Ref No:

# SRI KRISHNA INSTITUTE OF TECHNOLOGY, BANGALORE



# COURSE PLAN

# Academic Year 2020

Program:	BE
Semester :	2
Course Code:	18MAT21
Course Title:	Advanced Calculus and Numerical Methods
Credit / L-T-P:	4 / 3-2-0
Total Contact Hours:	50
Course Plan Author:	Dr. Veeresha A Sajjanara

Academic Evaluation and Monitoring Cell

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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:	CSE
Semester:	2	Academic Year:	2019-20
Course Title:	Advanced Calculus and Numerical Methods	Course Code:	18MAT21
Credit / L-T-P:	4 / 4-0-0	SEE Duration:	180 Minutes
Total Contact Hours:	50 Hours	SEE Marks:	100 Marks
CIA Marks:	50 Marks	Assignment	1 / Module
Course Plan Author:	Dr. Veeresha A Sajjanara	Sign	Dt:
Checked By:	Dr.Puttaraju C	Sign	Dt:
CO Targets	CIA Target : %	SEE Target:	%

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.

Mod	Content	Teachi	Identified Module	Blooms
ule		ng	Concepts	Learning
		Hours		Levels
1	Scalar and Vector fields, Gradient, directional derivative,curl	5	Vector	L3
	and divergence-physical interpretation: solenoidal and		Differentiation	
	irrotational vector fields-illustrative problems.			
1	Line Integrals, Theorems of Green, Gauss and Stokes(without	5	Vector	L3
	proof). Applications to work done by force and flux.		Integration	
2	Second order Linear ODE's with constant coefficients-Inverse	5	Ordinary	L3
	differential operators, method of variation of parameters.		Differential	
			equation	
2	Cauchy's and Legendre homogeneous equations.	5	Ordinary	L3
	Applications to oscillations of a spring and L-C-R circuits.		Differential	
			equation	
3	Formation of PDE's by elimination of arbitrary constants and	6	Partial Differential	L3
	functions. Solution of non-homogeneous PDE by direct		equation	
	integration. Homogeneous PDEs involving derivative with			
	respect to one independent variable only. Solution of			
	Lagrange's linear PDE. Derivative of one dimensional heat			
	and wave equations and solutions by the method of			
	separation of variables.			
3	Derivative of one dimensional heat and wave equations and	4	Partial Differential	L3
	solutions by the method of separation of variables.		equation	
4	Series of positive terms-convergence and divergence.	5	Infinite series	L3
	Cauchy's root test and D'Alembert's ratio test(without proof)-			
	illustrative examples.			
4	Series solution of Bessel's differential equation leading to	5	Power series	L3
	Jn(x)-Bessel's function of first kind-orthogonality. Series			
	solution of Legendre polynomials. Rodrigue's			
	formula(without proof),problems.			
5	Finite differences, Interpolation/extrapolation using	5	Numerical	L3
	Newton's forward and backward difference formulae,		methods	
	Newton's divided difference and Lagrange's formulae(All			
L	formulae without proof).			
5	Solution of polynomial and transcendental equations-	5	Numerical	L3
	Newton-Raphson and Regula-Falsi methods(only formulae)-		methods	
	illustrative examples.Simpson's (1/3) <sup>rd</sup> and (3/8) <sup>th</sup> rules,			
	Weddle's rule(without proof)-Problems.			
-	Total	50	-	-

## 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.

Modul	Details	Chapters	Availability
es		in book	
A	Text books (Title, Authors, Edition, Publisher, Year.)	-	-
1	B.S.Grewal: Higher Engineering Mathematics, Khanna publishers, 43 <sup>rd</sup> Ed.,2015.	1,2,10	In Dept
2	E.Kreyszig: Advanced Engineering Mathematics,John Wiley & Sons, 10 <sup>th</sup> Ed.(Reprint),2016.		Not Available
В	Reference books (Title, Authors, Edition, Publisher, Year.)	-	-
1	C Ray Wylie, Louis C Barrett: "Advanced Engineering Mathematics",6th Edition, 2.McGraw-Hill Book Co.,New york,1995.		Not Available
2	James Stewart:"Calculus- Early Transcendentals", Cengage Learning India Private Ltd.,2017.		Not Available
3	B.V.Ramana:"Higher Engineering Mathematics" 11 <sup>th</sup> Edition Tata McGraw- Hill,2010.	1,5,6,7	In Dept
4	Srimanta Pal & Subobh C Bhunia: "Engineering Mathematics", Oxford UniversityPress, 3 <sup>rd</sup> Reprint, 2016.		Not Available
5	Gupta C B, Singh S R and Mukesh Kumar:"Engineering Mathematics for SemesterI and II, Mc-Graw Hill Education(India)Pvt.Ltd., 2015.		Not Available
С	Concept Videos or Simulation for Understanding	-	-
C1	https://nptel.ac.in/course.html		
C2	http://www.class-central.com/subject/maths		
C3	http://academicearth.org/		
C4	<u>e-learning@vtu</u>		
C5	<u>e-shikshana@vtu</u>		
D	Software Tools for Design	-	-
E	Recent Developments for Research	-	-
-	Otherre (Wah Misles, Circulation, Nates ato)		
	Uthers (web, video, Simulation, NOTES etc.)	-	-
	<u> </u>		

### 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 ...

Mod	Course	Course Name	Topic / Descrip	otion Serr	n Remarks	Blooms
ules	Code					Level
-						
-						

## 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.

Mod	Topic / Description	Area	Remarks	Blooms
ules				Level
1				
3				
3				
5				
-				
-				

# 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.

Mod	Course	Course Outcome	Teach.	Concept	Instr	Assessme	Blooms'
ules	Code.#	At the end of the course,	Hours		Method	nt	Level
		student should be able to				Method	
1	18MAT21	Understand the physical	10	Vector	Lecture	Assignme	L2
		interpretation of properties of		Differentia		nt and	
		vector fields and evaluation of		tion		slip test	
		line, surface and volume integrals.					
2	18MAT21	Inderstand to generate solutions	10	Ordinany	Locturo	Assignmo	1.2
2	1014121	to various types of differential	10	Differential	Lecture	nt and	۲3
		equations its applications to		equations		slin test	
		engineering.		equations			
3	18MAT21	Construct a variety of partial	10	Partial	Lecture	Assignme	L3
		differential equations and solution		Differential		nt and	
		by exact methods/method of		equations		slip test	
		separation of variables.					
4	18MAT21	Understand the nature of infinite	10	Infinite	Lecture	Assignme	L3
		series and obtain the series		series		nt and	
		solution of ordinary differential				slip test	
		equation.	10	Nhuanawiaal	Looturo		
5	18MA   21	transpondental equations and	10	numerical	Lecture	Assignme	L3
		obtain intermediate values using		methous			
		Numerical methods				sup test	
		Total	50				
-	-	IUldi	50	-	-	-	

### 2. Course Applications

Write 1 or 2 applications per CO.

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

Mod	Application Area	СО	Level
ules	Compiled from Module Applications.		
1	Used extensively in physics and engineering especially in the description of	1	
	electromagnetic fields, gravitational fields and fluid flow.		L3
1	Used in computational electrodyanmics simulation.	1	L3
2	Used in computational fluid dynamics	2	L3
2	Used in studying the behaviour of LCR circuits and oscillations of springs	2	L3
3	It is used to describe a wide variety of phenomena such as sound,heat and	3	L3
	diffusion.		

3	lt	is	used	to	describe	а	wide	variety	of	phenomena	such	as	3	L3
	ele	ctro	statics,	electr	odynamics	and	quantu	m mecha	nics.					
4	lt is	s use	ed for ar	nalysi	s of current	flov	v and so	ound wave	es in	electric circuits			4	L3
4	It is used in nuclear engineering analysis.									4	L3			
5	Use	Used in network simulation and weather prediction									5	L3		
5	Use	ed ir	n compi	uter s	cience for r	oot a	algorithi	m and mu	ıltidir	nensional root <sup>-</sup>	finding.		5	L3

