LAPLACE TRANSFORMS, NUMERICAL METHODS & COMPLEX VARIABLES

Subject Code : MA401BS
Regulations : R18 - JNTUH
Class : II Year B.Tech EEE II Semester

Department of Electrical and Electronics and Engineering

BHARAT INSTITUTE OF ENGINEERING AND TECHNOLOGY

Ibrahimpatnam - 501 510, Hyderabad

LAPLACE TRANSFORMS, NUMERICAL METHODS & COMPLEX VARIABLES (MA401BS)
COURSE PLANNER

I. COURSE OVERVIEW:

The students will improve their ability to think critically, to analyze a real problem and solve it using a wide array of mathematical tools. They will also be able to apply these ideas to a wide range of problems that include the Engineering applications.

II. PREREQUISITE:

Mathematical Knowledge at pre-university level.

III. COURSE OBJECTIVE:

To learnConcept, properties of Laplace transforms

- Solving ordinary differential equations using Laplace transforms techniques.
- Various methods to the find roots of an equation.
- Concept of finite differences and to estimate the value for the given data using interpolation.
- Evaluation of integrals using numerical techniques
- Solving ordinary differential equations using numerical techniques.
- Differentiation and integration of complex valued functions.
- Evaluation of integrals using Cauchy's integral formula and Cauchy's residue theorem.
- Expansion of complex functions using Taylor's and Laurent's series.

IV.COURSE OUTCOMES:

After learning the contents of this paper the student must be able to

S. No	Description	Bloom's Taxonomy Level
1.	Use the Laplace transforms techniques for solving ODE's	Understand, Apply (Level 2, Level 3)
2.	Find the root of a given equation. Estimate the value for the given data using interpolation	Understand, Apply (Level 2, Level 3)
3.	Find the numerical solutions for a given ODE's	Apply, Create (Level 4, Level 6)
4.	Analyze the complex function with reference to their analyticity, integration using Cauchy's Integral and residue theorems.	Analyze, Apply (Level 4, Level 3)
5.	Taylor's and Laurent's series expansions of complex Function	Understand, Apply (Level 2, Level 3)

V. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes		Level	Proficiency Assessed by
PO1	**Engineering knowledge**: To Apply the knowledge of mathematics, science, engineering fundamentals and ELECTRICAL AND ELECTRONICS ENGINEERINGto the solution of complex engineering problems encountered in modern engineering practice.	**3**	Assignments and Tutorials.

PO2	**Problem analysis**: Ability to Identify, formulate, review research literature, and analyze complex engineering problems related to ELECTRICAL AND ELECTRONICS ENGINEERINGreaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	**3**	Assignments, Tutorials and Exams.
PO3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	**3**	Assignments, Tutorials and Exams.
PO4:	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	**2**	Assignments, Tutorials and Mock Exams.
PO5:	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern ELECTRICAL AND ELECTRONICS ENGINEERINGand IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.	-	--
PO6:	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the ELECTRICAL AND ELECTRONICS ENGINEERINGprofessional engineering practice.	-	--
PO7:	**Environment and sustainability**: Understand the impact of ELECTRICAL AND ELECTRONICS ENGINEERINGprofessional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	-	--
PO8:	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms ofthe engineering practice.	-	--
PO9:	**Individual and team work**: Function effectively as an individual, and as a member or leader indiverse teams, and in multidisciplinary settings.	-	--
PO10:	**Communication**: Communicate effectively on complex engineering activities with the engineeringcommunity and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	-	--
PO11:	**Project management and finance**: Demonstrate knowledge and understanding of theengineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	-	--

PO12:	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage inindependent and life-long learning in the broadest context of technological change.	1	Oral Tests

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)** **4: None**

VI. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes		**Level**	**Proficiency assessed by**
PSO1	**Professional Skills:** The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, multimedia, web design, big data analytics, and networking for efficient design of computer-based systems of varying complexitythem effectively to the concerned.	**2**	Assignments, Tutorials and Exams.
PSO2	**Problem-Solving Skills:** The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver a quality product for business successthe mercurial needs of the industry and society at large.	**1**	Assignments, Tutorials and Mock Exams.
PSO3	**Successful Career and Entrepreneurship:** The ability to employ modern computer languages, environments, and platforms in creating innovative career paths to be an entrepreneur, and a zest for higher studies of programme and developing ideas towards research.	**-**	--

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)** **4:None**

VII. SYLLABUS:

UNIT - I

Laplace Transforms **10 L**

Laplace Transforms; Laplace Transform of standard functions; first shifting theorem; Laplace Transforms of functions when they are multiplied and divided by‘t’. Laplace transforms of derivatives and integrals of function; Evaluation of integrals by Laplace transforms; Laplace transforms of Special functions; Laplace transform of periodic functions. Inverse Laplace transform by different methods, convolution theorem (without Proof), solving ODEs
by Laplace Transform method.

UNIT - II

Numerical Methods – I **10 L**

Solution of polynomial and transcendental equations – Bisection method, Iteration Method, Newton- Raphson method and Regula-Falsi method. Finite differences- forward differences- backward differences-central differences-symbolic relations and separation of symbols; Interpolation using Newton’s forward and backward difference formulae. Central difference interpolation: Gauss’s forward and backward formulae; Lagrange’s method of interpolation

UNIT - III

Numerical Methods – II **08 L**

Numerical integration: Trapezoidal rule and Simpson’s 1/3rd and 3/8 rules.
Ordinary differential equations: Taylor’s series; Picard’s method; Euler and modified Euler’s methods; Runge-Kutta method of fourth order.

UNIT - IV

Complex Variables (Differentiation) **10 L**

Limit, Continuity and Differentiation of Complex functions. Cauchy-Riemann equations (without proof), Milne-Thomson methods, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties.

