Ref No:

SRI KRISHNA INSTITUTE OF TECHNOLOGY, BANGALORE

COURSE PLAN

Academic Year 2019-20

Program:	B E – Information Science& Engineering
Semester :	3
Course Code:	18MAT31
Course Title:	Transform Calculus,Fourier Series And Numerical Techniques
Credit / L-T-P:	3 / 2-2-0
Total Contact Hours:	50
Course Plan Author:	Smitha N

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Note : Remove “Table of Content” before including in CP Book
Each Course Plan shall be printed and made into a book with cover page
Blooms Level in all sections match with A.2, only if you plan to teach / learn at higher levels

A. COURSE INFORMATION

1. Course Overview

Degree:	BE	Program:	IS
Semester:	3	Academic Year:	2019-20
Course Title:	Transform Calculus, Fourier Series and Numerical Techniques	Course Code:	18MAT31
Credit / L-T-P:	3 / 2-2-0	SEE Duration:	180 Minutes
Total Contact Hours:	50 Hours	SEE Marks:	60 Marks
CIA Marks:	40 Marks	Assignment	1 / Module
Course Plan Author:	Smitha N	Sign ..	Dt:21-10-2019
Checked By:	Mallikarjun G D	Sign ..	Dt:26-10-2019
CO Targets	CIA Target : 90%	SEE Target:	70 %

Note: Define CIA and SEE % targets based on previous performance.

2. Course Content

Content / Syllabus of the course as prescribed by University or designed by institute. Identify 2 concepts per module as in G.

Module	Content	Teaching Hours	Identified Module Concepts	Blooms Learning Levels
1	Laplace transforms of elementary functions.Laplace transforms of periodic functions and unit step functions.	5	Differential Equations	L3
1	Inverse laplace transforms, convolution theorem to find the inverse laplace transforms and problems.Solution of linear differential equations using Laplace transform.	5	Differential Equations	L3
2	Fourier series of 2Π,2l period & half range fourier series	6	Analyze circuits&system	L3

			communication	
2	Practical Harmonic analysis.	4	Analyze circuits&system communication	L4
3	Infinite Fourier transforms, fourier sine and cosine transforms & Fourier inverse transforms	4	Continuous signal process	L3
3	Z-transforms and inverse z-transforms	6	Discrete signal process	L3
4	Numerical Solutions of ODE of first order and degree-Taylor's Method,Modified Euler's Equations	5	Ordinary Differential Equations.	L3
4	RK method,Milne's and Adams Bashforth method	5	Ordinary Differential Equations.	L3
5	Numerical Solutions of second order ODE using Runge-Kutta method and Milne's Method.	7	Ordinary Differential Equations.	L3
5	Variational problems, euler's equations,geodesics and problems	3	Maximum and minimum	L4

3. Course Material

Books & other material as recommended by university (A, B) and additional resources used by course teacher (C).

1. Understanding: Concept simulation / video ; one per concept ; to understand the concepts ; 15 - 30 minutes
2. Design: Simulation and design tools used - software tools used ; Free / open source
3. Research: Recent developments on the concepts - publications in journals; conferences etc.

Modules	Details	Chapters in book	Availability
A	**Text books (Title, Authors, Edition, Publisher, Year.)**	-	-
1,2,3,4,5	1;.B.S Grewal, higher engineering mathematics		In Lib/dept
1,2,3,4,5	2:Advanced engineering mathematics by ERWIN KREYZIG		In Lib/dept
1,2,3,4,5	3:Advanced engineering mathematics by PETER V. O'NEIL		In Lib/dept
B	**Reference books (Title, Authors, Edition, Publisher, Year.)**	-	-
1,2,3,4,5	1: N.P.BAIL AND MANISH GOYAL:A text book of engineering mathematics,laxmi publishers,7th edition,2010		In dept
1,2,3,4	2: B.V Ramana:Higher engineering mathematics TATA McGRAW-HILL 2006		In Lib
C	**Concept Videos or Simulation for Understanding**	-	-

1	https://www.khanacademy.org/math/differential-equations/laplace-transform/laplace-transform-tutorial/v/laplace-transform-1		
2	https://www.youtube.com/watch?v=KeT6CB6Qi10		
3	https://www.youtube.com/watch?v=mJgVOV9jRZU		
5	https://www.youtube.com/watch?v=GiPOQC5nYMs		
D	**Software Tools for Design**		
E	**Recent Developments for Research**	-	-
F	**Others (Web, Video, Simulation, Notes etc.)**	-	-
4	https://www.youtube.com/watch?v=Os8OtXFBLkY		
4	*https://www.geeksforgeeks.org/runge-kutta-4th-order-method-solve-differential-equation/*		
5	https://www.youtube.com/watch?v=zr12pnzNoXI		

4. Course Prerequisites

Refer to GL01. If prerequisites are not taught earlier, GAP in curriculum needs to be addressed. Include in Remarks and implement in B.5.

Students must have learnt the following Courses / Topics with described Content . . .

Modules	Course Code	Course Name	Topic / Description	Sem	Remarks	Blooms Level
1	17MAT21	Transform Calculus, Fourier Series and Numerical Techniques	Module-1/Evaluation of homogeneous and non homogeneous differential equations.	2	Revision	L2

5. Content for Placement, Profession, HE and GATE

The content is not included in this course, but required to meet industry & profession requirements and help students for Placement, GATE, Higher Education, Entrepreneurship, etc. Identifying Area / Content requires experts consultation in the area.

Topics included are like, a. Advanced Topics, b. Recent Developments, c. Certificate Courses, d. Course Projects, e. New Software Tools, f. GATE Topics, g. NPTEL Videos, h. Swayam videos etc.

Modules	Topic / Description	Area	Remarks	Blooms Level
1				
2				

B. OBE PARAMETERS

1. Course Outcomes

Expected learning outcomes of the course, which will be mapped to POs. Identify a max of 2 Concepts per Module. Write 1 CO per Concept.

Modules	Course Code.#	Course Outcome **At the end of the course, student should be able to . . .**	Teach. Hours	Concept	Instr Method	Assessment Method	Blooms' Level
1	18MAT31.1	Use laplace transform in solving Differential equations arising in network analysis, control systems and other fields of engineering.	5	Differential equations	Lecture	Assignment and Slip Test	L3
1	18MAT31.2	Use inverse laplace transform in solving Differential/ integral equations arising in network analysis, control systems and other fields of engineering.	5	Differential equations	Lecture	Assignment and Slip Test	L3
2	18MAT31.3	Analyze expansion of Fourier series using Euler formula	6	Analyze circuits&system communication	Lecture	Assignment and Slip Test	L3
2	18MAT31.4	Apply Fourier expansion in practical harmonic problems	4	Analyze circuits&system communication	Lecture	Assignment and Slip Test	L4
3	18MAT31.5	Apply to transform form one to another domain by Fourier integrals	5	Continuous signal process	Lecture	Assignment and Slip Test	L3
3	18MAT31.6	Apply to transform one domain to another domain by z-transforms	5	Discrete signal process	Lecture	Assignment and Slip Test	L3
4	18MAT31.7	Use appropriate single step numerical methods to solve first order ordinary differential equations.	6	O.D.E	Lecture	Assignment and slip test	L3
4	18MAT31.8	Use appropriate multi-step numerical methods to solve first order ordinary differential equations arising in flow data design problems.	4	O.D.E	Lecture	Assignment and slip test	L3
5	18MAT31.9	Use appropriate multi-step	5	Differentia	Lecture	Assignme	L3

		numerical methods to solve second order ordinary differential equations arising in flow data design problems.		l equations		nt and slip test	
5	18MAT31.10	Analyze how to apply the Euler's equations for a given function by Euler's equation	5	maximum &minimum	Lecture	Assignment and Slip Test	L4
-	-		**50**	-	-	-	-

2. Course Applications

Write 1 or 2 applications per CO.

Students should be able to employ / apply the course learnings to . . .

Modules	Application Area Compiled from Module Applications.	CO	Level
1	To study the nature of signals and control systems.	CO1 &C02	L3
2	To solve equations arising in network analysis and other fields of engineering.	CO3	L3
2	To study the nature of wave forms in voltage- current characteristics .	CO4	L3
3	Used to convert to discrete time domain signal into discrete frequency domain signal.	CO5	L3
3	To study the continuous and Apply to transform one domain to another domain by z-transforms discrete signals and its properties.	CO6	L3
4	To solve first order ODE using single step numerical methods	CO7	L3
4	To solve first order ODE using single step and multistep numerical methods	CO8	L3
5	To solve first order and second order ODE using single step numerical methods	CO9	L3
5	To determine extremal functions arising in dynamics of rigid bodies and vibrational analysis in the field of civil engineering.	CO10	L4

3. Mapping And Justification

CO – PO Mapping with mapping Level along with justification for each CO-PO pair.

