TITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad -500 043

MECHANICAL ENGINEERING

COURSE DESCRIPTOR

Course Title	MATHEMATICAL TRANSFORM TECHNIQUES								
Course Code	AHS0	AHS011							
Programme	B.Tech	B.Tech							
	II	EEF	3						
Semester	III	AE	ECE						
	IV	ME	CE						
Course Type	Foundation								
Regulation	IARE	- R16							
			Theory		Practic	cal			
Course Structure	Lectu	ires	Tutorials	Credits	Laboratory	Credits			
	3		1	4	-	-			
Chief Coordinator	Ms. B Praveena, Assistant Professor								
Course Faculty	Dr. S Jagadha, Associate Professor Ms. V Subba Laxmi, Assistant Professor								

I. COURSE OVERVIEW:

The course focuses on more advanced engineering mathematics topics which provide with the relevant mathematical tools required in the analysis of problems in engineering and scientific professions. The course includes types of matrices, difference calculus methods and differential equations. The mathematical skills derived from this course form a necessary base to analytical and design concepts encountered in the program.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	Basic principles of integration

2000

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks		
Mathematical Transform Techniques	70 Marks	30 Marks	100		

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

~	Chalk & Talk	~	Quiz	~	Assignments	×	MOOCs			
~	LCD / PPT	~	Seminars	×	Mini Project		Videos			
×	Open Ended Experiments									

V. EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into five units and each unit carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each unit. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

The emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
50 %	To test the analytical skill of the concept OR to test the application skill of the concept.

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1:	Assessment	pattern	for	CIA
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Component		Total Marks			
Type of Assessment	CIE Exam	Quiz / AAT	i otai wiai ks		
CIA Marks	25	05	30		

Continuous Internal Examination (CIE):

Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz / Alternative Assessment Tool (AAT):

Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

	Proficiency assessed by	
PO 1 Engineering knowledge: Apply the knowledge of 3 Pres	resentation on	
mathematics, science, engineering fundamentals, and an	real-world	
engineering specialization to the solution of complex	problems	
engineering problems.		
PO 2 Problem analysis : Identify, formulate, review research 2	Seminar	
literature, and analyze complex engineering problems reaching		
substantiated conclusions using first principles of mathematics,		
natural sciences, and engineering sciences		
PO 4 Conduct investigations of complex problems: Use research- 2 Te	Term Paper	
based knowledge and research methods including design of		
experiments, analysis and interpretation of data, and synthesis		
of the information to provide valid conclusions.		

3 = High; **2** = Medium; **1** = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

	Program Specific Outcomes (PSOs)	Strength	Proficiency assessed by							
PSO 1	Professional Skills: To produce engineering professional	1	Seminar							
	capable of synthesizing and analyzing mechanical systems									
	including allied engineering streams									
PSO 2	Software Engineering Practices: An ability to adopt and	-	-							
	integrate current technologies in the design anmanufacturing									
	domain to enhance the employability.									
PSO 3	Successful Career and Entrepreneurship: To build the	-	-							
	nation, by imparting technological inputs and managerial skills									
	to become Technocrats									
	3 = High; $2 =$ Medium; $1 =$ Low									

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:								
Ι	Epress 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.							