UNIT - V

Complex Variables (Integration) **10 L**

Line integrals, Cauchy's theorem, Cauchy's Integral formula, Liouville's theorem, Maximum-Modulus theorem (All theorems without proof); zeros of analytic functions, singularities, Taylor's series, Laurent's series; Residues, Cauchy Residue theorem (without proof)

TEXT BOOKS:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
2. S.S. Sastry, Introductory methods of numerical analysis, PHI, 4th Edition, 2005.
3. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Ed., Mc-Graw Hill, 2004.

REFERENCE BOOKS:

1. M. K. Jain, SRK Iyengar, R.K. Jain, Numerical methods for Scientific and Engineering Computations , New Age International publishers.
2. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons 2006.

GATE SYLLABUS:

Complex Analysis: Analytic functions, Cauchy's integral theorem, Cauchy's integral formula; Taylor's and Laurent's series, residue theorem.

Numerical Methods: Solution of nonlinear equations, single and multi-step methods for differential equations, convergence criteria.

VIII. LESSON PLAN-COURSE SCHEDULE:

LESSON PLAN ACADEMIC YEAR 2020-2021 II SEM									
Course Instructor : Dr. P. Rahira **Class: EEE**									
Subject: **WEF :**									
Lecture No.	**Unit No.**	**Date**	**Topics to be covered**	**Link for PPT**	**Link for PDF**	**Link for Small Projects/ Numericals (if any)**	**Course learning outcomes**	**Teaching Methodology**	**Reference**
1	**1**		Introduction	https://drive.google.com/file/d/1xvmo1lqSt_lipFC2EwUNQMimC2phTmci/view?usp=sharing	https://drive.google.com/file/d/1zV7aw1TAPluhWRFIp9kssHqURUEjz0OT/view?usp=sharing	**NA**	Find the root of a given equation by Bisection Method	ICT , Chalk & Talk	**T1,T2 &R1**
2			Solution of polynomial and transcendental equations ,Bisection Method			**NA**		ICT , Chalk & Talk	**T1,T2 &R1**

3			Iteration Method	https://drive.google.com/file/d/1lBn4NswVj0SIxwM-V6gyrP34vuaYTxLM/view?usp=sharing	https://drive.google.com/file/d/1ItKy5ZEUFxfhNeUsrBVsx7LGT-Yq8qp/view?usp=sharing	**NA**	Find the root of a given equation by Iterative Method Method	ICT , Chalk & Talk	**T1,T2 &R1**
4			Newton-Raphson method	https://drive.google.com/file/d/1MCR9e9QyipX0e-gRvZxqP7XNZcPdZr0v/view?usp=sharing	https://drive.google.com/file/d/1frGUJw3CpRaHlBq7P0F_q_bwuLNa5iUH/view?usp=sharing	**NA**	Find the root of a given equation by Newton Raphson Method Method Method	ICT , Chalk & Talk	**T1,T2 &R1**
5			Regula-Falsi method	https://drive.google.com/file/d/1Z3EbHvYUFadgG9FCy6CaMFWQ7HUbHczs/view?usp=sharing	https://drive.google.com/file/d/19EXNQjbw18oHWCg-Yvjfrgtkma8dawOI/view?usp=sharing	**NA**	Find the root of a given equation by Iterative Method Method	ICT , Chalk & Talk	**T1,T2 &R1**
6			forward, Backward, Central differences	https://drive.google.com/file/d/1yFN7gstsWfGztMyHwNz2bQ0pq71DHsiA/view?usp=sharing	https://drive.google.com/file/d/1mS9m1QktrhIpt2u4ooJHtoRj07NN_a1c/view?usp=sharing	**NA**	Estimate the value for the given data using interpolation	ICT , Chalk & Talk	**T1,T2 &R1**
7			symbolic relations and separation of symbols	https://drive.google.com/file/d/1kpCaVB6lpsYX0CuO9W8DlQerDOGSVhIi/view?usp=sharing	https://drive.google.com/file/d/1EGSxfn9s2jMqzs2tEbwc1TDG6AYi8xzU/view?usp=sharing	**NA**	Undestand the Symbolic Relations	ICT , Chalk & Talk	**T1,T2 &R1**
8			Interpolation using Newton's forward and backward difference formulae	https://drive.google.com/file/d/11vdaJ8sIR8ZyKa1AXE6GpDaRSeSp6ShC/view?usp=sharing	https://drive.google.com/file/d/1-yzN5AA1ayp80Q7O7I8S2Z0m7er3ZR5C/view?usp=sharing	**NA**	Estimate the value for the given data using interpolation	ICT , Chalk & Talk	**T1,T2 &R1**
9			Central difference interpolation: Gauss's forward and backward formulae	https://drive.google.com/file/d/1KTroi-tQogC8LctpHwHZI_6EyJCUttqA/view?usp=sharing	https://drive.google.com/file/d/1_tNrs6qeHR-B9ICAKQ8Tklb0ZTH3pWc0/view?usp=sharing	**NA**	Estimate the value for the given data using interpolation	ICT , Chalk & Talk	**T1,T2 &R1**
10			Lagrange's method of interpolation	https://drive.google.com/file/d/11-GZ7ViF70mZOu2-FST1OVFSXkCL17zp/view?usp	https://drive.google.com/file/d/1f4PyTeOZq5lPdKPFOgAFimfYW8KxyPva/view?usp=sharing	**NA**	Estimate the value fo runequally spaced values the given data using	ICT , Chalk & Talk	**T1,T2 &R1**

