

	P.R. Government College (Autonomous) KAKINADA	Program & Semester II B.Sc. Major (III Sem) w.e.f 2023-24 admitted batch			
Course Code MAT- 303 T	TITLE OF THE COURSE Laplace Transforms & Problem Solving Sessions				
Teaching	Hours Allocated: 60 (Theory)	L	T	P	C
Pre-requisites:	Knowledge of Calculus, specifically integration and differentiation and an understanding of Complex numbers.	3	1	-	3

Course Objectives:

To formalise the study of numbers and functions and to investigate important concepts such as limits and continuity. These concepts underpin calculus and its applications.

Course Outcomes:

On Completion of the course, the students will be able to-	
C01	Understand the definition and properties of Laplace transformations.
C02	Get an idea about first and second shifting theorems and change of scale property.
C03	Understand Laplace transforms of standard functions like Bessel, Error function etc
C04	Know the reverse transformation of Laplace and properties.
C05	Get the knowledge of application of convolution theorem.

Course with focus on employability/entrepreneurship /Skill Development modules

Skill Development		Employability		Entrepreneurship	
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UNIT I

LAPLACE TRANSFORMS – I

Definition of Laplace Transform - Linearity Property - Piecewise Continuous Function - Existence of Laplace Transform - Functions of Exponential order and of Class A.

UNIT II:

LAPLACE TRANSFORMS – II

First Shifting Theorem, Second Shifting Theorem, Change of Scale Property, Laplace transform of the

derivative of $f(t)$, Initial value theorem and Final value theorem.

UNIT III:

LAPLACE TRANSFORM – III

Laplace Transform of Integrals - Multiplication by t , Multiplication by t^n - division by t -Laplace transform of Bessel Function - Laplace Transform of Error Function -Laplace transform of Sine and Cosine integrals

UNIT IV:

INVERSE LAPLACE TRANSFORMS – I

Definition of Inverse Laplace Transform - Linearity Property - First Shifting Theorem -Second Shifting Theorem - Change of Scale property - use of partial fractions - Examples.

UNIT V:

INVERSE LAPLACE TRANSFORMS – II

Inverse Laplace transforms of Derivatives - Inverse Laplace Transforms of Integrals -Multiplication by Powers of ' p ' - Division by powers of ' p ' - Convolution Definition -Convolution Theorem - proof and Applications - Heaviside's Expansion theorem and its Applications.

Co-Curricular Activities

Seminar/ Quiz/ Assignments/ Applications of Laplace Transforms to Real life Problem /Problem Solving Sessions.

TEXT BOOK

Laplace Transforms by A.R.Vasishtha, Dr.R.K.Gupta, KrishnaPrakashanMedia Pvt.Ltd., Meerut.

REFERENCE BOOKS:

1. Introduction to Applied Mathematics by Gilbert Strang, Cambridge Press
2. Laplace and Fourier transforms by Dr.J.K. Goyal and K.P. Gupta, PragathiPrakashan, Meerut.

CO-PO Mapping:

(1:Slight[Low]; 2:Moderate[Medium]; 3:Substantial[High], '-' :NoCorrelation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
C01	3	3	2	3	3	3	1	2	2	3	2	3	2
C02	3	2	3	3	2	3	3	1	3	3	3	2	1
C03	2	3	2	3	2	3	2	2	2	3	2	2	3
C04	3	2	3	2	2	1	3	3	1	1	3	1	2
C05	2	2	3	2	2	3	3	1	3	3	3	2	1

BLUE PRINT FOR QUESTION PAPER PATTERN
SEMESTER-III

Unit	TOPIC	S.A.Q	E.Q	Marks allotted to the Unit
I	LAPLACE TRANSFORMS – I	1	1	15
II	LAPLACE TRANSFORMS – II	2	2	30
III	LAPLACE TRNASFORM – III	2	1	20
IV	INVERSE LAPLACE TRANSFORMS – I	1	1	15
V	INVERSE LAPLACE TRANSFORMS – II	1	1	15
Total		7	6	95

S.A.Q. = Short answer questions (5 marks)

E.Q = Essay questions (10 marks)

Short answer questions : 4 X 5 = 20 M

Essay questions : 3 X 10 = 30 M

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Total Marks = 50 M

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Pithapur Rajah's Government College (Autonomous), Kakinada
II year B.Sc., Degree Examinations - III Semester
Mathematics Course VII: LAPLACE TRANSFORMS
Model Paper (w.e.f. 2024-25)

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Time: 2Hrs

Max. Marks: 50

SECTION-A

Answer any three questions selecting atleast one question from each part

Part – A

3 X 10 = 30

1. Essay question from unit - I.
2. Essay question from unit - II.
3. Essay question from unit - II.

Part – B

4. Essay question from unit - III.
5. Essay question from unit - IV.
6. Essay question from unit - V.

SECTION-B

Answer any four questions

4 X 5 M = 20 M

7. Short answer question from unit – I.
8. Short answer question from unit - II.
9. Short answer question from unit – II.
10. Short answer question from unit - III .
11. Short answer question from unit – III.
12. Short answer question from unit – IV.
13. Short answer question from unit - V