To attain competency required (as defined in POs) in a specified area and the knowledge & ability required to accomplish it.

Modules	Mapping		Mapping Level	Justification for each CO-PO pair	Level
-	**CO**	**PO**	-	**'Area': 'Competency' and 'Knowledge' for specified 'Accomplishment'**	-
1	CO1	PO1	L3	Apply the knowledge of Laplace transforms to find the solution to complex engineering problems	L3
1	CO1	PO2	L4	To analyze and study the nature of signals and control systems.	L4
1	CO2	PO1	L3	Apply the knowledge of Laplace transforms and inverse laplace transforms to find the solution to complex engineering problems	L3

1	CO2	PO2	L4	To analyze and study the nature of signals and control systems.	L4
2	CO3	PO1	L3	Apply the knowledge of Fourier series to find the solution to complex engineering problems.	L3
2	CO3	PO2	L4	To analyze boundary value problems for linear ODE's	L4
2	CO4	PO1	L3	Apply the knowledge of Fourier series to find the solution to complex engineering problems.	L3
2	CO4	PO2	L3	To analyze boundary value problems for linear ODE's	L3
3	CO5	PO1	L3	Apply the knowledge of Fourier transforms to find solution to complex engineering problems.	L3
3	CO5	PO2	L4	To analze time domain and frequency domain in signal processing.	L4
3	CO6	PO1	L3	Apply the knowledge of Z-Transforms to find the solution to complex engineering problems.	L3
3	CO6	PO2	L4	To Analyze digital filters and discrete signal.	L4
4	CO7	PO1	L3	Apply the knowledge of Numerical techniques to solve ordinary differential equations	L3
4	CO7	PO2	L4	To analyze and solve first order ODE using single step numerical methods	L4
4	CO8	PO1	L3	Apply the knowledge of Numerical techniques to solve ordinary differential equations	L3
4	CO8	PO2	L4	To analyze and solve first order ODE using single step and multistep numerical methods	L4
5	CO9	PO1	L3	Apply the knowledge of Numerical techniques to solve ordinary differential equations	L3
5	CO9	PO2	L4	To analyze and apply first order and second order ODE using single step numerical methods	L4
5	CO10	PO1	L3	Apply the knowledge of calculus in solving complex engineering problems.	L3
5	CO10	PO2	L4	To analyze the rotation of a rigid body using a reference frame with its axis fixed to the body.	L4

4. Articulation Matrix

CO - PO Mapping with mapping level for each CO-PO pair, with course average attainment.

-	-	Course Outcomes	Program Outcomes															-
Modules	CO.#	**At the end of the course student should be able to . . .**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	Level
1	CO1	Use laplace transform in solving Differential equations arising in network analysis, control systems and other fields of engineering.	2.5	2.5														L3
1	CO2	Use inverse laplace transform in solving Differential/ integral	2.5	2.5														L3

		equations arising in network analysis, control systems and other fields of engineering.																
2	CO3	Analyze expansion of Fourier series using Euler formula	2.5	2.5														L3
2	CO4	Apply Fourier expansion in practical harmonic problems	2.5	2.5														L4
3	CO5	Apply to transform form one to another domain by Fourier integrals	2.5	2.5														L3
3	CO6	Apply to transform one domain to another domain by z-transforms	2.5	2.5														L3
4	CO7	Use appropriate single step numerical methods to solve first order ordinary differential equations.	2.5	2.5														L3
4	CO8	Use appropriate multi-step numerical methods to solve first order ordinary differential equations arising in flow data design problems.	2.5	2.5														L3
5	CO9	Use appropriate multi-step numerical methods to solve second order ordinary differential equations arising in flow data design problems.	2.5	2.5														L3
5	CO10	Analyze how to apply the Euler's equations for a given function by Euler's equation	2.5	2.5														L4

5. Curricular Gap and Content

Topics & contents not covered (from A.4), but essential for the course to address POs and PSOs.

Modules	Gap Topic	Actions Planned	Schedule Planned	Resources Person	PO Mapping

6. Content Beyond Syllabus

Topics & contents required (from A.5) not addressed, but help students for Placement, GATE, Higher Education, Entrepreneurship, etc.

Modules	Gap Topic	Area	Actions Planned	Schedule Planned	Resources Person	PO Mapping

C. COURSE ASSESSMENT

1. Course Coverage

Assessment of learning outcomes for Internal and end semester evaluation. Distinct assignment for each student. 1 Assignment per chapter per student. 1 seminar per test per student.

Modules	Title	Teach. Hours	No. of question in Exam						CO	Levels
			CIA-1	CIA-2	CIA-3	Asg	Extra Asg	SEE		
1	Laplace transforms	10	2	-	-	1		2	CO1, CO2	L3
4	Numerical Methods-1	10	2	-	-	1		2	CO7,CO8	L3
5	Numerical methods and Calculus of variations	10	-	2	-	1		2	CO9,CO10	L4
2	Fourier series	10	-	2	-	1		2	CO3,CO4	L4
3	Fourier Transforms and Z- Transforms	10	-	-	4	1		2	CO5,CO6	L3
-	**Total**	**50**	**4**	**4**	**4**	**5**		**10**	**-**	**-**

2. Continuous Internal Assessment (CIA)

Assessment of learning outcomes for Internal exams. Blooms Level in last column shall match with A.2.

Modules	Evaluation	Weightage in Marks	CO	Levels
1 &4	CIA Exam – 1	30	CO1, CO2, CO7,CO8	L3
2 & 5	CIA Exam – 2	30	CO3,CO4 ,CO9, CO10	L4
3	CIA Exam – 3	30	CO5,CO6	L3
1 &4	Assignment - 1	10	CO1, CO2, CO7,CO8	L3
2 & 5	Assignment - 2	10	CO3,CO4 ,CO9, CO10	L4
3	Assignment - 3	10	CO5,CO6	L3
	Seminar - 1	-	-	-
	Seminar - 2	-	-	-
	Seminar - 3	-	-	-
		-	-	-
	Other Activities – define – Slip test	-	-	-
	Final CIA Marks	**40**	**-**	**-**

D1. TEACHING PLAN - 1

Module - 1

Title:	Laplace Transforms and Inverse Laplace Transforms	Appr Time:	10Hrs
a	*Course Outcomes*	-	**Blooms**
-	The student should be able to:	-	**Level**
1	Use laplace transform in solving Differential equations arising in network analysis, control systems and other fields of engineering.	CO1	L3
2	Use inverse laplace transform in solving Differential/ integral equations arising in network analysis, control systems and other fields of engineering.	CO2	L3
b	*Course Schedule*	-	-
Class No	**Module Content Covered**	**CO**	**Level**
1	Laplace transforms of elementary functions.	CO1	L3
2	Laplace transforms of periodic functions	CO1	L3
3	Problems on periodic functions	CO1	L3
4	Unit step functions	CO1	L3
5	Problems on unit step functions	CO1	L3
6	Inverse laplace transforms,	CO2	L3
7	Convolution theorem to find the inverse laplace transforms	CO2	L3
8	Additional problems	CO2	L3
9	Solution of linear differential equations using Laplace transform.	CO2	L3
10	Additional problems	CO2	L3
c	**Application Areas**	**CO**	**Level**
1	To study the nature of signals and control systems.	CO1	L3
2	To solve equations arising in network analysis and other fields of engineering.	CO2	L3
d	**Review Questions**	-	-
1	Find the laplace transform of $(i)\ te^{(4t)}\sin 3t \quad (ii)\ \frac{(e^{(t)} - e^{(at)})}{t}$	CO1	L3
2	Express in terms of unit step function and hence find its laplace transform $f(t) = \begin{cases} \cos t & 0 < t < \pi \\ 1 & \pi < t < 2\pi \\ \sin t & t > 2\pi \end{cases}$	CO1	L3
3	Solve by using laplace transforms $\frac{d^2y}{dt^2} + 4\frac{dy}{dt} + 4y = e^{-t}$ and	CO2	L3