				=sharing			interpolation		
11			Solving Problems , Mocktest - I			**NA**	Estimate the value fo runequally spaced values the given data using interpolation	ICT , Chalk & Talk	**T1,T2 &R1**
12			Numerical integration, Trepizoidal rule	https://drive.google.com/file/d/1r6oDZxSimV34EkZ51R8tqn_Kv4SPXYaa/view?usp=sharing	https://drive.google.com/file/d/1CcLlFs_D1-k1av1EiPIk5ajYXuzpwiNN/view?usp=sharing	**NA**	Understand to find Integration by using Numerical Technics	ICT , Chalk & Talk	**T1,T2 &R1**
13			Simpson's 1/3rd and 3/8 rules	https://drive.google.com/file/d/14CKxkf9hdxFiNThlaUI5GZwfsCDnZAWZ/view?usp=sharing	https://drive.google.com/file/d/1DR7ScumijGTairdn9CwbDe1iaItVF84v/view?usp=sharing	**NA**	Understand to find Integration by using Numerical Technics	ICT , Chalk & Talk	**T1,T2 &R1**
14			Simpson's 1/3rd and 3/8 rules			**NA**	Understand to find Integration by using Numerical Technics	ICT , Chalk & Talk	**T1,T2 &R1**
15	**2**		Taylor's series	https://drive.google.com/file/d/14ZdwAFeaSLZ09FzOQ-Ii1cxNjFnzuV0V/view?usp=sharing	https://drive.google.com/file/d/1DR7ScumijGTairdn9CwbDe1iaItVF84v/view?usp=sharing	**NA**	Find the numerical solutions for a given ODE's	ICT , Chalk & Talk	**T1,T2 &R1**
16			Picard's method			**NA**	Find the numerical solutions for a given ODE's	ICT , Chalk & Talk	**T1,T2 &R1**
17			Euler Method	https://drive.google.com/file/d/1l2bKkb1ZidvSDm28PnBZ0Zs4W_Mj_h6Z/view?usp=sharing	https://drive.google.com/file/d/1PbUl87o5x8HR87GZms56Ip7g_jSsdm1-/view?usp=sharing	**NA**	Find the numerical solutions for a given ODE's	ICT , Chalk & Talk	**T1,T2 &R1**
18			Modified Euler's Methods		https://drive.google.com/file/d/1XPy314REUdjQ9a87G4j8ObvZb5tzvjT-/view?usp=sharing	**NA**	Find the numerical solutions for a given ODE's	ICT , Chalk & Talk	**T1,T2 &R1**

19			Rungekutta method	https://drive.google.com/file/d/18XRyjWJrtqzfox18qngKuSxhOYIOkV0K/view?usp=sharing	https://drive.google.com/file/d/1YBOQGN0QwhshVIwxPgIpYl4PqLye0naJ/view?usp=sharing	**NA**	Find the numerical solutions for a given ODE's	ICT , Chalk & Talk	**T1,T2 &R1**
20			Problems			**NA**	Find the numerical solutions for a given ODE's	ICT , Chalk & Talk	**T1,T2 &R1**
21	**3**		Laplace Transform of standard functions	https://drive.google.com/file/d/1kwSllAOtWRqhCXLG0UDsg-ZDEyY_TFez/view?usp=sharing	https://drive.google.com/file/d/1qYB8k20oNEaANIuD9h3OZ163a-RV-bhV/view?usp=sharing	**NA**	Understand the basics of Laplace Transform	ICT , Chalk & Talk	**T1,T2 &R2**
22			Properties of L.T			**NA**	Understand the properties of LT	ICT , Chalk & Talk	**T1,T2 &R2**
23			Special functions	https://drive.google.com/file/d/1bLz4a0WgKEmet47ngYggzBBvBkrKn46l/view?usp=sharing	https://drive.google.com/file/d/15AgVjtzkTm6YBF5mt7uLo0SoOruuCCST/view?usp=sharing	**NA**	Find the solution for Special Functions	ICT , Chalk & Talk	**T1,T2 &R2**
24			Inverse Laplace transform by different methods	https://drive.google.com/file/d/1xjWTboIIdrqWWWUqhPnryhQyD02CFJuw/view?usp=sharing	https://drive.google.com/file/d/1h-0qL37t_jRjo2NiS98dj9-OPnTjHWTz/view?usp=sharing	**NA**	Understand the Inverse f Laplace Transform	ICT , Chalk & Talk	**T1,T2 &R2**
25			Convolution Theorem	https://drive.google.com/file/d/11nAmnQvWjAhpsH2lbwbbHUIq1836cQS8/view?usp=sharing	https://drive.google.com/file/d/1Uaass1EfsMRiElhBL0sYTODPhM009o-5/view?usp=sharing	**NA**	Apply the Convolution Theorem	ICT , Chalk & Talk	**T1,T2 &R2**
26			Problems			**NA**	Apply the Convolution Theorem	ICT , Chalk & Talk	**T1,T2 &R2**
27			Applications to ODE	https://drive.google.com/file/d/1GEsRwTpJ4xmUK8y2_m4z9nH00rpU4ZjT/view?usp=sharing	https://drive.google.com/file/d/1C9sZcvy7c9TnfTLEV0BsTbPC5P9Yoelu/view?usp=sharing	**NA**	Use the Laplace transforms techniques for solving ODE's	ICT , Chalk & Talk	**T1,T2 &R2**
28			Problems			**NA**	Use the Laplace transforms techniques for solving ODE's	ICT , Chalk & Talk	**T1,T2 &R2**
29			Limit, Continuity and Differentiation of	https://drive.google.com/file/d/1fQ8ycOoA4nKVVK7E_Fj7asQf_p8QCRdT/view?	https://drive.google.com/file/d/1QxxEqaKiEYVM_DT-Nl8vQZqBLIOl	**NA**	Analyze the complex function	ICT , Chalk & Talk	**T1,T3 &R2**