PITHAPUR RAJAH'S GOVERNMENT COLLEGE (A), KAKINADA
DEPARTMENT OF MATHEMATICS
Question Bank
PAPER-VII : LAPLACE TRANSFORMS

Short answers

Unit - I

1. Find the Laplace transform of $(t^2 + 1)^2$
1. Find the Laplace transform of $e^{2t} + 4t^3 - 2 \sin 3t + 3 \cos 3t$
2. Find $L\{7e^{2t} + 9e^{-2t} + 5 \cos t + 7t^3 + 5 \sin 3t + 2\}$
3. Find the $L\{F(t)\}$ where $F(t) = \begin{cases} e^{t-a}, & t > a \\ 0, & t < a \end{cases}$
4. Prove that the function $F(t) = t^2$ is of exponential order 3.

Unit - II

5. Find the Laplace transform of $e^{-t}(3 \sin 2t - 5 \cosh 2t)$.
6. Find $L\{(t + 3)^2 e^t\}$
7. Find $L\{(1 + te^{-t})^3\}$
8. Find the Laplace transform of $G(t)$, where $G(t) = \begin{cases} \cos(t - \frac{\pi}{3}), & t > \frac{\pi}{3} \\ 0, & t < \frac{\pi}{3} \end{cases}$
9. Find the Laplace transform of $e^{-3t}u(t - 2)$
10. State and prove Change of Scale property.
11. Apply change of scale property, if $L\{F(t)\} = \frac{p^2 - p - 1}{(2p + 1)^2(p - 1)}$.
12. If $L\{\sin \sqrt{t}\} = \frac{\sqrt{\pi}}{2p^2} e^{-\frac{1}{4p}}$, find $L\left\{\frac{\cos \sqrt{t}}{\sqrt{t}}\right\}$.

Unit – III

13. Find $L\left\{\int_0^t e^{-t} \cos t \, dt\right\}$
14. Find $L\int_0^t \int_0^t \cosh au \, du \, du$
15. Evaluate $L\{\sin at - at \cos at\}$
16. Find $L\{te^{3t} \sin 2t\}$
17. Find the Laplace transform of $\frac{e^{-at} - e^{-bt}}{t}$

18. Find the Laplace transform of $\frac{\sin at}{t}$

19. Show that $L\left\{\frac{\cosh at}{t}\right\}$ does not exist.

20. Prove that $L\{J_1(t)\} = 1 - \frac{p}{\sqrt{p^2+1}}$

Unit – IV

21. State and prove second shifting theorem

22. State and prove change of scale property.

23. Find $L^{-1}\left[\frac{3p-2}{p^2} - \frac{7}{3p+2}\right]$

24. Find $L^{-1}\left[\frac{1}{(p+1)(p-2)}\right]$

25. Prove that $L^{-1}\left[\frac{p^2}{(p+2)^3}\right] = e^{-2t}(1 - 4t + 2t^2)$

26. Find $L^{-1}\left[\frac{e^{-5p}}{(p-2)^4}\right]$

27. If $L^{-1}\left[\frac{p}{(p^2+1)^2}\right] = \frac{1}{2}t \sin t$, find $L^{-1}\left[\frac{8p}{(4p^2+1)^2}\right]$

Unit – V

28. Evaluate $L^{-1}\left[\frac{p}{(p^2+a^2)^2}\right]$

29. Find $L^{-1}\left[\frac{p}{(p^2-a^2)^2}\right]$

30. Find $L^{-1}\left[\frac{p}{p^2-a^2}\right]$

31. Find $L^{-1}\left[\frac{1}{p} \log\left(\frac{p+2}{p+1}\right)\right]$

32. Find the inverse Laplace transform of $\frac{1}{p^3(p^2+1)}$

Essay Question

Unit - I

1. Find the Laplace transform of $F(t) = |t-1| + |t+1|$, $t \geq 0$.

2. Find the Laplace Transform of $(\sin t - \cos t)^3$.

3. Obtain the Laplace transform the function $F(t) = \begin{cases} (t-1)^2, & t > 1 \\ 0, & 0 < t < 1 \end{cases}$

4. Find the Laplace Transform of $F(t) = \begin{cases} 0, & t > \pi \\ \sin t, & 0 < t < \pi \end{cases}$

5. Using the expansion $\sin x = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} + \dots$, show that $L\{\sin\sqrt{t}\} = \frac{\sqrt{\pi}}{2p^{\frac{3}{2}}} e^{-\frac{1}{4p}}$

Unit - II

6. State and prove First Shifting theorem.
 7. State and prove Second Shifting theorem.
 8. Find $L\{\sinh at \cos at\}$
 9. Prove that $L\{F^{(n)}(t)\} = p^n f(p) - p^{n-1}F(0) - p^{n-2}F'(0) - \dots - F^{(n-1)}(0)$.
 10. State and prove Initial Value theorem.
 11. State and prove Final value theorem.
 12. Show that (i) $L\{t \sin at\} = \frac{2ap}{(p^2+a^2)^2}$ and (ii) $L\{t \cos at\} = \frac{p^2-a^2}{(p^2+a^2)^2}$
 13. If $L\{t \sin at\} = \frac{2ap}{(p^2+a^2)^2}$, then prove that $L\{\sin at + at \cos at\} = \frac{2ap}{(p^2+a^2)^2}$