	$y(0)=y'(0)=0$		
4	If a periodic function of period $2a$ is defined by $f(t)=\begin{cases} t & if\ 0\le t\le a \\ 2a-t & if\ a\le t\le 2a \end{cases}$ then show that $L[f(t)]=\frac{1}{s^2}\tanh\left(\frac{as}{2}\right)$	CO1	L4
5	Find the inverse laplace transform of $\frac{(s+5)}{(s-1)^3(s+2)}$	CO2	L3
6	Find $L^{-1}\frac{1}{(s+1)(s^2+9)}$ using Convolution Theorem.	CO2	L3
7	Solve $y''+6y'+9y=12t^2e^{-3t}$ by laplace transforms method with $y(0)=0=y'(0)$	CO2	L3
8	If a periodic function of period $\frac{2\pi}{w}$ is defined by $f(t)=\begin{cases} E\sin wt & if\ 0\le t\le \frac{\pi}{w} \\ 0 & if\ \frac{\pi}{w}\le t\le \frac{2\pi}{w} \end{cases}$ then show that $L[f(t)]=\frac{Ew}{(s^2+w^2)(1-e^{-\frac{as}{w}})}$	CO1	L4
e	**Experiences**	-	-
1			
2			

Module - 4

Title:	Numerical Solution Of ODE's:	Appr Time:	10 Hrs
a	***Course Outcomes***	-	**Blooms**
-	The student should be able to:	-	**Level**
1	Use appropriate single step numerical methods to solve first order ordinary differential equations.	CO7	L3
2	Use appropriate multi-step numerical methods to solve second order ordinary differential equations arising in flow data design problems.	CO8	L3
b	**Course schedule**	-	-
Class No	**Module Content Covered**	**CO**	**Level**
1	Numerical solution of ordinary differential equations of first order and first degree, by Taylor's series method	CO7	L3
2	Taylor's series method	CO7	L3
3	Numerical solution of ordinary differential equations of first order and first degree, by modified Euler's method	CO7	L3
4	Numerical solution of ordinary differential equations of first order and first degree, by modified Euler's method	CO7	L3

5	Runge – Kutta method of fourth order.	CO7	L3
6	Runge – Kutta method of fourth order.	CO7	L3
7	Milne's predictor and corrector methods	CO8	L3
8	Additional problems		
9	Adams-Bashforth predictor and corrector methods	CO8	L3
10	Additional problems	CO8	L3
c	**Application Areas**	**CO**	**Level**
1	To solve first order ODE using single step numerical methods	CO7	L3
2	To solve first order ODE using single step and multistep numerical methods	CO8	L3
d	**Review Questions**	-	-
1	Use Taylor's method to find y at $x = 0.1,\ 0.2,\ 0.3$ of the problem $\frac{dy}{dx} = x^2 + y^2$ with $y(0) = 1$ .Consider upto 3rd degree terms.	CO7	L3
2	Using Euler's modified method, solve for y at $x = 0.1$ if $\frac{dy}{dx} = \frac{y-x}{y+x}$ with $y(0) = 1$. Carry out three modifications.	CO7	L3
3	Apply Runge Kutta method of order four compute $y(0.2)$ given $10\frac{dy}{dx} = x^2 + y^2$ with $y(0) = 1$ taking h=0.2	CO7	L3
4	Solve $\frac{dy}{dx} = \frac{y^2 - x^2}{y^2 + x^2}$ with $y(0) = 1$ find y at $x = 0.2$ using RK method taking h=0.2	CO7	L3
5	Given $\frac{dy}{dx} = xy + y^2$ with $y(0) = 1,\ y(0.1) = 1.1169,\ y(0.2) = 1.2773,\ y(0.3) = 1.5049$ find $y(0.4)$ correct to three decimal places using Milne's method.	CO8	L3
6	Given $\frac{dy}{dx} = (1 + y)x^2$ and $y(0) = 1,\ y(0.1) = 1.233,\ y(0.2) = 1.548,\ y(0.3) = 1.979$ find $y(0.4)$ by Adams-Bashforth method	CO8	L3
e	**Experiences**	-	-
1			
2			

E1. CIA EXAM – 1

a. Model Question Paper - 1

Dept:	IS	Sem / Div:	3 / A	Course:	Transform Calculus, Fourier Series and	Elective:	N

				Numerical Techniques			
Date:	18-09-2019	Time:	9:30 -11:00	C Code:	18MAT31	Max Marks:	50

Note: Answer all full questions. All questions carry 25 marks.

QNo		Questions	CO	Level	Marks	Module
1	a	Find the laplace transform of (i) $e^{-4t}\sin 3t$ (ii) $\frac{e^{-bt} - e^{-at}}{t}$	CO1	L3	6	1
	b	Express in terms of unit step function and hence find its laplace transform $f(t)=\begin{cases} \cos t & 0<t<\pi \\ 1 & \pi<t<2\pi \\ \sin t & t>2\pi \end{cases}$	CO1	L3	6	1
	c	Solve by using laplace transforms $\frac{d^2y}{dt^2}+4\frac{dy}{dt}+4y=e^{-t}$ and $y(0)=y'(0)=0$	CO2	L3	6	1
	d	If a periodic function of period $2a$ is defined by $f(t)=\begin{cases} t & if\ 0\le t\le a \\ 2a-t & if\ a\le t\le 2a \end{cases}$ then show that $L\{f(t)\}=\left(\frac{1}{s^2}\right)\tanh\left(\frac{as}{2}\right)$	CO1	L4	7	1
		OR				
2	a	Find the inverse laplace transform of $\frac{(s+5)}{(s-1)^2(s+2)}$	CO2	L3	6	1
	b	Find $L^{-1}\frac{1}{(s+1)(s^2+9)}$ using Convolution Theorem.	CO2	L3	6	1
	c	Solve $y''+6y'+9y=12t^2e^{-3t}$ by laplace transforms method with $y(0)=0=y'(0)$	CO2	L3	6	1
	d	If a periodic function of period $\frac{(2\pi)}{w}$ is defined by $f(t)=\begin{cases} E\sin wt & if\ 0<t<\frac{\pi}{w} \\ 0 & if\ \frac{\pi}{w}<t<\frac{(2\pi)}{w} \end{cases}$ then show that $L\{f(t)\}=\frac{Ew}{(s^2+w^2)(1-e^{-\frac{as}{w}})}$	CO1	L4	7	1
3	a	Use Taylor's method to find y at $x=0.1,\ 0.2,\ 0.3$ of the problem $\frac{dy}{dx}=x^2+y^2$ with $y(0)=1$ .Consider upto 3rd degree terms.	CO7	L3	9	4
	b	Using Euler's modified method, solve for y at $x=0.1$ if $\frac{dy}{dx}=\frac{y-x}{y+x}$ with $y(0)=1$. Carry out three modifications.	CO7	L3	8	4
	c	Apply Runge Kutta method of order four compute $y=0.2$ given $10\frac{dy}{dx}=x^2+y^2$ with $y(0)=1$ taking h=0.2	CO7	L3	8	4
		OR				

4	a	Solve $\frac{dy}{dx}=\frac{y^2-x^2}{y^2+x^2}$ with $y(0)=1$ find y at $x=0.2$ using RK method taking h=0.2	CO7	L3	9	4
	b	Given $\frac{dy}{dx}=xy+y^2$ with $y(0)=1,\ y(0.1)=1.1169,\ y(0.2)=1.2773,\ y(0.3)=1.5049$ find $y(0.4)$ correct to three decimal places using Milne's method.	CO8	L3	8	4
	c	Given $\frac{dy}{dx}=(1+y)x^2$ and $y(1)=1,\ y(1.1)=1.233,\ y(1.2)=1.548,\ y(1.3)=1.979$ find $y(1.4)$ by Adams-Bashforth method	CO8	L3	8	4

b. Assignment -1

Note: A distinct assignment to be assigned to each student.

Model Assignment Questions							
Crs Code:	18MAT31	Sem:	3	Marks:	10/ 10	Time:	90 - 120 minutes
Course:	Transform Calculus, Fourier Series and Numerical Techniques						
Note: Each student to answer 2-3 assignments. Each assignment carries equal mark.							