			Complex functions	usp=sharing	gM57/view?usp=sharing				
I Mid Examinations									
30	**4**		Cauchy-Riemann equations	https://drive.google.com/file/d/1nqK2Noxg8S0Vmt67CWq9hds-30k9kgZQ/view?usp=sharing	https://drive.google.com/file/d/1dxPVBlD0tOED-IWbZwIwaiugaY-U5m19/view?usp=sharing	**NA**	Find the Analyticity of Complex Function	ICT , Chalk & Talk	**T1,T3 &R2**
31			Cauchy-Riemann equations			**NA**	Find the Analyticity of Complex Function	ICT , Chalk & Talk	**T1,T3 &R2**
32			analytic functions, harmonic functions	https://drive.google.com/file/d/1nqK2Noxg8S0Vmt67CWq9hds-30k9kgZQ/view?usp=sharing	https://drive.google.com/file/d/1cgW4nCTE2DESDcxGUrFPVFZROHaOsYHv/view?usp=sharing	**NA**	Analyse the Harmonic Functions	ICT , Chalk & Talk	**T1,T3 &R2**
33			finding harmonic conjugate			**NA**	Finding the Harmonic Conjugate	ICT , Chalk & Talk	**T1,T3 &R2**
34			elementary analytic functions and their properties.	https://drive.google.com/file/d/1lLy0b-3TvS68xh0ISf4BkHcJ9zi8IgNT/view?usp=sharing	https://drive.google.com/file/d/1poM4XaA0L4JgYYIwk2CVOI5njkA17AI4/view?usp=sharing	**NA**	Undestand the elementary functions	ICT , Chalk & Talk	**T1,T3 &R2**
35			Milne-Thomson methods	https://drive.google.com/file/d/1mTRacYrkz9mRVsfbHHD10kX4nO5FWxDN/view?usp=sharing	https://drive.google.com/file/d/19jWc-uR6v2-rQQ6ZlCgBP5ECTmZ3VCdx/view?usp=sharing	**NA**	Applying Milne thomson Method	ICT , Chalk & Talk	**T1,T3 &R2**
36			Solving Problems	https://drive.google.com/file/d/1mTRacYrkz9mRVsfbHHD10kX4nO5FWxDN/view?usp=sharing		**NA**	Applying Milne thomson Method	ICT , Chalk & Talk	**T1,T3 &R2**
37	**5**		Line integrals	https://drive.google.com/file/d/14TYNfHUghJv5-11dY7HbcYkQ_LkJ0pJ4/view?usp=sharing	https://drive.google.com/file/d/1tFRHChAL2QRQxVrmsb6saRuKPnmvrVlR/view?usp=sharing	**NA**	Find the Line Integral for complex function	ICT , Chalk & Talk	**T1,T3 &R2**
38			Cauchy's theorem,Cauchys Integral Theorem	https://drive.google.com/file/d/1RZpvGlTQa3IRjsq0JyRSUkXszeaVlzO6/view?usp=sharing	https://drive.google.com/file/d/1_LxdL8PCIb68vCTFIMMz9CQzrDwO-t4z/view?usp=sharing	**NA**	Find the comlex integration	ICT , Chalk & Talk	**T1,T3 &R2**
39			Liouville's theorem, Maximum	https://drive.google.com/file/d/1y-Zoejdu70xUqDIo	https://drive.google.com/file/d/1QHlfscWWgPJ	**NA**	Find the comlex integration	ICT , Chalk & Talk	**T1,T3 &R2**

			Modulus Principle	QTFlEirx3en2w2p5/view?usp=sharing	YyhkXJdcHIqOEGpTp_5Qv/view?usp=sharing				
40			zeros of analytic functions	https://drive.google.com/file/d/1NOJlxyVoar1LroE_iP9jOpggCkjtRLKD/view?usp=sharing	https://drive.google.com/file/d/1Noq7kCWcAIMhSXmYHCKyuF9oJg_3irUY/view?usp=sharing	**NA**	finding the singular points	ICT , Chalk & Talk	**T1,T3 &R2**
41			Laurent's series , Taylers Series, Residue Theorem	https://drive.google.com/file/d/1U5zp0GSzaxtDPed_KPGXzsXTIcbEJG29/view?usp=sharing	https://drive.google.com/file/d/1cdc37Cs6dlRHr3BmgO62lxpqR59FL5mH/view?usp=sharing	**NA**	Taylor's and Laurent's series expansions of complex Function	ICT , Chalk & Talk	**T1,T3 &R2**
42			Problems	https://drive.google.com/file/d/1i8F8amNZaowbK8Nyt_NcEhonf6tr9OyJ/view?usp=sharing	https://drive.google.com/file/d/1ZYTSzz5bNctxysnRlS_nSYCviEdDWxeo/view?usp=sharing	**NA**	Taylor's and Laurent's series expansions of complex Function	ICT , Chalk & Talk	**T1,T3 &R2**
II Mid Examinations									

*** Topics beyond Syllabus**

1. Conformal Mapping

TEXT BOOKS:

. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010
2. S.S. Sastry, Introductory methods of numerical analysis, PHI, 4th Edition, 2005.
3. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Ed., Mc-Graw Hill, 2004

FACULTY SIGN **ACADEMIC I/C**

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

Course Outcomes	Program Outcomes (PO)												Program Specific Outcomes (PSO)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO3
I	3	2	2	2	-	-	-	-	-	-	-	1	2	1	-
II	3	2	2	2	-	-	-	-	-	-	-	1	2	1	-
III	2	2	2	1	-	-	-	-	-	-	-	1	1	1	-
IV	2	3	2	2	-	-	-	-	-	-	-	1	2	1	-
V	2	2	2	2	-	-	-	-	-	-	-	1	2	1	-
AVG	2.4	2.2	2	1.8								1	1.8	1.0	-

1: Slight(Low) **2: Moderate (Medium)** **3: Substantial(High)** **4 : None**

QUESTION BANK: (JNTUH)