### 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.

Mod	Мар	lapping Mapping		Justification for each CO-PO pair	Lev
ules			Level		el
-	CO	PO	-	'Area': 'Competency' and 'Knowledge' for specified 'Accomplishment'	-
1	CO1	PO1	L3	'Engineering Knowledge:' - Acquisition of Knowledge of Vector Differentiation is essential to accomplish solutions to complex engineering problems.	L3
1	CO1	PO2	L3	'Problem Analysis': Analyzing problems require knowledge / understanding of Vector Differentiation accomplish solutions to complex engineering problems .	L3
1	CO1	PO3	L3	'Design / Development of Solutions': Design & development of solutions require knowledge / understanding & analysis Vector Differentiation to accomplish solutions to complex engineering problems .	L3
1	CO1	PO4	L3	Conduct investigations of complex engineering problems: using research based knowledge and research methods in vector Differentiation to accomplish solutions to complex engineering problems.	L3
1	CO1	PO9	L3	Individual and team work: Function effectively as an individual in multidisciplinary settings using vector Differentiation to achieve solutions to complex engineering problems.	L3
1	CO1	PO11	L3	Project management and finance: Demonstrate knowledge to manage projects using vector Differentiation to attain solutions to complex engineering problems.	L3
1	CO1	PO12	L3	Life-long learning: Recognize the need for life- long learning with practical applications in engineering field using vector Differentiation.	L3
1	CO2	PO1	L3	'Engineering Knowledge:' - Acquisition of Knowledge of Vector Integration is essential to accomplish solutions to complex engineering problems.	L3
1	CO2	PO2	L3	'Problem Analysis': Analyzing problems require knowledge / understanding of Vector Integration accomplish solutions to complex engineering problems .	L3
1	CO2	PO3	L3	Design / Development of Solutions': Design & development of solutions require knowledge / understanding & analysis Vector Integration to accomplish solutions to complex engineering problems .	L3
1	CO2	PO4	L3	Conduct investigations of complex engineering problems: using research based knowledge and research methods in vector Integration to accomplish solutions to complex engineering problems.	L3
1	CO2	PO10	L3	Communication: Communicate effectively on complex engineering activities using vector integration.	L3
1	CO2	PO11	L3	Project management and finance: Demonstrate knowledge to manage projects using vector Integration to attain solutions to complex engineering problems.	L3
1	CO2	PO12	L3	Life-long learning: Recognize the need for life- long learning with practical applications in engineering field using vector Integration.	L3
2	CO3	PO1	L3	'Engineering Knowledge:' - Acquisition of Knowledge of Ordinary differential equations is essential to accomplish solutions to complex engineering problems.	L3
2	CO3	PO2	L3	'Problem Analysis': Analyzing problems require knowledge / understanding of Ordinary differential equations accomplish solutions to complex engineering problems .	L3

2	CO3	PO3	L3	'Design / Development of Solutions': Design & development of solutions require knowledge / understanding & analysis Ordinary differential equations to accomplish solutions to complex engineering problems .	L3
2	CO3	PO4	L3	Conduct investigations of complex engineering problems: using research based knowledge and research methods in Ordinary differential equations to accomplish solutions to complex engineering problems.	L3
2	CO3	PO9	L3	Individual and team work: Function effectively as an individual in multidisciplinary settings using Ordinary differential equations to achieve solutions to complex engineering problems.	L3
2	CO3	PO11	L3	Project management and finance:Demonstrate knowledge to manage projects using Ordinary differential equations to attain solutions to complex engineering problems.	L3
2	CO3	PO12	L3	Life-long learning: Recognize the need for life- long learning with practical applications in engineering field using Ordinary differential equations.	L3
2	CO4	PO1	L3	'Engineering Knowledge:' - Acquisition of Knowledge of Ordinary differential equations is essential to accomplish solutions to complex engineering problems.	L3
2	CO4	PO2	L3	'Problem Analysis': Analyzing problems require knowledge / understanding of Ordinary differential equations accomplish solutions to complex engineering problems .	L3
2	CO4	PO3	L3	'Design / Development of Solutions': Design & development of solutions require knowledge / understanding & analysis Ordinary differential equations to accomplish solutions to complex engineering problems .	L3
2	CO4	PO4	L3	Conduct investigations of complex engineering problems: using research based knowledge and research methods in Ordinary differential equations to accomplish solutions to complex engineering problems.	L3
2	CO4	PO9	L3	Individual and team work: Function effectively as an individual in multidisciplinary settings using Ordinary differential equations to achieve solutions to complex engineering problems.	L3
2	CO4	PO11	L3	Project management and finance:Demonstrate knowledge to manage projects using Ordinary differential equations to attain solutions to complex engineering problems.	L3
2	CO4	PO12	L3	Life-long learning: Recognize the need for life- long learning with practical applications in engineering field using Ordinary differential equations.	L3
3	CO5	PO1	L3	'Engineering Knowledge:' - Acquisition of Knowledge of Partial Differential equations is essential to accomplish solutions to complex engineering problems.	L3
3	CO5	PO2	L3	'Problem Analysis': Analyzing problems require knowledge / understanding of Partial Differential equations accomplish solutions to complex engineering problems .	L3
3	CO5	PO3	L3	'Design / Development of Solutions': Design & development of solutions require knowledge / understanding & analysis Partial Differential equations to accomplish solutions to complex engineering problems .	L3
3	CO5	PO4	L3	Conduct investigations of complex engineering problems: using research based knowledge and research methods in Partial Differential equations to accomplish solutions to complex engineering problems.	L3
3	CO5	PO10	L3	Communication: Communicate effectively on complex engineering activities using Partial Differential equations.	L3
3	CO5	PO11	L3	Project management and finance:Demonstrate knowledge to manage projects using Partial Differential equations to attain solutions to complex engineering problems.	L3
3	CO5	PO12	L3	Life-long learning: Recognize the need for life- long learning with practical applications in engineering field using Partial Differential equations.	L3
3	CO6	PO1	L3	'Engineering Knowledge:' - Acquisition of Knowledge of Partial differential equations is essential to accomplish solutions to complex engineering problems.	L3

3	CO6	PO2	L3	'Problem Analysis': Analyzing problems require knowledge / understanding of Partial differential equations accomplish solutions to complex engineering problems .	L3
3	CO6	PO3	L3	'Design / Development of Solutions': Design & development of solutions require knowledge / understanding & analysis Partial differential equations to accomplish solutions to complex engineering problems .	L3
3	CO6	PO4	L3	Conduct investigations of complex engineering problems: using research based knowledge and research methods in Partial differential equations to accomplish solutions to complex engineering problems.	L3
3	CO6	PO9	L3	Individual and team work: Function effectively as an individual in multidisciplinary settings using Partial differential equations to achieve solutions to complex engineering problems.	L3
3	CO6	PO11	L3	Project management and finance:Demonstrate knowledge to manage projects using Partial differential equations to attain solutions to complex engineering problems.	L3
3	CO6	PO12	L3	Life-long learning: Recognize the need for life- long learning with practical applications in engineering field using Partial differential equations.	L3
4	CO7	PO1	L3	'Engineering Knowledge:' - Acquisition of Knowledge of Infinite series is essential to accomplish solutions to complex engineering problems.	L3
4	CO7	PO2	L3	'Problem Analysis': Analyzing problems require knowledge / understanding of Infinite series accomplish solutions to complex engineering problems .	L3
4	CO7	PO3	L3	'Design / Development of Solutions': Design & development of solutions require knowledge / understanding & analysis Infinite series to accomplish solutions to complex engineering problems.	L3
4	CO7	PO4	L3	Conduct investigations of complex engineering problems: using research based knowledge and research methods in Infinite series to accomplish solutions to complex engineering problems.	L3
4	CO7	PO9	L3	Individual and team work: Function effectively as an individual in multidisciplinary settings using Infinite series to achieve solutions to complex engineering problems.	L3
4	CO7	PO11	L3	Project management and finance:Demonstrate knowledge to manage projects using Infinite series to attain solutions to complex engineering problems.	L3
4	CO7	PO12	L3	Life-long learning: Recognize the need for life- long learning with practical applications in engineering field using Infinite series .	L3
4	CO8	PO1	L3	'Engineering Knowledge:' - Acquisition of Knowledge of Power series is essential to accomplish solutions to complex engineering problems.	L3
4	CO8	PO2	L3	'Problem Analysis': Analyzing problems require knowledge / understanding of Power series accomplish solutions to complex engineering problems .	L3
4	CO8	PO3	L3	'Design / Development of Solutions': Design & development of solutions require knowledge / understanding & analysis Power series to accomplish solutions to complex engineering problems .	L3
4	CO8	PO4	L3	Conduct investigations of complex engineering problems: using research based knowledge and research methods in Power series to accomplish solutions to complex engineering problems.	L3
4	CO8	PO9	L3	Individual and team work: Function effectively as an individual in multidisciplinary settings using Power series to achieve solutions to complex engineering problems.	L3
4	CO8	PO11	L3	Project management and finance:Demonstrate knowledge to manage projects using Power series to attain solutions to complex engineering problems.	L3
4	CO8	PO12	L3	Life-long learning: Recognize the need for life- long learning with practical applications in engineering field using Power series .	L3
5	CO9	PO1	L3	'Engineering Knowledge:' - Acquisition of Knowledge of Numerical Methods is essential to accomplish solutions to complex engineering problems.	L3