SNo	USN	Assignment Description	Marks	CO	Level
1		Find the laplace transform of $(i)\ e^{4t}\sin 3t$ $(ii)\ \frac{e^{t}-e^{at}}{t}$	6	CO1	L3
2		Express in terms of unit step function and hence find its laplace transform $f(t)=\begin{cases}\cos t & 0<t<\pi\\ 1 & \pi<t<2\pi\\ \sin t & t>2\pi\end{cases}$	6	CO1	L3
3		Solve by using laplace transforms $\frac{d^2y}{dt^2}+4\frac{dy}{dt}+4y=e^{-t}$ and $y(0)=0,\ y'(0)=0$	6	CO2	L3
4		If a periodic function of period $2a$ is defined by $f(t)=\begin{cases}t & if\ 0\le t\le a\\ 2a-t & if\ a\le t\le 2a\end{cases}$ then show that $L[f(t)]=\frac{1}{s^2}\tanh\left(\frac{as}{2}\right)$	7	CO1	L4
5		Find the inverse laplace transform of $\frac{(s+5)}{(s-1)^3(s+2)}$	6	CO2	L3
6		Find $L^{-1}\frac{1}{(s+1)(s^2+9)}$ using Convolution Theorem.	6	CO2	L3
7		Solve $y''+6y'+9y=12t^2e^{-3t}$ by laplace transforms method with $y(0)=0=y'(0)$	6	CO2	L3
8		If a periodic function of period $\frac{2\pi}{w}$ is defined by	7	CO1	L4

		$f(t)=\begin{cases} E\sin wt & if\ 0<t<\frac{\pi}{w} \\ 0 & if\ \frac{\pi}{w}<t<\frac{2\pi}{w} \end{cases}$ then show that $L\{f(t)\}=\frac{Ew}{(s^2+w^2)(1-e^{-\pi s/w})}$			
9		Use Taylor's method to find y at $x=0.1,\ 0.2,\ 0.3$ of the problem $\frac{dy}{dx}=x^2+y^2$ with $y(0)=1$ .Consider upto 3rd degree terms.	9	CO7	L3
10		Using Euler's modified method, solve for y at $x=0.1$ if $\frac{dy}{dx}=\frac{y-x}{y+x}$ with $y(0)=1$. Carry out three modifications.	8	CO7	L3
11		Apply Runge Kutta method of order four compute $y(0.2)$ given $10\frac{dy}{dx}=x^2+y^2$ with $y(0)=1$ taking h=0.2	8	CO7	L3
12		Solve $\frac{dy}{dx}=\frac{y^2-x^2}{y^2+x^2}$ with $y(0)=1$ find y at $x=0.2$ using RK method taking h=0.2	9	CO7	L3
13		Given $\frac{dy}{dx}=xy+y^2$ with $y(0)=1,\ y(0.1)=1.1169,\ y(0.2)=1.2773,\ y(0.3)=1.5049$ find $y(0.4)$ correct to three decimal places using Milne's method.	8	CO8	L3
14		Given $\frac{dy}{dx}=(1+y)x^2$ and $y(0)=1,\ y(0.1)=1.233,\ y(0.2)=1.548,\ y(0.3)=1.979$ find $y(0.4)$ by Adams-Bashforth method	8	CO8	L3

D2. TEACHING PLAN - 2

Module - 5

Title:	Numerical solution of second order ODE's and Calculus of variations	Appr Time:	10 Hrs
a	***Course Outcomes***	-	**Blooms**
-	The student should be able to:	-	**Level**
1	Use appropriate multi-step numerical methods to solve second order ordinary differential equations arising in flow data design problems.	CO9	L3
2	Analyze how to apply the Euler's equations for a given function by Euler's equation	CO10	L4
b	***Course Schedule***		

Class No	Module Content Covered	CO	Level
1	Numerical Solution of second order ODE-RK method	CO9	L3
2	Problems on RK method	CO9	L3
3	Numerical Solution of second order ODE-Milne’s method	CO9	L3
4	Problems on Milne’s Method	CO9	L3
5	Calculus of variation: Basic definitions and problems on Variation of functional	CO10	L4
6	Problems on functionals	CO10	L4
7	Derivation of Euler’s equation.	CO10	L4
8	Applications of Calculus of Variation-Geodesics	CO10	L4
9	Problems on Geodesic and Hanging chain	CO10	L4
10	Additional problems	CO10	L4
c	**Application Areas**	**CO**	**Level**
1	To solve first order and second order ODE using single step numerical methods	CO9	L3
2	To determine extremal functions arising in dynamics of rigid bodies and vibrational analysis in the field of civil engineering.	CO10	L4
d	**Review Questions**	-	-
1	By Runge Kutta method solve $\frac{d^2y}{dx^2} = x\left(\frac{dy}{dx}\right)^2 - y^2$ for x=0.2 correct to 4 decimal places using the initial conditions $y = 1$ and $y' = 0$ when $x = 0$	CO9	L3
2	$\int_0^{\frac{\pi}{2}} \left(y'^2 - y^2 + 2xy\right)dx$ On what curves can be the functional $y(0) = 0, y\left(\frac{\pi}{2}\right) = 0$ be extremum.	CO10	L4
3	State and prove Euler’s equation.	CO10	L4
4	Apply Milne’s Method to compute $y(0.4)$ given the equation $y'' + y' = 2e^x$ and the following table of initial values. <table><tr><td>x</td><td>0</td><td>0.1</td><td>0.2</td><td>0.3</td></tr><tr><td>y</td><td>2</td><td>2.01</td><td>2.04</td><td>2.09</td></tr><tr><td>y’</td><td>0</td><td>0.2</td><td>0.4</td><td>0.6</td></tr></table>	CO9	L3
5	Find the function y which makes the integral $\int_{x_1}^{x_2} \left(1 + xy' + xy'^2\right)dx$ an extremum	CO10	L4
6	Prove that the shortest distance between two points in a plane is along the straight line joining them.	CO10	L4

e	**Experiences**	-	-
1			
2			

Module - 2

Title:	Fourier Series	Appr Time:	10 Hrs
a	***Course Outcomes***	-	**Blooms**
-	The student should be able to:	-	**Level**
1	Analyze expansion of Fourier series using Euler formula	CO3	L3
2	Apply Fourier expansion in practical harmonic problems	CO4	L4
b	***Course Schedule***		
Class No	**Module Content Covered**	**CO**	**Level**
1	Periodic functions, Dirichlet's conditions	CO3	L3
2	Fourier series of periodic functions of period 360	CO3	L3
3	Fourier series of periodic functions of arbitrary period 2c	CO3	L3
4	Fourier series of even and odd functions	CO3	L3
5	Solving numericals	CO3	L3
6	half range cosine Fourier series	CO3	L3
7	half range sine Fourier series	CO3	L3
8	Practical harmonic analysis	CO4	L3
9	Solving numericals	CO4	L3
10	Solving numericals	CO4	L3
c	**Application Areas**	**CO**	**Level**
1	To study the nature of wave forms in voltage- current characteristics .	CO3	L3
2	Used to convert to discrete time domain signal into discrete frequency domain signal.	CO4	L3
d	**Review Questions**	-	-
1	Find the fourier series for the function $f(x) = x(\pi - x)$ over the interval $(0, 2\pi)$ and hence deduce that $\frac{\pi^2}{12} = \sum_{n=1}^{\infty} \frac{(-1)^{n+1}}{n^2}$	CO3	L3
2	If $f(x) = \begin{cases} x & 0 \le x \le \frac{\pi}{2} \\ \pi - x & \frac{\pi}{2} \le x \le \pi \end{cases}$ Show that $f(x) = \frac{4}{\pi}\left(\sin x - \frac{\sin 3x}{3^2} + \frac{\sin 5x}{5^2} - \ldots\ldots\ldots\ldots\right)$	CO3	L3
3	The following table gives variations of periodic current over a period T. Show that	CO4	L4

	there is a direct current part of 0.75amp in the variable current and obtain the amplitude of first harmonic		

t(sec)	0	T/6	T/3	T/2	2T/3	5T/6	T
A(amp)	1.98	1.3	1.05	1.3	-0.88	-0.25	1.98

4	Find the fourier series of the function $f(x) = \begin{cases} 2-x & 0 \le x \le 4 \\ x-6 & 4 \le x \le 8 \end{cases}$ and hence deduce that $\frac{\pi^2}{8} = \frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \ldots\ldots$	CO3	L3
5	Find the half range cosine series for the function $f(x) = (x-1)^2$ in $0 < x < 1$	CO3	L3
6	Compute the constant term and first two harmonic of the function of $f(x)$ given by	CO4	L4

x	0	$\frac{\pi}{3}$	$\frac{2\pi}{3}$	π	$\frac{4\pi}{3}$	$\frac{5\pi}{3}$	2π
f(x)	1.0	1.4	1.9	1.7	1.5	1.2	1.0

e	**Experiences**	-	-
1			
2			

E2. CIA EXAM – 2

a. Model Question Paper - 2

Dept:	IS	Sem / Div:	3 / A	Course:	Transform Calculus, Fourier series and Numerical Techniques.	Elective:	N
Date:	24-10-19	Time:	9:30-11:00	C Code:	18MAT31	Max Marks:	50

Note: Answer all full questions. All questions carry 25 marks

QNo		Questions	CO	Level	Marks	Module
1	a	Find the fourier series for the function $f(x) = x(\pi - x)$ over the interval $(0, 2\pi)$ and hence deduce that $\frac{\pi^2}{12} = \sum_{n=1}^{\infty} \frac{(-1)^{n+1}}{n^2}$	CO3	L3	9	2
	b	If $f(x) = \begin{cases} x & 0 < x < \frac{\pi}{2} \\ \pi - x & \frac{\pi}{2} < x < \pi \end{cases}$ Show that	CO3	L3	8	2