AHS011.01 CLO 1 Ability to compute the Fourier series of the function with one variable. PO 1 3 AHS011.02 CLO 2 Understand the nature of the Fourier series that represent even and odd functions. PO 1 3 AHS011.03 CLO 3 Determine Half-range Fourier sine and PO 1 2 cosine expansions. CLO 4 Understand the concept of Fourier series to PO 2 1 AHS011.04 CLO 4 Understand the nature of the Fourier integral. PO 2 2 AHS011.05 CLO 6 Ability to compute the Fourier transforms of PO 2 2 2 AHS011.07 CLO 7 Evaluate finite and infinite Fourier transforms. PO 4 1 AHS011.08 CLO 8 Understand the concept of Fourier transforms. PO 2 3 AHS011.08 CLO 9 Solving Laplace transforms using integrals. PO 2 1 AHS011.00 CLO 10 Evaluate inverse of Laplace transforms by the PO 2 2 1 AHS011.11 CLO 12 Summarize the concept of Laplace transforms by the method of convolution. PO 1 3 AHS011.12 CLO 12 summarize the concept of Laplace transforms using integrals. PO 1 3	CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AHS011.02 CLO 2 Understand the nature of the Fourier series PO 1 3 AHS011.03 CLO 3 Determine Half- range Fourier sine and odd functions. PO 1 2 AHS011.04 CLO 4 Understand the concept of Fourier series to the real-world problems of signal processing PO 2 1 AHS011.05 CLO 5 Understand the nature of the Fourier integral. PO 2 2 AHS011.06 CLO 6 Ability to compute the Fourier transforms of PO 2 2 the function. AHS011.08 CLO 7 Evaluate finite and infinite Fourier transforms of the real-world problems of circuit analysis, control system design PO 2 3 AHS011.08 CLO 8 Understand the concept of Fourier transforms by the PO 2 1 AHS011.09 CLO 9 Solving Laplace transforms using integrals. PO 1 2 AHS011.10 CLO 10 Evaluate inverse of Laplace transforms by the PO 2 1 1 AHS011.12 CLO 11 Solving the linear differential equations using the PO 1 3 3 AHS011.12 CLO 12 summarize the concept of Laplace transforms by the PO 2 3 3 AHS011.12 CLO 12 Solving the linear differential	AHS011.01	CLO 1	Ability to compute the Fourier series of the	PO 1	3
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AHS011.21 CLO.21 Possess the knowledge and chills for PO.1	AHS011.20	CLO 20	Summarize the concept of partial differential	PO 1	3
electromagnetic and fluid dynamics	1115011.20		equations to the real-world problems of	PO 2	5
AHS011.21 CLO.21 Decrease the knowledge and skills for DO.1 2			electromagnetic and fluid dynamics		
TANDULLZI FULUZI POSSESS THE KNOWLEDGE AND SKILLS TOFT PUT T	AHS011.21	CLO 21	Possess the knowledge and skills for	PO 1	3
employability and to succeed in national and			employability and to succeed in national and		-
international level competitive examinations.			international level competitive examinations.		

IX. COURSE LEARNING OUTCOMES (CLOs):

3 = High; 2 = Medium; 1 = Low

X . MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

CLOs	Ds Program Outcomes (POs) Program Outcome						ram Sj comes (1	pecific PSOs)							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3												1		
CLO 2	3												1		
CLO 3	2												1		
CLO 4		1													
CLO 5		2													
CLO 6		2													
CLO 7				1											
CLO 8				3											
CLO 9		1											1		
CLO 10		2											1		
CLO 11	3														
CLO 12	3														
CLO 13	3														
CLO 14	3	2											1		
CLO 15		3													
CLO 16		2													
CLO 17	3	3											1		
CLO 18	3	3											1		
CLO 19	2	3											1		
CLO 20	3	2											1		
CLO 21	3														

3= **High**; **2** = **Medium**; **1** = **Low**

X1. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO 1, PO 2,	SEE Exams	PO 1, PO 2,	Assignments	PO 1, PO 2,	Seminars	PO 2
	PO 4		PO 4	0	PO 4		

Laboratory Practices	-	Student Viva	-	Mini Project	-	Certification	-
Term Paper	PO 4						

XII. ASSESSMENT METHODOLOGIES - INDIRECT

~	Early Semester Feedback	~	End Semester OBE Feedback
×	Assessment of Mini Projects by Experts		

XIII. SYLLABUS

UNIT-I FOURIER SERIES				
Definition of periodic function, determination of Fourier coefficients; Fourier expansion of periodic				
function in a given interval of length 2π ; Fourier series of even and odd functions; Fourier series in an				
arbitrary interval; Half- range Fourier sine and cosine expansions.				
UNIT-II FOURIER TRANSFORMS				
Fourier integral theorem, Fourier sine and cosine integrals; Fourier transforms; Fourier sine and cosine				
transform, properties, inverse transforms, finite Fourier transforms.				
UNIT-III LAPLACE TRANSFORMS				
Definition of Laplace transform, linearity property, piecewise continuous function, existence of Laplace				
transform, function of exponential order, first and second shifting theorems, change of scale property,				
Laplace transforms of derivatives and integrals, multiplied by t, divided by t, Laplace transform of				
periodic functions.				
Inverse Laplace transform: Definition of Inverse Laplace transform, linearity property, first and second				
shifting theorems, change of scale property, multiplied by s, divided by s; Convolution theorem and				
applications.				
UNIT-IV Z –TRANSFORMS				
Z-transforms: Elementary properties, inverse Z-transform, convolution theorem, formation and solution of				
difference equations.				
UNIT-V PARTIAL DIFFERENTIAL EQUATIONS AND APPLICATIONS				
Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions,				
solutions of first order linear equation by Lagrange method; Charpit's method; method of separation of				
variables; One dimensional heat and wave equations under initial and boundary conditions.				
TEXT BOOKS:				
1. Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons Publishers, 10 th Edition, 2010.				
2. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 43 rd Edition, 2015.				
REFERENCES:				
1. G. Shanker Rao, "Mathematical Methods", I. K. International Publications, 1 st Edition, 2009.				
2. G. Shanker Rao, "Engineering Mathematics-1", I. K. International Publications, 1 st Edition, 2009.				