UNIT - 1

S.No	Question	Blooms taxonomy level	Course outcome
1	If L(f(t)) = F(s), then show that L(f(at)) =1/a *F (S/a)	Understand	1
2	Find the Laplace transform of $te^{-t}sint$.	Understand	1
3	Write a function for which Laplace transformation doesnot exist. Explain why Laplace transform does not exist.	Apply	1
4	State the final value theorem for Laplace transforms.	Apply	1
5	Verify the initial value theorem for f(t) = 5 + 4cos2t.	Apply	1
6	Find the Laplace transform of t coshat.	Apply	1
7	Solve the differential equation, using Laplace transform y"+5y'+6y=2 given that y(0)=0 and y'(0)=0.	Understand	1
8	Using Laplace transform solve y"+2y'-3y=3 given that y(0)=4 and y'(0)= -7	Apply	1
9	Find L(tsin2t).	Apply	1
10	state the condition for the existence of Laplace Transfrom of f(t).	Apply	1

UNIT II

S.No	Question	Blooms taxonomy level	Course outcome
1	State Newton's forward difference formula for equal intervals.	Apply	2
2	Find the divided differences of f(x) = x3 − x2 + 3x + 8for the arguments 0,1,4,5.	Evaluate	2
3	Construct a table of divided difference for the given data: X: 54, 58, 59, 61 y: 2.81, 2.82, 2.81, 2.82	Apply	2
4	Write down the Newton's forward difference interpolation formula for equal intervals	Evaluate	2
5	State Newton's forward formula and Backward formula.	Understand	2
6	Construct the divided difference table for the data (0, 1), (1, 4) , (3, 40) and (4, 85).	Understand	2
7	Given y0 = 3, y1 = 12, y2 = 81, y3 = 200, y4 = 100. Find $\Delta^4 y_0$.	Apply	2
8	Define Δ, ∇, E.	Understand	2
9	What are the n^{th} divided differences of a polynomial of the n^{th} degree?	Apply	2
10	Using divided differences, show that f(x, x) = f'(x) through the limiting process.	Apply	2

UNIT III

S.No	Question	Blooms taxonomy level	Course outcome
1	State Trapezoidal rule to evaluate a double integral.	Apply	3
2	State Simpson's 1/3 rule to evaluate a double integral.	Apply	3
3	what is the order of truncation error in Taylor's series method of nth order?	Apply	3
4	Compare Taylor series and Runge-Kutta methods.	Apply	3
5	What do we mean by single step methods and multistep methods?	Apply	3
6	Why the predictor-corrector methods are called so?	Apply	3
7	Compare Runge-Kutta method and predictor corrector methods	Apply	3

8	Write down the Milne's predictor-corrector formula	Apply	3
9	State Simpson's 1/3 rule to evaluate a double integral.	Apply	3
10	State Simpson's 1/3 and 3/8 formulas for numerical integration.	Apply	3

UNIT IV

S.No	Question	Blooms taxonomy level	Course outcome
1	If w = log z, find $\frac{dw}{dz}$ and determine where w is not-analytic.	Understand	4
2	Every analytic function f(z) = u+iv defines two families of curves u(x,y) =k_1 and v(x,y) = k_2 forming an Orthogonal system.	Understand	4
3	Evaluate $\int(z^2+3z)dz$ along the straight line from (2,0) to (2,2) and then from (2,2) to (0,2).	Evaluate	4
4	Find the analytic function of $f(z)=u+iv$ *if* $u-v=e^x(\cos y-\sin y)$	Apply	4
5	S.T $u\,(x,y) = e^{2x}\,(x\cos 2y - y\sin 2y)$ is Harmonic and find its Harmonic conjugate	Apply	4
6	Show that the both Real and Imaginary parts of an Analytic function are Harmonic.	Apply	4
7	Derive the polar form of Cauchy Riemann equation	Evaluate	4
8	Given $u\,(x,y) = e^{2x}(x\cos 2y - y\sin 2y)$, find its Analytic Function	Apply	4
9	Find the analytic function $f(z) = u+iv$ if $u-v = e^x$ $(\cos y - \sin y)$ find f(z) in terms of z.	Apply	4
10	Show that f(x,y) = |xy| is analytic except at origin.	Apply	4

UNIT V

S.No	Question	Blooms taxonomy level	Course outcome
1	Expand $f(z) = \int \frac{1}{z^2-3z+2}$ in the region $1<\|z\|<2$ by Laurent's series.	Apply	5
2	Verify Cauchy's theorem, for $\int Z^3dz$,taken over the boundary of the rectangle with vertices -1, 1, (1+i), (-1+i)	Apply	5
3	Expand *sinhz* by Taylor's series about $z=\pi i$	Apply	5
4	Evaluate $\oint\frac{4z-3}{z(z-1)(z-2)}dz$, where C is the circle $\|Z\|=\frac{3}{2}$using Residue Theorem	Apply	5
5	$\int_C\frac{e^{2z}}{(z-1)(z-2)}dz$, *where c is the circle* $\|z\|=3$ by Cauchy residue theorem	Apply	5
6	Verify Cauchy's theorem for the function$f\,(z) = 3z^2 + iz - 4$ if C is the square with vertices (1 + i) (1 – i) (-1 + i) (-1- i)	Apply	5
7	Determine the poles of the function $\frac{z^2}{(z-1)^2(z+2)}$ and the Residues at each pole.	Apply	5
8	Find the fixed points of the transformation	Apply	5

	(i) W= $\frac{6z-9}{z}$ (ii) W = $\frac{z-i}{z+i}$		
9	Find the Mobius transformation that maps the point (-1,0,1) into the points (0,i,3i)	Apply	5
10	Find the Bilinear transformations which maps (0,1,∞) to (- 1, - 2, -I)	Apply	5

OBJECTIVE QUESTIONS:

UNIT I

1. Find the inverse laplace transform of $Y(s) = \frac{2s}{1-s^2} e^{-s}$

a) $-e^{-t+1} + e^{t-1}$

b)$-e^{-t+1} - e^{t+1}$

c) $-e^{-t+1} + e^{t+1}$

d)$-e^{-t+1} - e^{t-1}$

2. Inverse Laplace transform of 1/(s+1)(s-1)(s+2) is

a) $-\frac{1}{2} e^{t} + \frac{1}{6} e^{-t} + \frac{1}{3} e^{2t}$

b) $-\frac{1}{2} e^{-t} + \frac{1}{6} e^{t} + \frac{1}{3} e^{-2t}$

c) $\frac{1}{2} e^{-t} - \frac{1}{6} e^{t} - \frac{1}{3} e^{-2}$

d) $-\frac{1}{2} e^{-t} + \frac{1}{6} e^{-t} + \frac{1}{3} e^{-2}$

3. Inverse laplace transform of $1/(s-1)^2 (s+5)$ is

a) $\frac{1}{6} e^{-t} - \frac{1}{36} e^{t} + \frac{1}{36} e^{-5t}$

b) $\frac{1}{6} e^{t}t - \frac{1}{36} e^{t} + \frac{1}{36} e^{-5t}$

c) $\frac{1}{6} e^{-t}t^2 - \frac{1}{36} e^{-t} + \frac{1}{36} e^{5t}$

d) $\frac{1}{6} e^{-t}$ t-$\frac{1}{36} e^{-t} + \frac{1}{36} e^{5t}$

4. Find the inverse lapalce transform of $\frac{1}{(s^2+1)(s-1)(s+5)}$

a) $\frac{1}{12} e^{t} - \frac{1}{13}$ Cos(-t) – $\frac{1}{12}$ Sin(-t) – $\frac{1}{156} e^{-5t}$

b) $\frac{1}{12} e^{-t} - \frac{1}{13}$ Cos(t) – $\frac{1}{12}$ Sin(t) – $\frac{1}{156} e^{5t}$

c) $\frac{1}{12} e^{t} - \frac{1}{13}$ Cos(t) – $\frac{1}{12}$ Sin(t) – $\frac{1}{156} e^{-5t}$

d) $\frac{1}{12} e^{t} + \frac{1}{13}$ Cos(t) + $\frac{1}{12}$ Sin(t) + $\frac{1}{156} e^{-5t}$

5. Find the inverse laplace transform of $\frac{s}{(s^2 + 4)^2}$

a) $\frac{1}{4}$ sin(2t)

b) $\frac{t^2}{4}$ sin(2t)

c) $\frac{t}{4}$ sin(2t)

d) $\frac{1}{4}$ sin($2t^2$)

6. Final value theorem states that

a) $x(0) = \lim_{x \to \infty} sX(s)$

b) $x(\infty) = \lim_{x \to \infty} sX(s)$

c) $x(0) = \lim_{x \to 0} sX(s)$

d) $x(\infty) = \lim_{x \to 0} sX(s)$

7. Initial value theorem states that

a) $x(0) = \lim_{x \to \infty} sX(s)$

b) $x(\infty) = \lim_{x \to \infty} sX(s)$

c) $x(0) = \lim_{x \to 0} sX(s)$

d) $x(\infty) = \lim_{x \to 0} sX(s)$

$$X(s) = \frac{2s^2+5s+\frac{12}{s}}{s^3+4s^2+14s+20}$$

8. Find the value of x(∞) if

a) 5

b) 4

c) 12⁄20

d) 2

$$X(s) = \frac{2s^2+5s+\frac{12}{s}}{s^3+4s^2+14s+20}$$

9. Find the value of x(0) if

a) 5

b) 4

c) 12⁄20

d) 2

10. Find the inverse lapace of $\frac{(s+1)}{[(s+1)^2+4][(s+1)^2+1]}$

a) ⅓ e^{t} [Cos(t) – Cos(2t)].

b) ⅓ e^{-t} [Cos(t) + Cos(2t)].

c) ⅓ e^{t} [Cos(t) + Cos(2t)].

d) ⅓ e^{-t} [Cos(t) – Cos(2t)].

Fill in the Blanks:

1) $\mathcal{L}[\delta(t)] = 1$_____

2) $\mathcal{L}[u(t)] = \frac{1}{s}$_____

3) $\mathcal{L}[t] = \frac{1}{s^2}$_____

4) $\mathcal{L}\left[t^2\right] = \frac{2}{s^3}$_____

5) $\mathcal{L}\left[t^3\right] = \frac{6}{s^4}$_____

6) $\mathcal{L}\left[t^n\right] = \frac{n!}{s^{n+1}}$_____

7) $\mathcal{L}\left[e^{-\alpha t}\right] = \frac{1}{s+\alpha}$_____

8) $\mathcal{L}\left[e^{\alpha t}\right] = \frac{1}{s-\alpha}$_____

9) $\mathcal{L}\left[te^{-\alpha t}\right] = \frac{1}{(s+\alpha)^2}$_____

10) $\mathcal{L}\left[te^{\alpha t}\right] = \frac{1}{(s-\alpha)^2}$_____

11) $\mathcal{L}\left[t^n e^{-\alpha t}\right] = \frac{n!}{(s+\alpha)^{n+1}}$_____

12) $\mathcal{L}\left[\cos \omega t\right] = \frac{s}{s^2+\omega^2}$_____

13) $\mathcal{L}\left[\sin \omega t\right] = \frac{\omega}{s^2+\omega^2}$_____

14) $\mathcal{L}\left[e^{-\alpha t}\sin \omega t\right] = \frac{\omega}{(s+\alpha)^2+\omega^2}$_____

15) $\mathcal{L}\left[e^{-\alpha t}\cos \omega t\right] = \frac{s+\alpha}{(s+\alpha)^2+\omega^2}$_____

16) $\mathcal{L}\left[\sinh \alpha t\right] = \frac{\alpha}{s^2-\alpha^2}$_____

17) $\mathcal{L}\left[\cosh \alpha t\right] = \frac{s}{s^2-\alpha^2}$_____

UNIT II

1. In which of the following method, we approximate the curve of solution by the tangent in each interval.

a. Picard's method
b. Euler's method
c. Newton's method
d. RungeKutta method

2. The number of significant digits in the number 204.020050 is

a. 5
b. 6
c. 8
d. 9

3. In general the ratio of truncation error to that of round off error is

a. 2:1
b. 1:1
c. 1:2
d. 1:3

4. The convergence of which of the following method is sensitive to starting value?

a. False position
b. Gauss seidal method
c. Newton-Raphson method
d. All of these