		$f(x) = \frac{4}{\pi}\left(\sin x - \frac{\sin 3x}{3^2} + \frac{\sin 5x}{5^2} - \ldots\ldots\ldots\ldots\right)$				
	c	The following table gives variations of periodic current over a period T. Show that there is a direct current part of 0.75amp in the variable current and obtain the amplitude of first harmonic	CO4	L4	8	2

t(sec)	0	T/6	T/3	T/2	2T/3	5T/6	T
A(amp)	1.98	1.3	1.05	1.3	-0.88	-0.25	1.98

		OR				
2	a	Find the fourier series of the function $f(x) = \begin{cases} 2-x & 0 \le x \le 4 \\ x-6 & 4 \le x \le 8 \end{cases}$ and hence deduce that $\frac{\pi^2}{8} = \frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \ldots\ldots$	CO3	L3	8	2
	b	Find the half range cosine series for the function $f(x) = (x-1)^2$ in $0 < x < 1$	CO3	L3	8	2
	c	Compute the constant term and first two harmonic of the function of $f(x)$ given by	CO4	L4	9	2

x	0	$\frac{\pi}{3}$	$\frac{2\pi}{3}$	π	$\frac{4\pi}{3}$	$\frac{5\pi}{3}$	2π
f(x)	1.0	1.4	1.9	1.7	1.5	1.2	1.0

3	a	By Runge Kutta method solve $\frac{d^2y}{dx^2} = x\left(\frac{dy}{dx}\right)^2 - y^2$ for x=0.2 correct to 4 decimal places using the initial conditions $y = 1$ and $y' = 0$ when $x = 0$	CO9	L3	8	5
	b	$\int_0^{\frac{\pi}{2}} (y'^2 - y^2 + 2xy)\,dx$ On what curves can be the functional $y(0) = 0, y\left(\frac{\pi}{2}\right) = 0$ be extremum.	CO10	L4	8	5
	c	State and prove Euler's equation.	CO10	L4	9	5
		OR				
4	a	Apply Milne's Method to compute $y(0.4)$ given the equation $y'' + y' = 2e^x$ and the following table of initial values.	CO9	L3	9	5

x	0	0.1	0.2	0.3
y	2	2.01	2.04	2.09
y'	0	0.2	0.4	0.6

	b	Find the function y which makes the integral	CO10	L4	8	5

		$\int_{x_1}^{x_2}(xy' + xy'^2)\,dx$ an extremum				
	c	Prove that the shortest distance between two points in a plane is along the straight line joining them.	CO10	L4	8	5

b. Assignment – 2

Note: A distinct assignment to be assigned to each student.

Model Assignment Questions							
Crs Code:	18MAT31	Sem:	3	Marks:	10/ 10	Time:	90 – 120 minutes
Course:	Transform Calculus, Fourier series and Numerical Techniques.						
Note: Each student to answer 2-3 assignments. Each assignment carries equal mark.							

SNo	USN	Assignment Description	Marks	CO	Level
1		By Runge Kutta method solve $\frac{d^2y}{dx^2} = x\left(\frac{dy}{dx}\right)^2 - y^2$ for x=0.2 correct to 4 decimal places using the initial conditions $y=1$ and $y'=0$ when $x=0$	8	CO9	L3
2		$\int_0^{\frac{\pi}{2}}(y'^2 - y^2 + 2xy)\,dx$ On what curves can be the functional $y(0)=0, y\left(\frac{\pi}{2}\right)=0$ be extremum.	8	CO10	L4
3		State and prove Euler's equation.	9	CO10	L4
4		Apply Milne's Method to compute $y(1.4)$ given the equation $y'' + y' = 2e^x$ and the following table of initial values. | x | 0 | 0.1 | 0.2 | 0.3 | | y | 2 | 2.01 | 2.04 | 2.09 | | y' | 0 | 0.2 | 0.4 | 0.6 |	9	CO9	L3
5		Find the function y which makes the integral $\int_{x_1}^{x_2}(xy' + xy'^2)\,dx$ an extremum	8	CO10	L4
6		Prove that the shortest distance between two points in a plane is along the straight line joining them.	8	CO10	L4
7		Find the fourier series for the function $f(x) = x(\pi - x)$ over the interval $(0, 2\pi)$ and hence deduce that $\frac{\pi^2}{12} = \sum_{n=1}^{\infty}\frac{(-1)^{n-1}}{n^2}$	9	CO3	L3

<table>
<tr><td>8</td><td></td><td>If $f(x) = \begin{cases} x & 0 \le x \le \frac{\pi}{2} \\ \pi - x & \frac{\pi}{2} \le x \le \pi \end{cases}$ Show that
$f(x) = \frac{4}{\pi}\left(\sin x - \frac{\sin 3x}{3^2} + \frac{\sin 5x}{5^2} - ....\right)$</td><td>8</td><td>CO3</td><td>L3</td></tr>
<tr><td>9</td><td></td><td>The following table gives variations of periodic current over a period T. Show that there is a direct current part of 0.75amp in the variable current and obtain the amplitude of first harmonic
<table>
<tr><td>t(sec)</td><td>0</td><td>T/6</td><td>T/3</td><td>T/2</td><td>2T/3</td><td>5T/6</td><td>T</td></tr>
<tr><td>A(amp)</td><td>1.98</td><td>1.3</td><td>1.05</td><td>1.3</td><td>-0.88</td><td>-0.25</td><td>1.98</td></tr>
</table></td><td>8</td><td>CO4</td><td>L4</td></tr>
<tr><td>10</td><td></td><td>Find the fourier series of the function
$f(x) = \begin{cases} 2 - x & 0 \le x \le 4 \\ x - 6 & 4 \le x \le 8 \end{cases}$ and hence deduce that
$\frac{\pi^2}{8} = \frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + ...$</td><td>8</td><td>CO3</td><td>L3</td></tr>
<tr><td>11</td><td></td><td>Find the half range cosine series for the function
$f(x) = (x - 1)^2$ in $0 \le x \le 1$</td><td>8</td><td>CO3</td><td>L3</td></tr>
<tr><td>12</td><td></td><td>Compute the constant term and first two harmonic of the function of $f(x)$ given by
<table>
<tr><td>x</td><td>0</td><td>$\frac{\pi}{3}$</td><td>$\frac{2\pi}{3}$</td><td>π</td><td>$\frac{4\pi}{3}$</td><td>$\frac{5\pi}{3}$</td><td>2π</td></tr>
<tr><td>f(x)</td><td>1.0</td><td>1.4</td><td>1.9</td><td>1.7</td><td>1.5</td><td>1.2</td><td>1.0</td></tr>
</table></td><td>9</td><td>CO4</td><td>L4</td></tr>
</table>

D3. TEACHING PLAN - 3

Module - 3

Title:	Fourier transform ; Difference equations and z-transforms	Appr Time:	10 Hrs
a	***Course Outcomes***	-	**Blooms**
-	The student should be able to:	-	**Level**
1	Apply to transform form one to another domain by fourier intergrals	CO5	L3
2	Apply to transform one domain to another domain by z-transforms	CO6	L3
b	***Course Schedule***		
Class No	**Module Content Covered**	**CO**	**Level**