5	CO9	PO2	L3	'Problem Analysis': Analyzing problems require knowledge / understanding of Numerical Methods accomplish solutions to complex engineering problems .	L3
5	CO9	PO3	L3	'Design / Development of Solutions': Design & development of solutions require knowledge / understanding & analysis Numerical Methods to accomplish solutions to complex engineering problems .	L3
5	CO9	PO4	L3	Conduct investigations of complex engineering problems: using research based knowledge and research methods in Numerical Methods to accomplish solutions to complex engineering problems.	L3
5	CO9	PO10	L3	Communication: Communicate effectively on complex engineering activities using Numerical Methods.	L3
5	CO9	PO11	L3	Project management and finance:Demonstrate knowledge to manage projects using Numerical Methods to attain solutions to complex engineering problems.	L3
5	CO9	PO12	L3	Life-long learning: Recognize the need for life- long learning with practical applications in engineering field using Numerical Methods .	L3
5	CO10	PO1	L3	'Engineering Knowledge:' - Acquisition of Knowledge of Numerical Methods is essential to accomplish solutions to complex engineering problems.	L3
5	CO10	PO2	L3	'Problem Analysis': Analyzing problems require knowledge / understanding of Numerical Methods accomplish solutions to complex engineering problems .	L3
5	CO10	PO3	L3	'Design / Development of Solutions': Design & development of solutions require knowledge / understanding & analysis Numerical Methods to accomplish solutions to complex engineering problems .	L3
5	CO10	PO4	L3	Conduct investigations of complex engineering problems: using research based knowledge and research methods in Numerical Methods to accomplish solutions to complex engineering problems.	L3
5	CO10	PO9	L3	Individual and team work: Function effectively as an individual in multidisciplinary settings using Numerical Methods to achieve solutions to complex engineering problems.	L3
5	CO10	PO11	L3	Project management and finance: Demonstrate knowledge to manage projects using Numerical Methods to attain solutions to complex engineering problems.	L3
5	CO10	PO12	L3	Life-long learning: Recognize the need for life- long learning with practical applications in engineering field using Numerical Methods.	L3

### 4. Articulation Matrix

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

											<u> </u>							
-	-	Course Outcomes	Program Outcomes								-							
Mod	CO.#	At the end of the course	PO	PO	Ρ	PO	PO	PO	PO	PO	PO	PO	PO	PO	PS	PS	PS	Lev
ules		student should be able to	1	2	Ο	4	5	6	7	8	9	10	11	12	O1	02	03	el
					3													
1	18MAT21.1	Understand the physica	I 3	3	2	2					2			2				L3
		interpretation of properties of	f															
		vector fields and evaluation o	f															
		line, surface and volume integrals.																
2	18MAT21.2	Understand to generate solutions to various types of differential equations its applications to engineering.	3	3	2	2					2			2				L3
3	18MAT21.3	Construct a variety of partia differential equations and solutior by exact methods/method or separation of variables.	3 1 f	3	2	2					2			2				L3
4	18MAT21.4	Understand the nature of infinite series and obtain the series	3	3	2	2					2			2				L3

		solution of ordinary differential equation.															
5	18MAT21.5	To solve algebraic and transcendental equations and obtain intermediate values using Numerical methods.	3	3	2	2				2			2				L3
-	CS501PC	Average attainment (1, 2, or 3)															-
-	PO, PSO	1.Engineering Knowledge; 2.Probl 4.Conduct Investigations of Compl Society; 7.Environment and Su	lem ex F ista	An Prob inal	aly ler pilit	vsis; ns; ; y;	3.De 5.Moc 8.Eth	esign dern nics; Eir	Too 9.Ir	Dev L Us ndiv	iduc	рт г; 6. аl	ent The and	of e En d	Sc Igine Tea	oluti eer mw	ons; and ′ork;
		S1.Software Engineering; S2.Data E	Base	age Mc	ine ina	iger	nent;	۳۱ S3.W	eb	Le, Des	ign	спе	-10	ng	Le	cun	шıд,

### 5. Curricular Gap and Content

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

Mod	Gap Topic	Actions Planned	Schedule Planned	<b>Resources Person</b>	PO Mapping
ules					
1					
2					

### 6. Content Beyond Syllabus

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

Mod	Gap Topic	Area	Actions Planned	Schedule	Resources	PO Mapping
ules				Planned	Person	
1						
1						

## 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.

Mod	Title		CO	Levels						
ules		Hours	CIA-1	CIA-2	CIA-3	Asg	Extra	SEE		
							Asg			
1	Vector Calculus	10	2	-	-			2		L3
2	Differential Equations of higher	10	2	-	-			2		L3
	order									
3	Partial Differential equations	10	-	2	-			2		L3
4	Infinite and Power series	10	-	2	-			2		L3
5	Numerical Methods and	10	-	-	4			2		L3
	Integration									
-	Total	50	4	4	4			10	_	-

## 2. Continuous Internal Assessment (CIA)

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

Mod	Evaluation	Weightage in	СО	Levels
ules		Marks		
1	CIA Exam – 1	30	CO1, CO2,	L3,L3
2	CIA Exam – 2	30	CO3, CO4,	L3,L3
3	CIA Exam – 3	30	CO5	L3
1	Assignment - 1	10	CO1, CO2,	L3,L3,
2	Assignment - 2	10	CO3, CO4,	L3,L3
3	Assignment - 3	10	CO5	L3

Final CIA Marks	40	-	-

# D1. TEACHING PLAN - 1

# Module - 1

Title:	Vector Calculus	Appr Time:	12 Hrs
a	Course Outcomes	СО	Blooms
	The student should be able to:	-	Level
1	Illustrate the applications of multivariate calculus to understand the solenoidal	CO1	L3
	and irrotational vectors and also exhibit the interdependence of line , surface		
	and volume integrals.		
b	Course Schedule	-	-
Class No	Portion covered per hour	-	-
1	Scalar and Vector fields,	<u>CO1</u>	L3
2	Gradient, directional derivative	<u>CO1</u>	L3
3	curl and divergence-physical interpretation	CO1	L3
4	solenoidal and irrotational vector fields-illustrative problems.	CO1	L3
5	Line Integrals	<u>CO1</u>	L3
6	Theorems of Green, Gauss and Stokes(without proof).	<u>CO1</u>	L3
7	Applications to work done by force and flux.	CO1	L3
C	Application Areas	-	-
1	Used extensively in physics and engineering especially in the description of	1	L3
1	Lised in computational electrodycamics simulation	2	
	Osed in computational electrodyanimics simulation.	2	L3
d	Paviaw Questions	_	
1	If $\vec{F} = \nabla (x y^3 z^2)$ Find div $\vec{F}$ and curl $\vec{F}$ at the point (1 -1 1)	CO.1	L3
2	Find the angle between the surfaces $\frac{2}{2} + \frac{2}{2} + \frac{2}{2} = 0$ and $\frac{2}{2} + \frac{2}{2} + \frac{2}{2} = 0$	$CO_1$	
	Find the angle between the surfaces $x^+ y^+ z^- = 9$ and $z = x^+ y^ 3$ at (2,-1,2)	CO.1	L3
3	Find the directional derivative of $\phi = x^2 yz + 4 x z^2$ at(1, -2, -1) in the direction of 2i-j-2k.	CO.1	L3
4	Find the work done in moving a particle in the force field	CO.1	L3
	$\vec{F} = 3 x^2 i + (2 xz - y) i + zk$ along the straight line from (0,0,0) to (2,1,3)		
5	Use the divergence theorem to evaluate $\iint_{s} \vec{F} \cdot \hat{n} ds$ . Find the flux across	CO.1	L3
	the suface, S is the rectangular parallelopiped bounded by		
	x=0,y=0,z=0,x=2,y=1,z=3 where $\vec{F} = 2xyi + yz^2 j + xzk$		
6	Evaluate by Stokes theorem $\oint_{c} (sinzdx - cosxdy + sinydz)$ where c is the	CO.1	L3
	boundary in the rectangle $0 \le x \le \pi$ , $0 \le y \le 1, z=3$		
7	Derive an expression for radius of curvature in case of the polar curve $r=f(\theta)$ .	CO.1	L3
8	Find the radius of curvature at the point 't' on the curve	CO.1	L3
	x= a(t+sint) ,y= a(1-cost).		

### Module – 2

Title:	Differential Equations of higher order	Appr	7 Hrs
		Time:	
a	Course Outcomes	CO	Blooms
-	The student should be able to:	-	Level
1	Demonstrate various physical models through higher order differential	CO2	L3
	equations and solve such linear ordinary differential equations.		

b	Course Schedule	-	-
Class No	Portion covered per hour	-	-
1	Second order Linear ODE's with constant coefficients	CO2	L3
	Inverse differential operators,		
2	method of variation of parameters	CO2	L3
3	Cauchy's homogeneous equations	CO2	L3
4	Cauchy's homogeneous equations	CO2	L3
5	Legendre homogeneous equations	CO2	L3
6	Legendre homogeneous equations	CO2	L3
7	Applications to oscillations of a spring	CO2	L3
8	Applications to L-C-R circuits.	CO2	L3
9	Applications to L-C-R circuits.	CO2	L3
С	Application Areas	СО	Level
2	Used in computational fluid dynamics	CO2	L3
2	Used in studying the behaviour of LCR circuits and oscillations of springs	CO2	L3
d	Review Questions		
1	Solve $(4D^4 - 4D^3 - 23D^2 + 12D + 36)y = 0$	CO2	L3
2	Solve $y^{11} - 4y = \cosh(2x-1) + 3^{x}+2$ .	CO2	L3
3	Solve $6y'' + 17y' + 12y = e^{-x}$	CO2	L3
4	Solve y <sup>11</sup> +3y <sup>1</sup> +2y= 1+3x+x <sup>2</sup>	CO2	L3
5	Solve $y'' + 2y' + 5y = e^{-x} Sin 2x$	CO2	L3
6	Solve the equation $y^{11} - 4y^{1} + 4y = 8(e^{2x} + \sin 2x)$	CO2	L3
7	Solve y <sup>111</sup> +y <sup>11</sup> -4y <sup>1</sup> -4y= 3e <sup>x-</sup> 4x-6.	CO2	L3
8	Solve $\frac{d^3y}{dx^3} + y = Cos(\pi/2 - x) + e^x$	CO2	L3