5. Match the Following

A. Newton-Raphson 1. Integration
B. Runge-kutta 2. Root finding
C. Gauss-seidel 3. Ordinary Differential Equations
D. Simpson's Rule 4. Solution of system of Linear Equations

The correct sequence is

a. A2-B3-C4-D1

b. A3-B2-C1-D4
c. A1-B4-C2-D3
d. A4-B1-C2-D3

6. Order of convergence of Regula-Falsi method is
a. 1.321
b. 1.618
c. 2.231
d. 2.312

7. The Newton Raphson method is also called as _____
a)Tangent method
b)Secant method
c)Chord method
d)Diameter method

8. For decreasing the number of iterations in Newton Raphson method:
a)The value of f'(x) must be increased
b)The value of f''(x) must be decreased
c)The value of f'(x) must be decreased
d)The value of f''(x) must be increased

9. In Newton Raphson method f'(x) for a given point is given by the formula _____
a)y/x'
b)y'/x
c)y/x
d)y'/x'

10. The points where the Newton Raphson method fails are called?
a)floating
b)continuous
c)non-stationary
d)stationary

11. Root of the equation x3 - x - 11 = 0 correct to four decimals using bisection method is_____

12. Newton-Raphson method is applicable to the solution of_____

13. In which of the following methods proper choice of initial value is very important_____

14. Using Newton-Raphson method, find a root correct to three decimal places of the equation sin x = 1 – x_____

15. Errors may occur in performing numerical computation on the computer due to_____

16. Newton-Raphson method of solution of numerical equation is not preferred when_____

17. Double(Repeated) root of 4x3- 8x2- 3x + 9 = 0 by Newton-raphson method is_____

18. The convergence of which of the methods is sensitive to starting value is _____

19. We approximate the curve of solution by the tangent in each interval is_____

20. If $\Delta f(x) = f(x+h) - f(x)$, then a constant k, Δk equals_____

UNIT III

1. The highest order of polynomial integrand for which Simpson's 1/3 rule of integration is exact is

- first
- second
- third
- fourth

2. The value of $\int_{0.2}^{2.2} e^x dx$ by using two-segment Simpson's 1/3 rule is most nearly

- 7.8306
- 7.8423
- 8.4433
- 10.246

3. The value of $\int_{0.2}^{2.2} e^x dx$ by using four-segment Simpson's 1/3 rule is most nearly

- 7.8036
- 7.8062
- 7.8423
- 7.9655

4. The velocity of a body is given by

$$v(t) = 2t, \quad 1 \le t \le 5$$
$$= 5t^2 + 3, \quad 5 < t \le 14$$

where t is given in seconds, and v is given in m/s. Using two-segment Simpson's 1/3 rule, the distance covered in meters by the body from t=2 to t=9 seconds most nearly is

- 949.33
- 1039.7
- 1200.5
- 1442.0

5. The value of $\int_{3}^{19} f(x)dx$ by using two-segment Simpson's 1/3 rule is estimated as 702.039. The estimate of the same integral using four-segment Simpson's 1/3 rule most nearly is

- 702.39 + 8/3 [2*f*(7)-*f*(11)+2*f*(15)]
- 702.39/2 + 8/3 [2*f*(7)-*f*(11)+2*f*(15)]
- 702.39 + 8/3 [2*f*(7) +2*f*(15)]
- 702.39/2 + 8/3 [2*f*(7)+2*f*(15)]

6. The following data of the velocity of a body is given as a function of time.

Time (s)	4	7	10	15
Velocity (m/s)	22	24	37	46

The best estimate of the distance in meters covered by the body from t=4 to t=15 using combined Simpson's 1/3rd rule and the trapezoidal rule would be

- 354.70
- 362.50
- 368.00
- 378.80

7. The value of y'/x' in terms of the angle 0 is given by _____

a)tanθ b)secθ c)cotθ d)cosecθ

8 . The equation f(x) is given as x^2-4=0. Considering the initial approximation at x=6 then the value of x_1 is given as _____

a)10/3 b)4/3 c)7/3 d)13/3

9 Consider the function f(x) = sin(x) in the interval [π/4, 7π/4]. The number and location(s) of the local minima of this function are

a) At $\pi/2$ b) At 3 $\pi/2$ c)At both d)None

10. Function f is known at the following points:

x	0	0.3	0.6	0.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0
$f(x)$	0	0.09	0.36	0.81	1.44	2.25	3.24	4.41	5.76	7.29	9.00

The value of $\int_0^3 f(x)\,dx$ computed using the trapezoidal rule is

a) 8.98 b)9.003 c)9.017 d)9.045

11. The order of error s the Simpson's rule for numercal integration with a step size h is_____

12. Errors may occur in performing numerical computation on the computer due to_____

13. If X is the true value of the quantity and X1 is the approximate value then the relative error is ER = _____ and percentage error is EP = _____

14. If X is the true value and X1 is the approximate value of the given quantity then its absolute error is EA = _____ and relative is error ER = _____

15. Every algebraic equation of the nth degree has exactly _____ roots.

16. After rounding of the number 2.3762 to the two decimal places, we get the number ____

17. Rounding off the number 32.68673 to 4 significant digits, we get a number _____

18. The root of the equation x3 – 2x – 5 = 0 lies between _____

19. If true value of a number is 36.25and its absolute error is 0.002. the relative error and percentage error _____

20. If percentage error of a number is 3.264×10-4 then its relative error is _____

UNIT IV

1. Analytic function is

a) single valued function b) bounded function c) differential function d) all of these