1	Infinite fourier transform	CO5	L3
2	Fourier sine transform	CO5	L3
3	Fourier cosine transform	CO5	L3
4	Basic definition, Z-transforms definition	CO5	L3
5	Standard Z-transforms, damping rule	CO5	L3
6	Shifiting rule, initial value and final value theorems	CO5	L3
7	Solving numerical	CO5	L3
8	Inverse Z-transform	CO6	L3
9	Numericals	CO6	L3
10	Applications to solve difference equations	CO6	L3
c	**Application Areas**	**CO**	**Level**
1	To study the continuous and Apply to transform one domain to another domain by z-transforms discrete signals and its properties.	CO5	L3
2	Used to convert to discrete time domain signal into discrete frequency domain signal.	CO6	L3
d	**Review Questions**	-	-
1	Find the complex fourier transform of the function $f(x)=\begin{cases}1 & for\ \lvert x\rvert\le a\\ 0 & for\ \lvert x\rvert>a\end{cases}$ hence deduce $\int_0^\infty \frac{sinx}{x}dx$	CO9	L3
2	Find the complex fourier transform of the function $f(x)=\begin{cases}x & for\ \lvert x\rvert\le \alpha\\ 0 & for\ \lvert x\rvert>\alpha\end{cases}$ where α is a positive constant.	CO9	L3
3	Find the fourier transform of $f(x)=e^{-\lvert x\rvert}$	CO9	L3
4	Find the complex fourier transform of the function $f(x)=\begin{cases}1-\lvert x\rvert & for\ \lvert x\rvert\le 1\\ 0 & for\ \lvert x\rvert>1\end{cases}$ hence deduce $\int_0^\infty \frac{\sin^2 t}{t^2}dt=\frac{\pi}{2}$	CO9	L3
5	If $f(x)=\begin{cases}1-x^2 & for\ \lvert x\rvert\le 1\\ 0 & for\ \lvert x\rvert>1\end{cases}$ find the fourier transform of $f(x)$ and hence deduce $\int_0^\infty \frac{xcosx-sinx}{x^3}\cos\left(\frac{x}{2}\right)dx$	CO9	L3
6	Find the fourier sine and cosine transform of $f(x)=e^{-\alpha x}$	CO9	L3
7	Find the fourier sine transform of $f(x)=e^{-\lvert x\rvert}$ and hence evaluate $\int_0^\infty \frac{xsinmx}{1+x^2}dx, m>0$	CO9	L3
8	Find the inverse fourier sine transform of $f_s(\alpha)=\frac{e^{-a\alpha}}{\alpha}, a>0$	CO9	L3
9	Find the Z transforms of the following: $(i)e^{-an}; (ii)e^{-an}n; (iii)e^{-an}.n^2$	CO10	L3
10	Find the Z transform of $2n+\sin\left(\frac{n\pi}{4}\right)+1$	CO10	L3
11	Show that $Z_T\left(\frac{1}{n!}\right)=e^{\frac{1}{z}}$. Hence find $Z_T\left(\frac{1}{(n+1)!}\right)$ and $Z_T\left(\frac{1}{(n+2)!}\right)$	CO10	L3
12	Find the Z transform of $\sin(n+5)$	CO10	L3

13	Find the Z transform of $n\cos n\theta$	CO10	L3
14	Find $Z_T\left(\frac{1}{(n+1)!}\right)$	CO10	L3
15	If $U_T(z)=\frac{2z^2+3z+12}{(z-1)^4}$ find the value of u_0, u_1, u_2, u_3	CO10	L3
16	Given $Z_T(u_n)=\frac{2z^2+3z+4}{(z-3)^3}$, $\lvert z\rvert>3$ Show that $u_1=2, u_2=21, u_3=139$	CO10	L3
17	Find the inverse Z transform of $\frac{z}{(z-1)(z-2)}$	CO10	L3
18	Find the inverse Z transform of $\frac{3z^2+2z}{(5z-1)(5z+2)}$	CO10	L3
19	Given $U(z)=\frac{4z^2-2z}{z^3-5z^2+8z-4}$ find u_n	CO10	L3
e	**Experiences**	-	-
1			

E3. CIA EXAM – 3

a. Model Question Paper – 3

b. Assignment – 3

Note: A distinct assignment to be assigned to each student.

Model Assignment Questions							
Crs Code:	18MAT31	Sem:	3	Marks:	10/ 10	Time:	90 – 120 minutes
Course:	Transform Calculus, Fourier series and Numerical Techniques.						
Note: Each student to answer 2-3 assignments. Each assignment carries equal mark.							

SNo	USN	Assignment Description	Marks	CO	Level
1		Find the complex fourier transform of the function $f(x)=\begin{cases}x & for\ \lvert x\rvert\le\alpha\\ 0 & for\ \lvert x\rvert>\alpha\end{cases}$ where α is a positive constant.	6	CO9	L3
2		Find the fourier transform of $f(x)=e^{-\lvert x\rvert}$	7	CO9	L3
3		Find the complex fourier transform of the function $f(x)=\begin{cases}1-\lvert x\rvert & for\ \lvert x\rvert\le 1\\ 0 & for\ \lvert x\rvert>1\end{cases}$ hence deduce $\int_0^\infty \frac{\sin^2 t}{t^2}dt=\frac{\pi}{2}$	7	CO9	L3
4		Find the inverse Z transform of $\frac{z}{(z-1)(z-2)}$	6	CO10	L3

5		Find the inverse Z transform of $\frac{3z^2+2z}{(z-1)(z+2)}$	7	CO10	L3
6		Given $U(z)=\frac{4z^2-2z}{z^3-5z^2+8z-4}$ find u_n	7	CO10	L3
7		If $f(x)=\begin{cases}1-x^2 & for \; \lvert x\rvert \le 1 \\ 0 & for \; \lvert x\rvert > 1\end{cases}$ find the fourier transform of $f(x)$ and hence deduce $\int_0^\infty \frac{x\cos x-\sin x}{x^3}\cos\left(\frac{x}{2}\right)dx$	6	CO9	L3
8		Find the fourier sine and cosine transform of $f(x)=e^{-\alpha x}$	7	CO9	L3
9		Find the fourier sine transform of $f(x)=e^{-\lvert x\rvert}$ and hence evaluate $\int_0^\infty \frac{x\sin mx}{1+x^2}dx, m>0$	7	CO9	L3
10		Find the Z transforms of the following: $(i) e^{-an}; (ii) e^{-an} n; (iii) e^{-an}.n^2$	6	CO10	L3
11		Find the Z transform of $2n+\sin\left(\frac{n\pi}{4}\right)+1$	7	CO10	L3
12		Show that $Z_T\left(\frac{1}{n!}\right)=e^{\frac{1}{z}}$. Hence find $Z_T\left(\frac{1}{(n+1)!}\right)$ and $Z_T\left(\frac{1}{(n+2)!}\right)$	7	CO10	L3
13		Find the Z transform of $\sin(3n+5)$	6	CO10	L3
14		Find the Z transform of $n \cos n\theta$	7	CO10	L3
15		Find $Z_T\left(\frac{1}{(n+1)}\right)$	7	CO10	L3

F. EXAM PREPARATION

1. University Model Question Paper

Course:	Transform Calculus Fourier Series and Numerical Techniques					Month / Year	May /2019
Crs Code:	18MAT31	Sem:	3	Marks:	100	Time:	180 minutes

-	Note	Answer any FIVE full questions. All questions carry equal marks.	Marks	CO	Level
1	a	Find the laplace transform of $(i) te^{-4t}\sin 3t$ $(ii) \frac{e^{-bt}-e^{-at}}{t}$	6	CO1	L3
	b	Express in terms of unit step function and hence find its laplace transform $f(t)=\begin{cases}\cos t & 0<t<\pi \\ 1 & \pi<t<2\pi \\ \sin t & t>2\pi\end{cases}$	7	CO1	L3
	c	If a periodic function of period $2a$ is defined by $f(t)=\begin{cases}t & if\, 0\le t\le a \\ 2a-t & if\, a\le t\le 2a\end{cases}$ then show that	7	CO1	L3