# E1. CIA EXAM – 1

# a. Model Question Paper - 1

Crs C	Code:	18MAT21 Sem:	I Ma	arks:	50	Time:	1.30 minut	es			
Cour	se:	Advanced Calculus and	d Numerical Me	thods							
-	-	Note: Answer any 3 qu	estions, each c	arry equ	al marks.		CO	СО	Marks		
1	а	Solve $\frac{d^2x}{dt^2} + 4\frac{dx}{dt} + 29x$	x=0. Find y wh	nen x(0)=	=0 and $\frac{dx}{dt}$	(0)=15	CO2	L3	6		
	b	Solve the equation y <sup>1</sup>	¹ -4y¹+4y= 8(€	e <sup>2x</sup> + sin2	x)		CO2	L3	6		
	С	Solve by the method of	olve by the method of variation of parameters								
		$\frac{d^2 y}{dx^2} - 6\frac{dy}{dx} + 9y = \frac{e^{3x}}{x^2}$	$-6\frac{dy}{dx} + 9y = \frac{e^{3x}}{x^2}$								
	d	Solve $x^2 y'' + 5xy' + 13$	solve $x^2 y' + 5xy + 13 y = logx + x^2$								
			OR	2							
2	а	Solve $\frac{d^2 y}{dx^2} + 3\frac{dy}{dx} + 2 y$	$=1+3x+x^{2}$				CO2	L3	6		
	b	Solve by the method o	of variation of p	aramete	ers y <sup>''</sup> -y=	$=\frac{2}{1+e^x}$	CO2	L3	6		
	С	Solve $(D^4 + 8D^2 + 16)$	$y=2\cos^2 x$				CO2	L3	6		
	d	Solve $(3x+2)^2 y''+3(3)^2$	3x+2)y'-36y	$y = 8 x^{2} + 4$	4 <i>x</i> +1		CO2	L3	7		

3	a	$\frac{d^2 y}{dx^2} + 2\frac{dy}{dx} + 10 y + 37 \sin 3 x = 0.$ Find y	CO2	L3	6
	b	Obtain the PDE by eliminating the arbitrary function z=f(x+at)+g(x-at)	CO3	L3	6
	С	Form a PDE by eliminating arbitrary constants $\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1$	CO3	L3	6
	d	Solve $\frac{\partial^2 z}{\partial x \partial y} = \frac{x}{y}$ subject to the conditions $\frac{\partial z}{\partial x} = logx$ when y=1 and z=0 at x=1.	CO3	L3	7
		OR			
4	а	Solve $(D^3 + 3D^2)x = 1 + t$	CO3	L3	6
	b	Obtain the PDE of the function $\phi(xy+z^2,x+y+z)=0$	CO3	L3	6
	С	Obtain The PDE by eliminating $\varphi$ and $\psi$ from the relation $z = x \phi(y) + y \psi(x)$	CO3	L3	6
	d	Solve $\frac{\partial^2 z}{\partial x \partial y} = sinxsiny$ given that $\frac{\partial z}{\partial y} = -2siny$ when x=0 & z=0 when y is an odd multiple of $\frac{\pi}{2}$	CO3	L3	7

# b. Assignment -1

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

	Model Assignment Questions									
Crs C	ode:	18MAT2	1 Sem:		Marks:	10	Time:			
Cours	se:	Advance	d Calculus an	d Numerica	al Methods					
Note:	ote: Each student to answer 3 assignments. Each assignment carries equal mark.									
SNo		USN		Assigi	nment Desc	ription		Marks	СО	Level
1			Solve $(4D^4$ -	$4D^3 - 23D$	$D^2 + 12D +$	36)y = 0	)	5	CO2	L3
2			Solve y11 -4y	' = cosh(2x-1	) +3x+2.			5	CO2	L3
3			Solve 6y"+1	7y' + 12y	$=e^{-x}$			5	CO2	L3
4			Solve the eq	uation $y^{11}$ -	4y1+4y= 8(e2x	+ sin2x)		5	CO2	L3
5			Solve $y'' + 2j$	$y' + 5y = e^{-1}$	<sup>x</sup> Sin2x			5	CO2	L3
6			Solve y11+3y1+	2y= 1+3x+x <sup>2.</sup>				5	CO2	L3
7			Solve y <sup>111</sup> +y <sup>11</sup>	-4y¹ -4y= 3€	e <sup>x–</sup> 4x-6.			5	CO2	L3
8			Solve $\frac{d^3y}{dx^3}$ +	$y = Cos(\pi/$	$(2^{-}x) + e^{x}$			5	CO2	L3
9			Solve $\frac{d^2x}{dt^2} + dx$	$4\frac{dx}{dt}$ +29 x=	=0. Find y v	vhen x(0	)=0 and	5	CO2	L3
10			$\frac{dt}{dt}(0) = 15$ Solve $(D^3 + I)$	$D^2 - 4D - 4$	$y = 3e^{-x} - $	4x - 6		5	CO2	L3

11	Solve by the method of variation of parameters	5	CO2	L3
	$\frac{d^2 y}{dx^2} - 6\frac{dy}{dx} + 9 y = \frac{e^{3x}}{x^2}$			
12	Solve $x^2 y' + 5xy + 13 y = logx + x^2$	5	CO2	L3
13	Solve $\frac{d^2 y}{dx^2} + 3\frac{dy}{dx} + 2y = 1 + 3x + x^2$	5	CO2	L3
14	Solve by the method of variation of parameters $y'' - y = \frac{2}{1 + e^x}$	5	CO2	L3
15	Solve $(D^4 + 8D^2 + 16)y = 2\cos^2 x$	5	CO2	L3
	Solve $(3x+2)^2 y''+3(3x+2)y'-36y=8x^2+4x+1$	5	CO2	L3
3	$\frac{d^2 y}{dx^2} + 2\frac{dy}{dx} + 10 y + 37 \sin 3 x = 0.$ Find y	5	CO2	L3
16	Obtain the PDE by eliminating the arbitrary function z=f(x+at)+g(x-at)	5	CO3	L3
17	Form a PDE by eliminating arbitrary constants $\frac{x^{2}}{a^{2}} + \frac{y^{2}}{b^{2}} + \frac{z^{2}}{c^{2}} = 1$	5	CO3	L3
18	Solve $\frac{\partial^2 z}{\partial x \partial y} = \frac{x}{y}$ subject to the conditions $\frac{\partial z}{\partial x} = logx$ when y=1 and z=0 at x=1.	5	CO3	L3
19	Solve $(D^3+3D^2)x=1+t$	5	CO3	L3
20	Obtain the PDE of the function $\phi(xy+z^2,x+y+z)=0$	5	CO3	L3
21	Obtain The PDE by eliminating $\varphi$ and $\psi$ from the relation $z = x \phi(y) + y \psi(x)$	5	CO3	L3
22	Solve $\frac{\partial^2 z}{\partial x \partial y} = sinxsiny$ given that $\frac{\partial z}{\partial y} = -2siny$ when x=0 & z=0 when y is an odd multiple of $\frac{\pi}{2}$	5	CO3	L3
			1	

# D2. TEACHING PLAN - 2

Module - 3

Title:	Partial differential equations	Appr	12 Hrs
		Time:	
a	Course Outcomes	СО	Blooms
-	The student should be able to:	-	Level
1	Construct a variety of partial differential equations and solution by exact	CO3	L3
	methods/method of separation of variables		
b	Course Schedule		
Class No	Portion covered per hour	-	-
1	Formation of PDE's by elimination of arbitrary constants	CO3	L3

2	Formation of PDE's by elimination of arbitrary functions	CO3	L3
3	Solution of non-homogeneous PDE by direct integration	CO3	L3
4	Homogeneous PDEs involving derivative with respect to one independent variable only	CO3	L3
5	Solution of Lagrange's linear PDE.	CO3	L3
6	Derivative of one dimensional heat equations	CO3	L3
7	Derivative of one dimensional wave equations	CO3	L3
8	solutions by the method of separation of variables.	CO3	L3
с	Application Areas	-	-
3	It is used to describe a wide variety of phenomena such as sound,heat and diffusion.	CO3	L3
3	It is used to describe a wide variety of phenomena such as electrostatics,electrodynamics and quantum mechanics.	CO3	L3
d	Review Questions	-	-
-		-	-
1	Solve by eliminating arbitrary constants a) $2z = \frac{x^2}{a^2} + \frac{y^2}{b^2}$ . b). $(x - a)^2 + (y - b)^2 = z^2 Cot^2 \alpha$	CO3	L3
2	Solve by eliminating arbitrary functions 1. $z = y^2 + 2f\left(\frac{1}{x} + \log y\right)$ . <sup>2.</sup> $z = yf(x) + x\phi(y)$	CO3	L3
3	Find the solution of the heat equation by the method of separation of variables.	CO3	L3
4	Find the solution of the wave equation by the method of separation of variables.	CO3	L3
5	Derive D'Alemberts solution of the wave equation.	CO3	L3
6	A tightly stretched string with fixed end points at x=0, $x = l$ is initially in	CO3	L3
	a position $y = a \sin^3 \left( \frac{\Pi x}{l} \right)$ and released from rest. Find the displacement $y(x, t)$ at any time t		
7	A string is stretched and fastened to two points l apart. Motion is started by displacing the string in the form $y = a \sin\left(\frac{\Pi x}{l}\right)$ from which it is released at time t=0. show that the displacement of any point at a distance x from one and at time t is given by $y(x,t) = a \sin\left(\frac{\Pi x}{l}\right) \cos\left(\frac{\Pi ct}{l}\right)$	CO3	L3
8	Derive one dimentional Heat equation.	CO3	L3
9	Derive one dimensional wave equation.Find the solution of two – dimentional Laplace equation by the method of separation of variables.	CO3	L3
10	Find the solution of two – dimentional Laplace equation by the method of separation of variables.	CO3	L3
11	An insulated rod of length $$ / has its end Aand B maintained at $0^{ m o}{ m c}$	CO3	L3
	and $100^{\circ}$ c respectively until steady state condition prevail. If B is		
	suddenly reduce to $O^{0}$ c and maintained at $O^{0}$ c find the temperature at a distance x from A at time 't',		
12	Calve by divertiate antice $\partial Z$	CO3	L3
	Solve by direct integration $\frac{d}{\partial y} = -2Siny$		