XIV. COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1	Define periodic function	CLO 1	T1:22.5
2	Solve Fourier coefficients	CLO 2	T1:22.5 R1:2.4
3	Apply Fourier series for $(0, 2\pi)$	CLO 2	T1:22.6 R1:2.6
4-5	Determine even and odd function	CLO 4	T1:22.7 R1:4.4

6-7 Determine Fourier series in $(0,2l)$, $(-l,l)$ and also half range series CLC in $(0, l)$) 4 T1:22.7
$\lim_{t \to 0} (0, I)$	D1.410
	K1:4.10
8-9 Determine half range series in $(0, \pi)$ CLC) 7 T1:22.8 R1:4.15
10 Apply Fourier integral theorem to find integrals CLC	(1.4.13)
	R1:5.4
11 Apply Fourier sine and cosine integrals to find integrals CLC) 9 T1:22.9
	R1:5.8
12-13Define and apply Fourier transformsCLO	11 T1:23.10
	R1:6.8
14 Use properties to solve the given functions CLO	11 T1:23.10
15.16 Define and apply Inverse transforms	KI:6.13
13-10 Denne and apply inverse transforms CLO	R1.75
17 Define and apply Finite Fourier transforms CLO	11 T1:23.10
	R1:7.5
18 Define Laplace transform and its property CLC) 9 T1:23.10
	R1:8.1
19Define piecewise continuous functionCLO	14 T1:23.1
	R1:9.2
20 Define and apply shifting theorem, change of scale property CLO	14 T1:23.1
21 Calue derivatives and integrals multiplied but divided but	RI:9.4
21 Solve derivatives and integrals, multiplied by t, divided by t	R1.00
22-23 Define periodic functions CLO	14 T1:23.1
	R1:9.10
24-25 Solve Inverse Laplace transform CLO	14 T2:27.5
	R1:10.2
26 Define and apply shifting theorem, change of scale property CLO	17 T2:27.7
	R1:11.3
27 Solve multiplied by s, divided by s CLO	17 12:27.8 D1:11.6
28-30 Define and apply Convolution theorem	10 T2.27 12
28-50 Denne and appry convolution theorem CEO	R1.11 7
31-32 Define Z-transforms, Elementary properties CLO	19 T2:27.12
	R1:11.8
33-34 Define inverse Z-transform CLO	20 T2:27.12
	R1:11.9
35-36 Define and apply convolution theorem CLO	20 T2:27.12
	RI:11.10
57-58 Formulate partial differential equations	21 12:27.14 R1.12.3
39 Solve by lagrange's method CLO	12.3
	R1:12.7
40-41 Solve by Charpit's method CLO	23 T2:27.17
	R1:12.15
42 Apply method of separation of variables CLO	23 T2:18.2
	R1:13.1
43-45 Solve heat and wave equations CLO	T2:18.3-
	18.5 R1.13.2
	13.3

GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION XV. **REQUIREMENTS:**

S no	Description	Proposed Actions	Relevance with Pos	Relevance with Psos
1	Problem deduction, Initial and Boundary value problems	Seminars	PO 1	PSO 1
2	Fourier Integral Transforms, Convolution theorem in Fourier Transforms, Higher order difference equations	Seminars / NPTEL	PO 4	PSO 1
3	Encourage students to identify the type of transform involved in industry	NPTEL	PO 2	PSO 1

Prepared by: Ms B Praveena, Assistant Professor, FE

HOD,MECH