<table>
<tr><td></td><td></td><td>$L\left(\frac{1}{s^2}\tanh\left(\frac{as}{2}\right)\right)$</td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td>OR</td><td></td><td></td><td></td></tr>
<tr><td>2</td><td>a</td><td>Find the inverse laplace transform of $\frac{(s+5)}{(s-1)^3(s+2)}$</td><td>6</td><td>CO2</td><td>L3</td></tr>
<tr><td></td><td>b</td><td>Find $L^{-1}\frac{1}{(s+1)(s^2+9)}$ using Convolution Theorem.</td><td>7</td><td>CO2</td><td>L3</td></tr>
<tr><td></td><td>c</td><td>Solve $y''+6y'+9y=12t^2e^{-3t}$ by laplace transforms method with $y(0)=0=y'(0)$</td><td>7</td><td>CO2</td><td>L3</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>3</td><td>a</td><td>Find the fourier series for the function $f(x)=x(\pi-x)$ over the interval $(0,2\pi)$ and hence deduce that $\frac{\pi^2}{12}=\sum_{n=1}^{\infty}\frac{(-1)^{n+1}}{n^2}$</td><td>6</td><td>CO3</td><td>L3</td></tr>
<tr><td></td><td>b</td><td>If $f(x)=\begin{cases} x & 0\le x\le\frac{\pi}{2} \\ \pi-x & \frac{\pi}{2}\le x\le\pi \end{cases}$ Show that $f(x)=\frac{4}{\pi}\left(\sin x-\frac{\sin 3x}{3^2}+\frac{\sin 5x}{5^2}-\ldots\ldots\right)$</td><td>7</td><td>CO3</td><td>L3</td></tr>
<tr><td></td><td>c</td><td>The following table gives variations of periodic current over a period T. Show that there is a direct current part of 0.75amp in the variable current and obtain the amplitude of first harmonic
<table>
<tr><td>t(sec)</td><td>0</td><td>T/6</td><td>T/3</td><td>T/2</td><td>2T/3</td><td>5T/6</td><td>T</td></tr>
<tr><td>A(amp)</td><td>1.98</td><td>1.3</td><td>1.05</td><td>1.3</td><td>-0.88</td><td>-0.25</td><td>1.98</td></tr>
</table></td><td>7</td><td>CO4</td><td>L4</td></tr>
<tr><td></td><td></td><td>OR</td><td></td><td></td><td></td></tr>
<tr><td>4</td><td>a</td><td>Find the fourier series of the function $f(x)=\begin{cases} 2-x & 0\le x\le 4 \\ x-6 & 4\le x\le 8 \end{cases}$ and hence deduce that $\frac{\pi^2}{8}=\frac{1}{1^2}+\frac{1}{3^2}+\frac{1}{5^2}+\ldots\ldots$</td><td>6</td><td>CO3</td><td>L3</td></tr>
<tr><td></td><td>b</td><td>Find the half range cosine series for the function $f(x)=(x-1)^2$ in $0<x<1$</td><td>7</td><td>CO3</td><td>L3</td></tr>
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<table>
<tr><td>x</td><td>0</td><td>$\frac{\Pi}{3}$</td><td>$\frac{2\Pi}{3}$</td><td>Π</td><td>$\frac{4\Pi}{3}$</td><td>$\frac{5\Pi}{3}$</td><td>2Π</td></tr>
<tr><td>f(x)</td><td>1.0</td><td>1.4</td><td>1.9</td><td>1.7</td><td>1.5</td><td>1.2</td><td>1.0</td></tr>
</table></td><td>7</td><td>CO4</td><td>L4</td></tr>
<tr><td>5</td><td>a</td><td>Find the complex fourier transform of the function $f(x)=\begin{cases} 1 & for\ \lvert x\rvert\le a \\ 0 & for\ \lvert x\rvert>a \end{cases}$ hence deduce $\int_0^{\infty}\frac{sinx}{x}dx$</td><td>6</td><td>CO9</td><td>L3</td></tr>
</table>

	b	Find the inverse Z transform of $\frac{z}{(z-1)(z-2)}$	7	CO10	L3
	c	If $\bar{u}(z)=\frac{2z^2+3z+12}{(z-1)^4}$ find the value of u_0, u_1, u_2, u_3	7	CO10	L3
		OR			
6	a	If $f(x)=\begin{cases}1-x^2 & for \ \|x\|\le 1 \\ 0 & for \ \|x\|>1\end{cases}$ find the fourier transform of $f(x)$ and hence deduce $\int_0^\infty \frac{xcosx-sinx}{x^3}\cos\left(\frac{x}{2}\right)dx$	6	CO9	L3
	b	Find the Z transform of $2n+\sin\left(\frac{n\pi}{4}\right)+1$	7	CO10	L3
	c	Show that $Z_T\left(\frac{1}{n!}\right)=e^{\frac{1}{z}}$. Hence find $Z_T\left(\frac{1}{(n+1)!}\right)$ and $Z_T\left(\frac{1}{(n+2)!}\right)$	7	CO10	L3
7	a	Use Taylor's method to find y at $x=0.1,\ 0.2,\ 0.3$ of the problem $\frac{dy}{dx}=x^2+y^2$ with $y(0)=1$ .Consider upto 3rd degree terms.	6	CO7	L3
	b	Using Euler's modified method, solve for y at $x=0.1$ if $\frac{dy}{dx}=\frac{y-x}{y+x}$ with $y(0)=1$. Carry out three modifications.	7	CO7	L3
	c	Apply Runge Kutta method of order four compute $y=0.2$ given $10\frac{dy}{dx}=x^2+y^2$ with $y(0)=1$ taking h=0.2	7	CO8	L3
		OR			
8	a	Solve $\frac{dy}{dx}=\frac{y^2-x^2}{y^2+x^2}$ with $y(0)=1$ find y at $x=0.2$ using RK method taking h=0.2	6	CO8	L3
	b	Given $\frac{dy}{dx}=xy+y^2$ with $y(0)=1, y(0.1)=1.1169, y(0.2)=1.2773, y(0.3)=1.5049$ find $y(0.4)$ correct to three decimal places using Milne's method.	7	CO8	L3
	c	Given $\frac{dy}{dx}=(1+y)x^2$ and $y(0)=1, y(0.1)=1.233, y(0.2)=1.548, y(0.3)=1.979$ find $y(0.4)$ by Adams-Bashforth method	7	CO8	L3
9	a	By Runge Kutta method solve $\frac{d^2y}{dx^2}=x\left(\frac{dy}{dx}\right)^2-y^2$ for x=0.2 correct to 4 decimal places using the initial conditions $y=1$ and $y'=0$ when $x=0$	6	CO9	L3
	b	$\int_0^{\frac{\pi}{2}}(y'^2-y^2+2xy)dx$ On what curves can be the functional	7	CO10	L3

		$y(0)=0,\ y\left(\frac{\pi}{2}\right)=0$ be extremum.			
	c	State and prove Euler's equation.	7	CO10	L4
		OR			
10	a	Apply Milne's Method to compute $y(0.4)$ given the equation $y'' + y' = 2e^x$ and the following table of initial values. x: 0, 0.1, 0.2, 0.3 y: 2, 2.01, 2.04, 2.09 y': 0, 0.2, 0.4, 0.6	6	CO9	L3
	b	Find the function y which makes the integral $\int_{x_1}^{x_2} (1 + xy' + xy'^2)\,dx$ an extremum	7	CO10	L3
	c	Prove that the shortest distance between two points in a plane is along the straight line joining them.	7	CO10	L4

2. SEE Important Questions

Course:	Transform Calculus, Fourier series and Numerical Techniques.					Month / Year	May /2019
Crs Code:	18MAT31	Sem:	3	Marks:	100	Time:	180 minutes

Module	Qno.	Important Question	Marks	CO	Year
	Note	Answer any FIVE full questions. All questions carry equal marks.	-	-	
1	1	Find the laplace transform of $(i)\ te^{-4t}\sin 3t$ $(ii)\ \frac{e^{-bt} - e^{-at}}{t}$	6	CO1	
	2	Express in terms of unit step function and hence find its laplace transform $f(t) = \begin{cases} \cos t & 0 < t < \pi \\ 1 & \pi < t < 2\pi \\ \sin t & t > 2\pi \end{cases}$	7	CO1	
	3	If a periodic function of period $2a$ is defined by $f(t) = \begin{cases} t & if\ 0 \le t \le a \\ 2a - t & if\ a \le t \le 2a \end{cases}$ then show that $L\{f(t)\} = \left(\frac{1}{s^2}\right)\tanh\left(\frac{as}{2}\right)$	7	CO1	
	4	Find the inverse laplace transform of $\frac{(s+5)}{(s-1)^3(s+2)}$	6	CO2	
	5	Find $L^{-1}\frac{1}{(s+1)(s^2+9)}$ using Convolution Theorem.	7	CO2	
	6	Solve $y'' + 6y' + 9y = 12t^2e^{-3t}$ by laplace transforms method with $y(0) = 0 = y'(0)$	7	CO2	

<table>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2</td><td>1</td><td>Find the fourier series for the function $f(x)=x(\pi-x)$ over the interval $(0,2\pi)$ and hence deduce that $\frac{\pi^2}{12}=\sum_{n=1}^{\infty}\frac{(-1)^{n+1}}{n^2}$</td><td>6</td><td>CO3</td><td></td></tr>
<tr><td></td><td>2</td><td>If $f(x)=\begin{cases} x & 0<x<\frac{\pi}{2} \\ \pi-x & \frac{\pi}{2}<x<\pi \end{cases}$ Show that $f(x)=\frac{4}{\pi}\left(\sin x-\frac{\sin 3x}{3^2}+\frac{\sin 5x}{5^2}-\ldots\ldots\right)$</td><td>7</td><td>CO3</td><td></td></tr>
<tr><td></td><td>3</td><td>The following table gives variations of periodic current over a period T. Show that there is a direct current part of 0.75amp in the variable current and obtain the amplitude of first harmonic
<table>
<tr><td>t(sec)</td><td>0</td><td>T/6</td><td>T/3</td><td>T/2</td><td>2T/3</td><td>5T/6</td><td>T</td></tr>
<tr><td>A(amp)</td><td>1.98</td><td>1.3</td><td>1.05</td><td>1.3</td><td>-0.88</td><td>-0.25</td><td>1.98</td></tr>
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<tr><td></td><td>2</td><td>If $f(x)=\begin{cases} 1-x^2 & for\ |x|\le 1 \\ 0 & for\ |x|>1 \end{cases}$ find the fourier transform of $f(x)$ and hence deduce $\int_0^{\infty}\frac{xcosx-sinx}{x^3}\cos\left(\frac{x}{2}\right)dx$</td><td>7</td><td>CO9</td><td></td></tr>
<tr><td></td><td>3</td><td>Find the inverse fourier sine transform of $f_s(\alpha)=\frac{e^{-a\alpha}}{\alpha}, a>0$</td><td>7</td><td>CO9</td><td></td></tr>
<tr><td></td><td>4</td><td>Find $Z_T\left(\frac{1}{(n+1)!}\right)$</td><td>6</td><td>CO10</td><td></td></tr>
<tr><td></td><td>5</td><td>Find the inverse Z transform of $\frac{3z^2+2z}{(z-1)(z+2)}$</td><td>7</td><td>CO10</td><td></td></tr>
</table>