13	Solve by direct integration $\frac{\partial^2 z}{\partial x^2} + 4z = 0$	CO3	L3
14	Solve by direct integration $\frac{\partial^3 z}{\partial x^2 \partial y} = Cos(2x + 3y)$	CO3	L3

### Module – 4

Title:	Infinite series and Power series solutions	Appr	13 Hrs
a	Course Outcomes	CO	Blooms
-	The student should be able to:	-	
1	Explain the applications of infinite series and obtain series solution of ordinary differential equation	CO4	L3
b	Course Schedule		
<b>Class No</b>	Portion covered per hour	-	-
1	Series of positive terms-convergence and divergence.	CO4	L3
2	Cauchy's root test	CO4	L3
3	D'Alembert's ratio test(without proof)-illustrative examples.	CO4	L3
4	Series solution of Bessel's differential equation	CO4	L3
5	Bessel's function of first kind-orthogonality	CO4	L3
6	Series solution of Legendre differential equation	CO4	L3
7	Legendre polynomial	CO4	L3
8	Rodrigue's formula	CO4	L3
С	Application Areas	-	-
4	It is used for analysis of current flow and sound waves in electric circuits.	CO4	L3
4	It is used in nuclear engineering analysis.	CO4	L3
d	Review Questions	-	-
1	$\sum_{n=1}^{\infty} n^n x^n$	CO4	L3
	Test the convergence of $\sum_{n=1}^{n} \frac{n \cdot n}{(n+1)^n}$ ,x>0		
2	Obtain the range of convergence of the series $\frac{2x}{1^{2}} + \frac{3^{2}x^{2}}{2^{3}} + \frac{4^{3}x^{3}}{3^{4}} + \frac{5^{4}x^{4}}{4^{5}} + \dots, ; x > 0$	CO4	L3
3	Test for convergence or divergence of the series $\sum_{n=1}^{\infty} \frac{n!}{(n^n)^2}$	CO4	L3
4	Test for convergence or divergence of the series $\frac{1}{2\sqrt{1}} + \frac{x^2}{3\sqrt{2}} + \frac{x^4}{4\sqrt{3}} + \dots, x > 0$	CO4	L3
5	Test the convergence of the series: $1 + \frac{2^2}{2!} + \frac{3^2}{3!} + \frac{4^2}{4!} + \dots$	CO4	L3
6	Test the convergence of the series: $\left[\frac{2^{2}}{1^{2}} - \frac{2}{1}\right]^{-1} + \left[\frac{3^{3}}{2^{3}} - \frac{3}{2}\right]^{-2} + \left[\frac{4^{4}}{3^{4}} - \frac{4}{3}\right]^{-3} + \dots$	CO4	L3
7	Let us discuss the convergence of the series $\sum_{n=1}^{\infty} \frac{(n+1)^n x^n}{n^{n+1}}$	CO4	L3
8	Prove that $J_{1/2}(x) = \sqrt{\frac{2}{\pi x}} sinx$	CO4	L3
9	Express $f(x) = x^4 + 3x^3 - x^2 + 5x - 2$ in terms of legendres polynomials.	CO4	L3

10	Express the following polynomials in terms of legendres polynomials $(x+1)(x+2)(x+3)$	CO4	L3
11	If $\alpha$ and $\beta$ are the roots of $J_n(x)=0$ then $\int_{0}^{1} x J_n(\alpha x) J_n(\beta x) dx = 0; if \alpha \neq \beta$	CO4	L3
12	Using Rodrigues formula, obtain the expressions for $P_2(\cos\theta)$ , $P_3(\cos\theta)$	CO4	L3
13	Use Rodrigue's formula to find $P_n(x)$ for n=0,1,2,3,4	CO4	L3
14	If $x^3 + 2x^2 - x + 1 = aP_0(x) + bP_1(x) + cP_2(x) + dP_3(x)$ . Find the values of a,b,c,d	CO4	L3
15	Let us discuss the convergence of the series $\sum_{n=1}^{\infty} \frac{(n+1)^n x^n}{n^{n+1}}$	CO4	L3
16	Prove that $J_{-1/2}(x) = \sqrt{\frac{2}{\pi x}} \cos x$	CO4	L3
17	Derive series solution of Bessels DE leading to Bessel functions.	CO4	L3

### Module – 5

Title:	Numerical Method	ds							Appr	13 Hrs
а	Course Outcome	25							CO	Blooms
-	The student shou	ld be able to	:						-	Level
1	Explain the applied differential equation	cations of ir	finite	seri	es and ob	otain ser	ies solutio	n of ordinary	CO5	L3
b	Course Schedule	9								
Class No	Portion covered	per hour							-	-
1	Finite diferences								CO5	L3
2	Newtons forward	and backwa	rd dif	feren	ce formula	1			CO5	L3
3	Newtons divdede	lewtons divdede difference formula								
4	agranges formula									L3
5	Newton raphson								CO5	L3
6	Regula falsi method									L3
7	Numerical integra	tions,							CO5	L3
8	Simpsons 1/3 rd rule problems									L3
9	Simpsons 3/8 th rule problems									L3
10	Weddles rule and	problems							CO5	L3
C	Application Area								-	-
5	Used in network s	imulation ar	nd we	athe	r prediction	)		- 1 Caralia a	005	L3
5	Used in computer	science for	roota	aigor	ithm and m	nuitiaime	ensional ro	ot finding.	005	L3
<b>0</b>	Review Question	15 toble find t	h.aa	wah a	r of otudoo	towhok	ava abtai	ad loss than	-	-
	45	g table find t	ne nu	eami	r of studen	its who r	lave obtair	ied less than	005	L3
	Marks	30-40	40-5	0	50-60	60-70	70-80			
	No. of students	31	42		51	35	31			
		former de first	4h a		of		following	abla	005	1.2
2	Using Lagranges		the v	aiue	or yatx=		ionowing t		005	LJ
	X	0		1		2		5		
	у	2		3		12		147		

3	Find $\int_{4}^{5.2} (log)$	(x) dx using v	veddles rule ta	king the step s	size of 0.2		CO5	L3
4	Evaluate $\int_{0}^{1} ($ equal parts.H	$\left(\frac{x}{1+x^2}\right) dx$ by dence find an	v using simpso approximate v	n's (1/3) rd rul $ralue$ of $\log\sqrt{2}$	e dividing the	interval into 6	CO5	L3
5	Using the Newtons Raphson method find the real root of the equation 3x=cosx+1							L3
6	Using Regula	z=1.2	CO5	L3				
7	The area of a circle (A) corresponding to the diameter (D) is given below.							L3
	D	80	85	90	95	100		
	A	5026	5674	6362	7088	7854		
	Find the area formula.	terpolation						
7	Evaluate $\int_{0}^{0.3} \sqrt{1-8x^3} dx$ by using simpson's (3/8) th rule by taking 7 ordinates.							
8	Using the Ne	wtons Raphs	on method find	d the real root	of the equatio	n 3x=sinx+1	CO5	L3

