential equation $p^2z^2 \sin^2 x + q^2z^2 \cos^2 y = 1$.	Understand	CAHS011.09
3	Solve the partial differential equation $x^2 p^2 + xpq = z^2$.	Understand	CAHS011.09
4	Solve the partial differential equation $q^2 - p = y - x$.	Understand	CAHS011.09
5	Solve the partial differential equation $px + qy = pq$	Understand	CAHS011.09
6	Form a partial differential equation by eliminating a, b, c from $\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1$.	Understand	CAHS011.09

7	Solve the partial differential equation $(x^2 - yz)p + (y^2 - zx)q = z^2 - xy$	Understand	CAHS011.09
8	Solve the partial differential equation $(z^2 - 2yz - y^2)p + (xy + zx)q = xy - zx.$	Understand	CAHS011.09
9	Solve the partial differential equation. $(mz - ny)p + (nx - lz)q = (ly - mx)$.	Understand	CAHS011.09
10	Solve the partial differential equation $y^2zp+x^2zq = xy^2$	Understand	CAHS011.09
11	Solve the partial differential equation $z(p^2 - q^2) = x - y$	Understand	CAHS011.09
12	Solve the partial differential equation $\frac{x^2}{p} + \frac{y^2}{q} = z$	Understand	CAHS011.09
13	Solve the partial differential equation $p - x^2 = q + y^2$.	Understand	CAHS011.09
14	Solve the partial differential equation $q = px + p^2$.	Understand	CAHS011.09
15	Solve the partial differential equation $z^2 = pqxy$.	Understand	CAHS011.09
16	Solve the partial differential equation $z = p^2x + q^2y$	Understand	CAHS011.09
17	Find the differential equation of all spheres whose centres lie on z-axis with a given radius r.	Understand	CAHS011.09
18	Find a complete integral of $2(z+xp+yq)=yp^2$	Understand	CAHS011.09
19	Solve the partial differential equation $(x^2 - y^2 - yz)p + (x^2 - y^2 - zx)q = z(x - y).$	Understand	CAHS011.09
20	Solve the partial differential equation $(x^2-y^2-z^2)p+2xyq = 2xz$	Understand	CAHS011.09
Part – C (Problem Solving and Critical Thinking)			
1	Solve $\frac{\partial u}{\partial x} = 2\frac{\partial u}{\partial t} + u$ where $u(x,0) = 6e^{-3x}$ by the method of separation of variables.	Understand	CAHS011.09
2	Solve by the method of separation of variables $2xz_x - 3yz_y = 0$.	Understand	CAHS011.09
3	Solve $\frac{\partial^2 u}{\partial x \partial t} = e^{-t}\cos x$ given that u=0 when t = 0 and $\frac{\partial u}{\partial t} = 0$ When x = 0 show also that as t tends to ∞ , u tends to sin x.	Understand	CAHS011.09
4	Solve by the method of separation of variables $2u_x + u_y = 3u$ and $u(0, y) = e^{-5y}$	Understand	CAHS011.09
5	A tightly stretched string with fixed end points x=0 and x=l is initially at rest its equilibrium position. If it is set to vibrate by giving each of its points a velocity $\lambda x(1 - x)$, find the displacement of the string at any distance x from one end at any time t.	Understand	CAHS011.10
6	Solve the one dimensional heat flow equation $\frac{\partial u}{\partial t} = c^2\frac{\partial^2 u}{\partial x^2}$ given that $u(0,t) = 0, u(L,t) = 0, t > 0$ and $u(x,0) = 3\sin\left(\frac{\pi x}{L}\right), 0 < x < L.$	Understand	CAHS011.10

7	Derive the complete solution for the one dimensional heat equation with zero boundary problem with initial temperature $u(x,0) = x(L-x)$ in the interval (0 , L).	Understand	CAHS011.10
8	Write the boundary conditions for a rectangular plate is bounded by the line x=0, y=0, x=a, and y=b its surface are insulated the temperature along x=0 and y=0 are kept at 0^0C and the other are kept at100^0C.	Understand	CAHS011.10
9	a string is stretched and fastened to two points at x=0 and x=L.Motion is started by displacing the string into the form $y=k(lx-x^2)$ from which it is released at time t=0. Find the displacement of any point on the string at a distance of x from one end at time t	Understand	CAHS011.10
10	A tightly stretched string with fixed end points x=0 and x=l is initially in a position given by $y = y_0 \sin^3 \frac{\pi x}{l}$.If it is released from rest from this position, find the displacement(x,t).	Understand	CAHS011.10

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