	6	Given $U(z)=\frac{4z^2-2z}{z^3-5z^2+8z-4}$ find u_n	7	CO10	
4	1	Use Taylor's method to find y at $x=0.1,\ 0.2,\ 0.3$ of the problem $\frac{dy}{dx}=x^2+y^2$ with $y(0)=1$ .Consider upto 3rd degree terms.	6	CO7	
	2	Using Euler's modified method, solve for y at $x=0.1$ if $\frac{dy}{dx}=\frac{y-x}{y+x}$ with $y(0)=1$. Carry out three modifications.	7	CO7	
	3	Apply Runge Kutta method of order four compute $y=0.2$ given $10\frac{dy}{dx}=x^2+y^2$ with $y(0)=1$ taking h=0.2	7	CO8	
	4	Solve $\frac{dy}{dx}=\frac{y^2-x^2}{y^2+x^2}$ with $y(0)=1$ find y at $x=0.2$ using RK method taking h=0.2	6	CO8	
	5	Given $\frac{dy}{dx}=xy+y^2$ with $y(0)=1,\ y(0.1)=1.1169,\ y(0.2)=1.2773,\ y(0.3)=1.5049$ find $y(0.4)$ correct to three decimal places using Milne's method.	7	CO8	
	6	Given $\frac{dy}{dx}=(1+y)x^2$ and $y(1)=1,\ y(1.1)=1.233,\ y(1.2)=1.548,\ y(1.3)=1.979$ find $y(1.4)$ by Adams-Bashforth method	7	CO8	
5	1	By Runge Kutta method solve $\frac{d^2y}{dx^2}=x\left(\frac{dy}{dx}\right)^2-y^2$ for x=0.2 correct to 4 decimal places using the initial conditions $y=1$ and $y'=0$ when $x=0$	6	CO9	
	2	$\int_0^{\frac{\pi}{2}}(y'^2-y^2+2xy)dx$ On what curves can be the functional $y(0)=0,\ y\left(\frac{\pi}{2}\right)=0$ be extremum.	7	CO10	
	3	State and prove Euler's equation.	7	CO10	
	4	Apply Milne's Method to compute $y(0.4)$ given the equation $y''+y'=2e^x$ and the following table of initial values. <table><tr><td>x</td><td>0</td><td>0.1</td><td>0.2</td><td>0.3</td></tr><tr><td>y</td><td>2</td><td>2.01</td><td>2.04</td><td>2.09</td></tr><tr><td>y'</td><td>0</td><td>0.2</td><td>0.4</td><td>0.6</td></tr></table>	6	CO9	
	5	Find the function y which makes the integral $\int_{x_1}^{x_2}(1+xy'+xy'^2)dx$ an extremum	7	CO10	
	6	Prove that the shortest distance between two points in a plane is	7	CO10	

		along the straight line joining them.			

G. Content to Course Outcomes

1. TLPA Parameters

Table 1: TLPA – Example Course

Module-#	Course Content or Syllabus (Split module content into 2 parts which have similar concepts)	Content Teaching Hours	Blooms' Learning Levels for Content	Final Blooms' Level	Identified Action Verbs for Learning	Instruction Methods for Learning	Assessment Methods to Measure Learning
A	*B*	*C*	*D*	*E*	*F*	*G*	*H*
1	Laplace transforms of elementary functions.Laplace transforms of periodic functions and unit step functions.	5	L3	L3	Apply	Lecture	Assinments and Slip test
1	Inverse laplace transforms, convolution theorem to find the inverse laplace transforms and problems.Solution of linear differential equations using Laplace transform.	5	L3	L3	Apply	Lecture	Assinments and Slip test
2	Fourier series of 2Π,2l period & half range fourier series	6	L3	L3	Apply	Lecture	Assinments and Slip test
2	Practical Harmonic analysis.	4	L4	L4	Analyze	Lecture	Assinments and Slip test
3	Infinite Fourier transforms, fourier sine and cosine transforms & Fourier inverse transforms	4	L3	L3	Apply	Lecture	Assinments and Slip test
3	Z-transforms and inverse z-transforms	6	L3	L3	Apply	Lecture	Assinments and Slip test
4	Numerical Solutions of ODE of first order and degree-Taylor's Method,Modified Euler's Equations	5	L3	L3	Apply	Lecture	Assinments and Slip test
4	RK method,Milne's and Adams Bashforth method	5	L3	L3	Apply	Lecture	Assinments and Slip test
5	Numerical Solutions of second order ODE using Runge-Kutta method and Milne's Method.	7	L3	L3	Apply	Lecture	Assinments and Slip test
5	Variational problems, euler's equations,geodesics and problems	3	L4	L4	Analyze	Lecture	Assinments and Slip test

2. Concepts and Outcomes:

Table 2: Concept to Outcome – Example Course

Module-#	Learning or Outcome from study of the Content or Syllabus	Identified Concepts from Content	Final Concept	Concept Justification (What all Learning Happened from the study of Content / Syllabus. A short word for learning or outcome)	CO Components (1.Action Verb, 2.Knowledge, 3.Condition / Methodology, 4.Benchmark)	Course Outcome **Student Should be able to ...**
A	*I*	*J*	*K*	*L*	*M*	*N*
1	Solution of DE using laplace transforms	Laplace transformation	Differential Equations	Methods to solve differential equations using laplace transformation	Apply Differentiation Problem Solving	Use laplace transform in solving Differential equations arising in network analysis, control systems and other fields of engineering.
1	Solution of DE using laplace and inverse laplace transforms	Laplace transformation	Differential Equations	Methods to solve differential equations using laplace transformation	Apply Differentiation Problem Solving	Use inverse laplace transform in solving Differential/ integral equations arising in network analysis, control systems and other fields of engineering.
2	Solution of DE using fourier expansion	Fourier series	Analyze circuits&system communication	Methods to solve DE using fourier series expansion	Apply Integration Problem Solving	Analyze expansion of Fourier series using Euler formula
2	Solution of DE using fourier expansion	Harmonic Analysis	Analyze circuits&system communication	Methods to solve partical harmonic problem over a period using fourier expansion	Apply Problem Solving	Apply Fourier expansion in practical harmonic problems

3	Solution of DE using fourier transforms	Laplace transformation	Continuous signal process	Methods to solve differential equations using fourier transformation	Apply Integration Problem Solving	Apply to transform form one to another domain by Fourier integrals
3	Solution of DE using Z and inverse Z transforms	Laplace transformation	Discrete signal process	Methods to solve differential equations using Z and inverse Z transformation	Apply Integration Problem Solving	Apply to transform one domain to another domain by z-transforms
4	Numerical Methods to solve DE	Differential Equations	Ordinary Differential Equations.	Methods to solve DE using Numerical Methods	Apply Differentiation Problem Solving	Use appropriate single step numerical methods to solve first order ordinary differential equations.
4	Numerical Methods to solve DE	Differential Equations	Ordinary Differential Equations.	Methods to solve DE using Numerical Methods	Apply Differentiation Problem Solving	Use appropriate multi-step numerical methods to solve first order ordinary differential equations arising in flow data design problems.
5	Numerical Methods to solve DE	Differential Equations	Ordinary Differential Equations.	Methods to solve DE using Numerical Methods	Apply Differentiation Problem Solving	Use appropriate multi-step numerical methods to solve second order ordinary differential equations arising in flow data design problems.
5	Applications of Calculus of Variations	Extremum	Maximum and minimum	Calculus of variations	Apply Differentiation Problem Solving	Analyze how to apply the Euler's equations for a given function by Euler's equation