## E2. CIA EXAM – 2

# a. Model Question Paper - 2

Crs Code	e:	18MAT21	Sem:	II	Marks:	50	Time:	1.30 minu	0 minutes			
Cour	se:	Advanced C	alculus and	Numerical M	lethods							
-	-	Note: Answ	/er all quest	ions, each d	carry equal	marks. Mod	ule : 3, 4	CO	Level	Marks		
1	а	If $\vec{F} = \nabla(x)$	$y^3 z^2$ ) Find	div $ec{F}$ and c	curl $ec{F}$ at the p	oint (1, -1, 1	)	CO1	L3	6		
	b	Find the ang (2,-1,2)	gle between t	he surfaces	$x^2 + y^2 + z^2 =$	=9 and z	$=x^2 + y^2 - 3$	at CO1	L3	6		
	С	Find the dire direction of	ectional deriv 2i-j-2k.	ative of $\phi =$	$x^2$ yz +4 x z	<sup>2</sup> at(1, -2, -1	) in the	CO1	L3	6		
	d	Show that $\vec{F}$ function $\varphi$	$\overline{F} = (y+z)i +$ such that $\vec{F}$	o find a scala	r CO1	L3	7					
2	а	Find the wor $\vec{F} = 3x^2i + ($	$\frac{1}{2} xz - y j j + \frac{1}{2} zz - y j + \frac{1}{2} zz - y j + \frac{1}{2} zz - y zz - zz -$	oving a parti $z_k$ along the	cle in the for e straight line	ce field from (0,0,0)	) to (2,1,3)	CO1	L3	6		
	b	Use the dive suface, S is x=0,y=0,z=0	Use the divergence theorem to evaluate $\iint_{s} \vec{F} \cdot \hat{n} ds$ . Find the flux across the suface, S is the rectangular parallelopiped bounded by x=0,y=0,z=0,x=2,y=1,z=3 where $\vec{F}=2xyi+yz^{2}j+xzk$							6		
	С	Evaluate by boundary in	Stokes theorem the rectangle	$ \begin{array}{l} \operatorname{rem} \oint_{c}  \operatorname{sinz} \\ \circ & 0 \leq x \leq  \end{array} $	dx - cosxdy $\pi, 0 \le y \le 1$	+ sinydz) w, $z=3$	here c is the	CO1	L3	6		
	d	By using Gr	eens theoren	n evaluate	$\int_{a} \left( \left( y - sinx \right) \right)$	dx+cosxdy	,) where c is	CO1	L3	7		

		the triangle in	iangle in the xy-plane bounded by the lines x=0, y=0, x= $\pi/2$ , y=										
3	а	From the follo than 45	owing table f	ind the nu	ımbe	er of stude	ents	who ha	ave obt	ained less	CO5	L3	6
		Marks	30-40	40-5	0	50-60	6	0-70	70-80	)			
		No. of stude	nts 31	42		51	3	5	31				
	b	Using Lagran	iges formula	find the v	value	ofyatx	=6 k	by the f	ollowin	g table	CO5	L3	6
		x	0		1	<b>y</b>		2		5			
		у	2		3			12		147			
	с	Find $\int_{4}^{5.2} (logz)$	(x) dx using	weddles r	ule t	aking the	ste	p size o	of 0.2		CO5	L3	6
	d	Evaluate $\int_{0}^{1} \left(\frac{x}{1+x^2}\right) dx$ by using simpson's (1/3) rd rule dividing the interval into 6 equal parts. Hence find an approximate value of $\log \sqrt{2}$								CO5	L3	7	
						OR							
4	а	Using the Ne 3x=cosx+1	wtons Raph	son metho	od fir	nd the rea	ıl roo	ot of the	e equa	tion	CO5	L3	6
	b	Using Regula	a-falsi metho	d find the	real	root of th	e ec	quation	$x \log_1$	$_{0}x = 1.2$	CO5	L3	6
	С	The area of a	a circle (A) co	prrespond	ling t	to the diar	nete	er (D) is	s given	below.	CO5	L3	6
		D	80	85		90	9	95	1	00			
		A 5026 5674 6362 7088 7854								854			
		Find the area corresponding to diameter 105 using an appropriate interpolation formula.											
	d	Evaluate $\int_{0}^{0.3} \sqrt{1-8x^3} dx$ by using simpson's (3/8) th rule by taking 7 ordinates.							king 7	CO5	L3	7	

## b. Assignment – 2

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

	Model Assignment Questions									
Crs C	ode:	18MAT2	1 Sem:	II	Marks:	10				
Cours	Course: Advanced Calculus and Numerical Methods Module : 3, 4									
Note:	ote: Each student to answer 2-3 assignments. Each assignment carries equal mark.									
SNo USN Assignment Description							Marks	CO	Level	
1					$\sum_{n=1}^{\infty} n^n x^n$			5	CO4	L3
			Test the conv	ergence of	$\sum_{n=1}^{n} \frac{n}{(n+1)}$	<u>_</u> ,x>0				
2			Obtain the rar	nge of conve	rgence of th	ne series		5	CO4	L3
			$\frac{2x}{1^2} + \frac{3^2x^2}{2^3}$	$+\frac{4^3x^3}{3^4}+\frac{5^4x^3}{4}$	$\frac{x^{4}}{5}$ +;	<i>x</i> >0				
3			Test for conve	ergence or d	ivergence o	f the series	$\sum_{n=1}^{\infty} \frac{n!}{(n^n)^2}$	5	CO4	L3

4	Test for convergence or divergence of the series	5	CO4	L3
	$\frac{1}{2\sqrt{1}} + \frac{x^2}{3\sqrt{2}} + \frac{x^4}{4\sqrt{3}} + \dots, x > 0$			
5	Test the convergence of the series: $1 + \frac{2^2}{2!} + \frac{3^2}{3!} + \frac{4^2}{4!} + \dots$	5	CO4	L3
6	Test the convergence of the series: $\left[\frac{2^2}{1^2} - \frac{2}{1}\right]^{-1} + \left[\frac{3^3}{2^3} - \frac{3}{2}\right]^{-2} + \left[\frac{4^4}{3^4} - \frac{4}{3}\right]^{-3} + \dots$	5	CO4	L3
7	Let us discuss the convergence of the series $\sum_{n=1}^{\infty} \frac{(n+1)^n x^n}{n^{n+1}}$	5	CO4	L3
8	Prove that $J_{1/2}(x) = \sqrt{\frac{2}{\pi x}} sinx$	5	CO4	L3
9	Express $f(x)=x^4+3x^3-x^2+5x-2$ in terms of legendres polynomials.	5	CO4	L3
10	Express the following polynomials in terms of legendres polynomials $(x+1)(x+2)(x+3)$	5	CO4	L3
11	If $\alpha$ and $\beta$ are the roots of $J_n(x)=0$ then $\int_0^1 x J_n(\alpha x) J_n(\beta x) dx = 0; if \alpha \neq \beta$	5	CO4	L3
12	Using Rodrigues formula, obtain the expressions for $P_2(\cos\theta)$ , $P_3(\cos\theta)$	5	CO4	L3
13	Use Rodrigue's formula to find $P_n(x)$ for n=0,1,2,3,4	5	CO4	L3
14	If $x^3+2x^2-x+1=aP_0(x)+bP_1(x)+cP_2(x)+dP_3(x)$ . Find the values of a,b,c,d	5	CO4	L3
15	Let us discuss the convergence of the series $\sum_{n=1}^{\infty} \frac{(n+1)^n x^n}{n^{n+1}}$	5	CO4	L3
16	Prove that $J_{-1/2}(x) = \sqrt{\frac{2}{\pi x}} cosx$	5	CO4	L3
17	Derive series solution of Bessels DE leading to Bessel functions.	5	CO4	L3

## F. EXAM PREPARATION

1. University Model Question Paper

Course:	Advanced cal	culus and N	lumerical me	ethods		Month / Year	May /2018
Crs Code:	18MAT21	Sem:		Marks:	100	Time:	180 minutes

Mod	Note	Answer all FIVE full questions. All questions carry equal marks.	Marks	CO	Level
ule 1	а	If $\vec{F} = \nabla(x y^3 z^2)$ Find div $\vec{F}$ and curl $\vec{F}$ at the point (1, -1, 1)	6	CO1	L3
	b	Find the angle between the surfaces $x^2 + y^2 + z^2 = 9$ and $z = x^2 + y^2 - 3$ at (2 -1 2)	7	CO1	L3
	С	Evaluate by Stokes theorem $\oint (sinzdx - cosxdy + sinydz)^{\text{where c is the}}$	7	CO1	L3
		boundary in the rectangle $0 \le x \le \pi, 0 \le y \le 1, z = 3$			
		OR			
2	а	Find the work done in moving a particle in the force field $\vec{F} = 3 x^2 i + (2 xz - y) i + zk$ along the straight line from (0.0.0) to (2.1.3)	6	CO1	L3
	b	Use the divergence theorem to evaluate $\iint_{a} \vec{F} \cdot \hat{n}  ds$ . Find the flux across the	7	CO1	L3
		suface, S is the rectangular parallelopiped bounded by			
		x=0,y=0,z=0,x=2,y=1,z=3 where $F = 2 xyi + y z^2 j + xzk$			
	С	Find the directional derivative of $\phi = x^2 yz + 4xz^2$ at(1, -2, -1) in the direction of 2i-j-2k.	7	CO1	L3
3	а	Solve $\frac{d^2x}{dt^2}$ + 4 $\frac{dx}{dt}$ + 29 x = 0. Find y when x(0)=0 and $\frac{dx}{dt}(0)$ = 15	6	CO2	L3
	b	Solve $(D^3 + D^2 - 4D - 4)y = 3e^{-x} - 4x - 6$	7	CO2	L3
	С	Solve by the method of variation of parameters $\frac{d^2 y}{dx^2} - 6\frac{dy}{dx} + 9 y = \frac{e^{3x}}{x^2}$	7	CO2	L3
		OR			
4	а	Solve $\frac{d^2 y}{dx^2} + 3\frac{dy}{dx} + 2y = 1 + 3x + x^2$	6	CO2	L3
	b	Solve by the method of variation of parameters $y'' - y = \frac{2}{1 + e^x}$	7	CO2	L3
	С	Solve $(D^4 + 8D^2 + 16) y = 2\cos^2 x$	7	CO2	L3
5	а	Obtain the PDE by eliminating the arbitrary function z=f(x+at)+g(x-at)	6	CO3	L3
	b	Form a PDE by eliminating arbitrary constants $\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1$	7	CO3	L3
	C	Solve $\frac{\partial^2 z}{\partial x \partial y} = \frac{x}{y}$ subject to the conditions $\frac{\partial z}{\partial x} = logx$ when y=1 and z=0 at x=1.	7	CO3	L3
6	a	Obtain the RDE of the function $f(m + r^2 + r + r + r) = 0$	6	CO3	13
	a	Obtain the PDE of the function $\phi(xy+z, x+y+z)=0$		000	
	b	Obtain The PDE by eliminating $\varphi$ and $\psi$ from the relation $z = x \phi(y) + y \psi(x)$	7	CO3	L3
	С	Solve $\frac{\partial^2 z}{\partial x \partial y} = sinxsiny$ given that $\frac{\partial z}{\partial y} = -2siny$ when x=0 & z=0 when	7	CO3	L3