Unit – III

14. Find $L\{(t^2 - 3t + 2) \sin 3t\}$
 15. Find $L\left\{\frac{\cos 2t - \cos 3t}{t}\right\}$.
 16. Using Laplace transform, evaluate $\int_0^\infty \frac{\cos at - \cos bt}{t} dt$
 17. Find $L(\operatorname{erf}(\sqrt{t}))$ and hence prove that $L(t \operatorname{erf}(2\sqrt{t})) = \frac{3p+8}{p^2(p+4)^{\frac{3}{2}}}$
 18. Prove that $L\{J_0(t)\} = \frac{1}{\sqrt{p^2+1}}$
 19. Find the Laplace transform of $S_i(t)$.
 20. Find the Laplace transform of $C_i(t)$.

Unit – IV

21. Find $L^{-1}\left[\frac{3}{p^2-3} - \frac{3p+2}{p^3} - \frac{3p-27}{p^2+9} + \frac{6-30\sqrt{p}}{p^4}\right]$
 22. Find $L^{-1}\left[\frac{3p+1}{(p-1)(p^2+1)}\right]$
 23. Find the inverse Laplace transform of $\left[\frac{4p+5}{(p-1)^2(p+2)}\right]$
 24. Find $L^{-1}\left[\frac{e^{-\pi p}(p+1)}{p^2+p+1}\right]$
 25. For $a > 0$, prove that $L^{-1}\{f(p)\} = F(t)$ implies that $L^{-1}[f(ap+b)] = \frac{1}{a} e^{-\frac{bt}{a}} F\left(\frac{t}{a}\right)$

Unit - V

26. Find $L^{-1} \left[\frac{p-3}{p^2+4p+13} \right]$

27. Using Convolution theorem, find $L^{-1} \left[\frac{p}{(p^2+a^2)^2} \right]$

28. Apply Convolution theorem to find $L^{-1} \left[\frac{p+1}{(p^2+2p+2)^2} \right]$

29. Apply Heaviside's expansion formula to find $L^{-1} \left[\frac{6p^2+22p+18}{p^3+6p^2+11p+6} \right]$

30. Using Heaviside's expansion formula, find $L^{-1} \left[\frac{3p+1}{(p-1)(p^2+1)} \right]$

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Teaching	HoursAllocated:30(Practical)	L	T	P	C
Pre-requisites:	Knowledge of Calculus, specifically integration and differentiation and an understanding of Complex numbers.	-	-	2	1

UNIT I

LAPLACE TRANSFORMS – I

Definition of Laplace Transform - Linearity Property - Piecewise Continuous Function - Existence of Laplace Transform - Functions of Exponential order and of Class A.

UNIT II:

LAPLACE TRANSFORMS – II

First Shifting Theorem, Second Shifting Theorem, Change of Scale Property, Laplace transform of the derivative of $f(t)$, Initial value theorem and Final value theorem.

UNIT III:

LAPLACE TRNASFORM – III

Laplace Transform of Integrals - Multiplication by t , Multiplication by t^n - division by t -Laplace transform of Bessel Function - Laplace Transform of Error Function – Laplace transform of Sine and Cosine integrals.

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INVERSE LAPLACE TRANSFORMS – I

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Semester – III End Practical Examinations**Scheme of Valuation for Practical's**

Time : 2 Hours

Max. Marks : 50

- **Record - 10 Marks**
- **Viva voce - 10 Marks**
- **Test - 30 Marks**
- **Answer any 5 questions. At least 2 questions from each section. Each question carries 6 marks.**

BLUE PRINT FOR PRACTICAL PAPER PATTERN**COURSE-VII - LAPLACE TRANSFORMS**

Unit	TOPIC	E.Q	Marks allotted to the Unit
I	LAPLACE TRANSFORMS – I	2	06
II	LAPLACE TRANSFORMS – II	2	12
III	LAPLACE TRANSFORM – III	1	12
IV	INVERSE LAPLACE TRANSFORMS – I	2	06
V	INVERSE LAPLACE TRANSFORMS – II	1	12
	Total	08	48

PITHAPUR GOVERNMENT COLLEGE (AUTONOMOUS), KAKINADA

II year B.Sc., Degree Examinations - III Semester

Mathematics Course-VII: LAPLACE TRANSFORMS

(w.e.f. 2023-24 Admitted Batch)

Practical Model Paper (w.e.f. 2024-2025)

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Time: 2Hrs

Max. Marks: 50M

Answer any 5 questions. At least 2 questions from each section.

5 x 6 = 30 Marks

SECTION - A

6. Unit - I.
2. Unit – I.
3. Unit - II.
4. Unit – II.

SECTION – B

5. Unit - III.
6. Unit - IV.
7. Unit - IV.
8. Unit - V.

- **Record** - 10 Marks
- **Viva voce** - 10 Marks