2. The value of m so that $2x - x^2 + my^2$ may be harmonic is

a) 0 b)1 c)2 d)3

3. If $f(z) = \sin z$, then

a) $f(z)$ is continuous in every finite region b) $f(z)$ is not continuous in every finite region

c) $f(z)$ is not continuous at 1 *d*) None

4. The value of $\int_a^b z dz =$

a) b-a b) $b^2 - a^2$ c) $\frac{1}{2} b^2 - a^2$ d) None

5. The function $f(z) = xy + iy$is

a) every where continues but not analytic b) discontinuous everywhere but not analytic

c) every where continuous and analytic d) neither continuous nor analytic

6. The value of m so that $2x - x^2 + my^2$ may be harmonic is

a) 0 b)1 c)2 d)3

7. Let $f(z)=Z^2$, then f(1+3i) is

a) 8-6i b) -8+6i c) -8-6i d) 8+6i

8. The Cauchy-Riemann equations in polar form

a) $u_r=(1/r)\, v_\theta$, $v_r=-(1/r)\, u_\theta$ b) $u_\theta=(1/r)\, v_r$, $v_\theta=-(1/r)\, u_r$

c) 1, -1 d) None

9. The analytic function whose real part is $u=x^2-y^2-x$

a)z^2-z+c b)z^2+z+c c)$-z^2-z+c$ d) None

10. If f(z) is analytic within and on a closed curve C, and if a is any point within C, then $\int_c \frac{dz}{z-a}$

a) f(a) b) $2\pi i$ f(a) c) f(a) / 2π d) 2πf

11.The harmonic conjugate of x^3-3xy^2 is ----------

12. For what values of a, b, c, the function f(z)= (x + ay) + i(bx +cy) is analytic.

13. If f(z) = U + Iv then f^i(z) = ----------

14. Imaginary part of cos z ----------.

15. $e^x \cos y$Harmonic conjugate is _____

16. Imaginary part of e^{2z} ----------

17. Cauchy Riemann equations in Cartesian form _____.

18. Every Analytic function with _____ is constant.

19. Cauchy- Riemann equations for a function to be analytic in polar form are _____

20.The function $f(z) = z^2$is a function which is _____

UNIT V

1. Polynomial of degree n has a pole of order n at

A) zero B) infinity C) anywhere D) curve c

2. The residue of $f(z)=\frac{1}{(z+2)^2(z-2)^2}$ $at\ z=2$ is _____.

a)-1/32 b)-1/16 c)1/16 d)1/32

3. If the mapping w = f(z) is conformal then the function f(z) is

A) analytic B) non analytic C)harmonic D)none

4. The fixed point of the transformation w = $\frac{6z-9}{z}$ are

A) z =3,3 B) z = -3,3 C) z =-3 , -3 D) z =3i

5. Cauchy's integral theorem is applicable only for a _____ region R enclosed a simple curve C.

a)Simply connected b) Multiple connected c) Both A and B d) None

6. For $f(z)=\frac{\sin\sqrt{z}}{\sqrt{z}}$, z = 0 is

a) Simple pole b) Essential singularity c) Removable singularity d) None

7. A point at which f(z) fails to be analytic is called ……of f(z)

a)Singular point b) null point c) zero point d) none

8. If f(z) = z^2 then f(-2+i)=……

a) 3+4i (b) 3-4i (c) 4-3i (d) none

9. If f (z) value at a such that f(a)=0 . then a is called

a) Zero b) pole c) simple pole d) None

10. If $f(z)=\frac{z}{8-z^3}$ then residue of $f(z)atz=2$ is

A)-1/8 B)1/8 C)-1/6 D)1/6

1. If W = log z is analytic everywhere except at z =----------

2. For what values of a, b, c, the function f(z)= (x + ay) + i(bx +cy) is analytic.

3. An analytic function f(z) is such that $Re\left(f'(z)\right)=2y\ \&\ f(1+i)=2$ then the imaginary part of $f(z)is$ _____.

4 .The value of $\int_0^{4+2i} zdz$ is_____ .

5 .If c is the circle $|z-3i|=4\ then \oint \frac{dz}{z^2+9}$ = _____.

6. $\int \frac{\cos z}{z^3}$ at |z| = 2 is_____.

7. $\int \frac{z^2-4}{z^2+4} dz$ evaluated anticlockwise around the circle $|z - i| = 2$ *is* _____.

8. Given $f(z) = \frac{1}{z+1} - \frac{2}{z+3}$. If c is a counter clock wise path in the z-plane such that $|z + 1| =$ _____then the value of $\frac{1}{2\pi i} \oint f(z) dz$ *is*

9. The fixed points of f(z) = $\frac{2iz+5}{z-2i}$ are _____.

10. Find the radius of convergence of the series of the function $f(z) = \frac{1}{1-z}$ about $z = \frac{1}{4}$ is _____.

WEBSITES:

1. www.mathworld.wolfram.com
2. www.researchgate.net
3. www.ocw.mit.edu

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JOURNALS:

INTERNATIONAL:

1. Journal of American Mathematical Society
2. Journal of differential equations - Elsevier
3. Pacific Journal of Mathematics
4. Journal of Australian Society
5. Bulletin of "The American Mathematical Society"
6. Bulletin of "The Australian Mathematical Society"
7. Bulletin of "The London Mathematical Society"

NATIONAL:

1. Journal of Interdisciplinary Mathematics
2. Indian Journal of Pure and Applied Mathematics
3. Indian Journal of Mathematics
4. Proceedings of Mathematical Sciences
5. Journal of Mathematical and Physical Sciences.
6. Journal of Indian Academy and Sciences

LIST OF TOPICS FOR STUDENT SEMINARS:

1. Convolution theorem and Applications of Laplace transforms.
2. To find backward and forward differences
3. To find Integrations by using Numerical Methods.
4. Complex variables and C-R eqns.
5. Mobius Transformations.

CASE STUDIES / SMALL PROJECTS:

1. To Find Translation Theorems.
2. Study of numerical analysis.
3. To conduct case study on qualitative research and find the areas.