		y is an odd multir	ble of $\frac{\pi}{2}$										
7	а	Test the converg	ence of	$\sum_{n=1}^{\infty} \frac{n^n x^n}{(n+1)^n}$	$\frac{x^n}{1)^n}$	,x>0					6	CO4	L3
	b	Obtain the range $\frac{2x}{1^2} + \frac{3^2x^2}{2^3} + \frac{4}{2^3}$	of conve $\frac{x^{3}}{3^{4}} + \frac{5^{4}}{4}$	$\frac{x^4}{5} + \dots$	f the ; x:	series >0					7	CO4	L3
	С	Prove that $J_{1/2}$	$(x) = \sqrt{\frac{1}{\pi}}$	$\frac{2}{x}$ sinx							7	CO4	L3
					OF	R							
8	а	Test for converge	ence or d	ivergence	e of tl	he series	$\sum_{n=1}^{\infty}$	$\frac{n!}{(n^n)^2}$			6	CO4	L3
	b	Test for converge $\frac{1}{2\sqrt{1}} + \frac{x^2}{3\sqrt{2}} + \frac{x^2}{4}$	The set for convergence or divergence of the series $\frac{1}{2\sqrt{1}} + \frac{x^2}{3\sqrt{2}} + \frac{x^4}{4\sqrt{3}} + \dots, x > 0$								7	CO4	L3
	С	If $\alpha$ and $\beta$ are the roots of $J_n(x)=0$ then $\int_0^1 x J_n(\alpha x) J_n(\beta x) dx = 0; if \alpha \neq \beta$								7	CO4	L3	
9	а	From the followin than 45	g table fi	nd the nu	imbe	r of studei	nts	who ha	ave obtaine	ed less	6	CO5	L3
		Marks	30-40	40-5	0	50-60	6	0-70	70-80	]			
		No. of students	31	42		51	3	5	31				
	b	Using Lagranges	formula	find the v	alue	of y at x=	=6 b	y the f	ollowing ta	ble	7	CO5	L3
		x	0		1			2		5			
		у	2		3			12		147			
	С	Find $\int_{4}^{5.2} (logx) dx$	<sub>χ</sub> using v	weddles r	ule ta	aking the s	step	o size (	of 0.2		7	CO5	L3
					OR	2						0.0.7	
10	а	Using the Newtons Raphson method find the real root of the equation 3x=cosx+1								6	CO5	L3	
	b	Using Regula-falsi method find the real root of the equation $x \log_{10} x = 1.2$						=1.2	7	CO5	L3		
	С	The area of a circ	cle (A) co	prrespond	ing to	o the diam	ețe	er (D) is	s given bel	ow.	7	CO5	L3
		D 80		85	ę	90	ę	95	100				
		A 5026 5674 6362 7088 7854											
		Find the area cor interpolation form	the area corresponding to diameter 105 using an appropriate polation formula.										

#### 2. SEE Important Questions

Course: Advanced calculus and Numerical Methods

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Crs C	ode:	18MAT21 Sem: 2 Marks: 100 Time:		180 mi	nutes
	Note	Answer all FIVE full questions. All questions carry equal marks.	-	-	
Mod	Qno.	Important Question	Marks	CO	Year
1	а	If $\vec{F} = \nabla(x y^3 z^2)$ Find div $\vec{F}$ and curl $\vec{F}$ at the point (1, -1, 1)	6	CO 1	2013
	b	Find the angle between the surfaces $x^2 + y^2 + z^2 = 9$ and $z = x^2 + y^2 - 3$ at (21.2)	7	CO1	2015
	С	Find the directional derivative of $\phi = x^2 yz + 4 x z^2$ at(1, -2, -1) in the direction of 2i-i-2k.	7	CO1	2016
		OR			
2	а	Find the work done in moving a particle in the force field $\vec{E} = 3 x^2 i \pm (2 x_2 - y) i \pm z_k$ along the straight line from (0,0,0) to (2,1,3)	6	CO1	2014
	b	Use the divergence theorem to evaluate $\iint_{c} \vec{F} \cdot \hat{n}  ds$ . Find the flux across the	7	CO1	2016
		suface, S is the rectangular parallelopiped bounded by $x=0, y=0, z=0, x=2, y=1, z=3$ where $\vec{E}=2$ unit, $y=2^2$ is usely			
		x = 0, y = 0, z = 0, x = 2, y = 1, z = 3 where $F = 2xyl + yz$ $f + xzk$			
	С	Evaluate by Stokes theorem $\oint_{c} (sinzdx - cosxdy + sinydz)$ where c is the boundary in the rectangle $0 \le x \le \pi, 0 \le y \le 1, z = 3$	7	CO1	2017
3	а	Solve $\frac{d^2x}{dt^2} + 4\frac{dx}{dt} + 29x = 0$ . Find y when x(0)=0 and $\frac{dx}{dt}(0) = 15$	6	CO2	2013
	b	$\frac{dt}{dt} = \frac{dt}{dt}$	7	CO2	2013
	C	Solve $(D+D-4D-4)y=3e^{-4x-6}$ Solve by the method of variation of parameters $\frac{d^2y}{dx^2} - 6\frac{dy}{dx} + 9y = \frac{e^{3x}}{x^2}$	7	CO2	2013
		OR			
4	а	Solve $\frac{d^2 y}{dx^2} + 3\frac{dy}{dx} + 2y = 1 + 3x + x^2$	6	CO2	2013
	b	Solve by the method of variation of parameters $y'' - y = \frac{2}{1 + e^x}$	7	CO2	2012
	С	Solve $(D^4 + 8D^2 + 16) y = 2\cos^2 x$	7	CO2	2012
					2012
5	а	$\frac{d^2 y}{dx^2} + 2\frac{dy}{dx} + 10 y + 37 \sin 3 x = 0.$ Find y	6	C03	2010
	b	Solve $x^2 y' + 5xy' + 13 y = logx + x^2$	7	C03	2010
	С	Solve $(3x+2)^2 y''+3(3x+2)y'-36 y=8x^2+4x+1$	7	C03	2012
	_	OR		000	2012
6	а	Solve $x^2y + 5xy + 13y = sinx + x^2$	6	C03	
	b	Solve $(3x+2)^2 y''+3(3x+2) y'-36 y=8x^3+2x 2 sinx$	7	C03	2012
	С	$\frac{d^2 y}{dx^2} + 2\frac{dy}{dx} + 10 y + 37 \sin 3 x = 0.$ Find y	7	C03	2013

7	а	Obtain the PDE t z=f(x+at)+g(x-at)	oy elimina	ting the a	arbitr	rary functio	'n				6	CO3	2010
	b	Form a PDE by e	eliminating	arbitrar	y cor	instants $\frac{x^2}{a^2}$	$+\frac{y^2}{b^2}$	$+\frac{z^2}{c^2}=1$			7	CO3	2014
	С	Solve $\frac{\partial^2 z}{\partial x \partial y} =$ at x=1.	$\frac{x}{y}$ subject	t to the c	ondi	tions $\frac{\partial z}{\partial x}$ =	=log	x when	y=1 an	d z=0	7	CO3	2015
				OR									
7	а	Test the converg	ence of	$\sum_{n=1}^{\infty} \frac{n^n x}{(n+1)^n}$	$\frac{x^n}{1)^n}$	,x>0					6	CO4	2006
	b	Obtain the range $\frac{2x}{1^2} + \frac{3^2x^2}{2^3} + \frac{4}{3^2}$	of conver $\frac{3}{3}x^{3} + \frac{5^{4}x}{4^{5}}$	rgence o	f the ; x	series >0					7	CO4	2008
	С	Prove that $J_{1/2}$	$(x) = \sqrt{\frac{2}{\pi}}$	$\frac{1}{x}$ sinx							7	CO4	2016
					OF	र							
8	а	Test for convergence or divergence of the series $\sum_{n=1}^{\infty} \frac{n!}{(n^n)^2}$					6	CO4	2008				
	b	Test for converge $\frac{1}{2\sqrt{1}} + \frac{x^2}{3\sqrt{2}} + \frac{x^2}{4}$	The convergence of divergence of the series $\frac{1}{1} + \frac{x^2}{3\sqrt{2}} + \frac{x^4}{4\sqrt{3}} + \dots, x > 0$						7	CO4	2006		
	С	If $\alpha$ and $\beta$ $\int_{0}^{1} x J_{n}(\alpha x) J_{n}$	are the r $(\beta x) dx$	=0; if c	$J_n(\alpha \neq \beta)$	(x)=0 the	en				7	CO4	2014
9	а	From the followin than 45	ig table fir	nd the nu	imbe	r of studen	its w	ho have o	obtaine	ed less	6	C05	2013
		Marks	30-40	40-5	0	50-60	60-	-70 70-	-80				
		No. of students	31	42		51	35	31					
	b	Using Lagranges	formula f	ind the v	alue	of y at x=	6 by	the follow	ving ta	ble	7	C05	2015
		X	0		ו כ		2	ວ		5 147			
	<u> </u>	<b>y</b> 5.2	Z		3			Ζ		147	7	C05	2016
	C	Find $\int_{4}^{\infty} (logx) dx$	$_{\chi}$ using w	veddles r	ule t	aking the s	step :	size of 0	.2		,	000	2010
					OF	۲		<u> </u>				0.0	
10	а	Using the Newtons Raphson method find the real root of the equation 3x=cosx+1					6	C05	2014				
	b	Using Regula-falsi method find the real root of the equation $x \log_{10} x = 1.2$						=1.2	7	C05	2016		
	С	The area of a circle (A) corresponding to the diameter (D) is given below.							ow.	7	C05	2015	
		D 80	1	85	9	90	95	5	100				

A	5026	5674	6362	7088	7854		
Find the interpola	area correspon ation formula.	ling to diamet	ter 105 using	an appropria	ite		

#### G. Content to Course Outcomes

1. TLPA Parameters

# Table 1: TLPA – Example Course

Мо	Course Content or Syllabus	Content	Blooms'	Final	Identified	Instructio	Assessment
dul	(Split module content into 2 parts which have	Teachin	Learning	Bloo	Action	n	Methods to
e-	similar concepts)	g Hours	Levels	_ms'	Verbs for	Methods	Measure
#			for	Level	Learning	for	Learning
			Content	_		Learning	
A		C	D	E	F	G	
1	Scalar and Vector fields, Gradient, directional	4	1.0	L3	-	- Lecture	- Slip Test
	derivative, curi and divergence-physical		- L3		-	-	-
	interpretation: solenoidal and irrotational vector				understan	-	-
4	lieus-illustrative problems.	6	1.2	10	u anali <i>m</i> a	Looturo	
1	Line integrals, ineorems of Green, Gauss and	ю	- L3	LJ	-analyze	- Lecture	- Accienment
	done by force and flux				-	- Tutonai	Assignment
						-	-
2	Second order Linear ODE's with constant	1	_13	13	annly		
2	coefficients-Inverse differential operators	-	- 13		-арріу -		Assianment
	method of variation of parameters		20				-
2	Cauchy's and Legendre homogeneous	6		13	-annly	- Lecture	- Slip Test
2	equations Applications to oscillations of a	Ū	-13		_	-	-
	spring and I -C-R circuits						
3	Formation of PDE's by elimination of arbitrary	6		L3	_	- Lecture	- Slip Test
	constants and functions. Solution of non-		- L3		understan	-	-
	homogeneous PDE by direct integration.				d		
	Homogeneous PDEs involving derivative with				_		
	respect to one independent variable only.						
	Solution of Lagrange's linear PDE. Derivative of						
	one dimensional heat and wave equations and						
	solutions by the method of separation of						
	variables.						
3	Derivative of one dimensional heat and wave	4	- L3	L3	apply	- Lecture	-
	equations and solutions by the method of					<ul> <li>Tutorial</li> </ul>	Assignment
	separation of variables.					-	-
							-
4	Series of positive terms-convergence and	5		L3	analyze	- Lecture	-
	divergence. Cauchy's root test and		- L3			- Tutorial	Assignment
	D'Alembert's ratio test(without proof)-illustrative					-	-
-	examples.	-				1 - 1	-
4	Series solution of Bessel's differential equation	5	- L3	L3		- Lecture	-
	leading to Jn(x)-Bessel's function of first kind-				appiy	- Tutoriai	Assignment
	orthogonality. Series solution of Legendre					-	-
	polynomials. Roongue's formula(without						-
F	piour, piourenno. Einite differences Internalation/avtranalation	5		12		Lecture	
0	using Newton's forward and backward	5	13	ப	analyze		- Assignment
	difference formulae Newton's divided		- LJ		-anaiyze	_	-
	difference and Lagrange's formulae(All					-	
	formulae without proof)						
5	Solution of polynomial and transcendental	5		13		Lecture	Assignment
	equations- Newton-Ranhson and Regula-Falsi	5	13		apply	LCOULD	7.35ignment
	methods(only formulae)-illustrative				abbil		
	examples. Simpson's $(1/3)^{rd}$ and $(3/8)^{th}$ rules						
	Weddle's rule(without proof)-Problems.						
-	Total			-			

### 2. Concepts and Outcomes:

### Table 2: Concept to Outcome – Example Course

Мо	Learning or	Identified	Final Concept	Concept Justification	CO Components	Course Outcome
dul	Outcome from	Concepts		(What all Learning	(1.Action Verb,	
e-	study of the	from		Happened from the	2.Knowledge,	
#	Content or	Content		study of Content /	3.Condition /	Student Should be
	Syllabus			Syllabus. A short	Methodology,	able to
					4.Denchmark)	
Λ	1	1	K		Λ/	N
	I Scalar and	Vectors	Vector	L Illustrato the	Vector	/v Illustrate Vector
'	Vector fields	differentiat	Differentia	applications of	Differentiation	Differentiation
	Gradient.	ion	tion	multivariate calculus	Binoroniation	Binoronauton
	directional			to understand the		
	derivative,curl			solenoidal and		
	and			irrotational vectors.		
	divergence-					
	physical					
	interpretation:					
	solenoidal and					
	irrotational					
	vector fields-					
	nrobloms					
1	Line Integrals	integration	Vector	Evhihit the	Vector Integration	Analyze Vector
'	Theorems of	Integration	Integration	interdependence of		Integration
	Green, Gauss		integration	line, surface and		integration
	and			volume integrals.		
	Stokes(withou			Ū		
	t proof).					
	Applications					
	to work done					
	by force and					
	TIUX.		Ondia and	Demonstrate verieve	Ondinan Differential	A mahama Ondina ma
2	Second order	ODE	Ordinary Differential	Demonstrate various	Ordinary Differential	Analyze Ordinary
	with constant			through higher order	equations	
	coefficients-		equations	differential equations		
	Inverse			and solve such		
	differential			linear.Ordinary		
	operators,			differential equation.		
	method of					
	variation of					
	parameters.					
2	Cauchy's and	ODE	Ordinary	Io study the	Ordinary Differential	Analyze Ordinary
	Legendre		Differential	penaviour of LCR	equations	Differential equations
	nomogeneous		equations	circuits and		
	Applications			osciliations Ol springs using		
	to oscillations			Ordinary differential		
	of a spring			equation.		
	and L-C-R					
	circuits.					
3	Formation of	PDE	Partial	Construct a variety	Partial Differential	Analyze Partial
	PDE's by		Differential	of partial differential	equations	Differential equations
	elimination of		equations	equations.		
	arbitrary					
	constants and					

_					
	functions. Solution of non- homogeneous PDE by direct integration. Homogeneou s PDEs involving derivative with respect to one independent variable only. Solution of Lagrange's linear PDE. Derivative of one dimensional heat and wave equations and solutions by the method of separation of variables.	Partial	To find solution by	Partial Differential	Analyze Partial
	dimensional heat and wave equations and solutions by the method of separation of variables.	Differential equations	exact methods/method of separation of variables.	equations	Differential equations
	4 Series of positive terms- convergence and divergence. Cauchy's root test and D'Alembert's ratio test(without proof)- illustrative examples.	Infinite series	To explain the applications of infinite series.	Infinite series	Understand Infinite series
	4 Series solution of Bessel's differential equation leading to Jn(x)-Bessel's function of first kind- orthogonality. Series solution of	Power series	To obtain series solution 0f Ordinary differential equation.	Power series	Analyze Power series

Legendre polynomials. Rodrigue's formula(witho ut proof),proble ms.				
5 Finite differences, Interpolation/e xtrapolation using Newton's forward and backward difference formulae, Newton's divided difference and Lagrange's formulae(All formulae without proof).	Numeria	cal Apply the know of num methods in modeling of va physical engineering phenomena.	ledgeNumerical method lerical the arious and	ls Analyze Numerical methods
5 Solution or polynomial and transcendenta l equations Newton- Raphson and Regula-Falsi methods(only formulae)- illustrative examples.Sim pson's (1/3) <sup>rr</sup> and (3/8) <sup>tf</sup> rules, Weddle's rule(without proof)- Problems	Nume meth	erical Numerical nods integration comprises a of algorithms calculating numerical valu definite integral	broad for the ue of	ods Analyze Numerical methods