Ref No:

SRI KRISHNA INSTITUTE OF TECHNOLOGY, BANGALORE

COURSE PLAN

Academic Year 2019

Program:	B E
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:	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:	CV/ISE
Semester:	2	Academic Year:	2018-19
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:	Veeresha A Sajjanara	Sign ..	Dt:
Checked By:	Pavani A	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.

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

	Newton-Raphson and Regula-Falsi methods(only formulae)-illustrative examples.Simpson's (1/3)rd and (3/8)th rules, Weddle's rule(without proof)-Problems.		methods	
-	**Total**	**54**	-	-

3. Course Material

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

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

Modules	Details	Chapters in book	Availability
A	**Text books (Title, Authors, Edition, Publisher, Year.)**	-	-
1	B.S.Grewal: Higher Engineering Mathematics, Khanna publishers, 43rd Ed.,2015.	1,2,10	In Dept
2	E.Kreyszig: Advanced Engineering Mathematics,John Wiley & Sons, 10th Ed.(Reprint),2016.		Not Available
B	**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" 11th Edition Tata McGraw-Hill,2010.	1,5,6,7	In Dept
4	Srimanta Pal & Subobh C Bhunia: "Engineering Mathematics", Oxford UniversityPress, 3rd 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
C	**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	e-learning@vtu		
C5	e-shikshana@vtu		
D	**Software Tools for Design**	-	-
E	**Recent Developments for Research**	-	-
F	**Others (Web, Video, Simulation, Notes etc.)**	-	-

4. Course Prerequisites

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

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

Modules	Course Code	Course Name	Topic / Description	Sem	Remarks	Blooms Level

-						
-						

5. Content for Placement, Profession, HE and GATE

The content is not included in this course, but required to meet industry & profession requirements and help students for Placement, GATE, Higher Education, Entrepreneurship, etc. Identifying Area / Content requires experts consultation in the area.
Topics included are like, a. Advanced Topics, b. Recent Developments, c. Certificate Courses, d. Course Projects, e. New Software Tools, f. GATE Topics, g. NPTEL Videos, h. Swayam videos etc.

Modules	Topic / Description	Area	Remarks	Blooms Level
1				
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.

Modules	Course Code.#	Course Outcome **At the end of the course, student should be able to . . .**	Teach. Hours	Concept	Instr Method	Assessment Method	Blooms' Level
1	18MAT21	Illustrate the applications of multivariate calculus to understand the solenoidal and irrotational vectors.	5	Vector Differentiation	Lecture	Assignment and slip test	L2
1	18MAT21	Exhibit the interdependence of line, surface and volume integrals.	5	Vector Integration	Lecture	Assignment and slip test	L3
2	18MAT21	Demonstrate various physical models through higher order differential equations and solve such linear .Ordinary differential equation.	5	Ordinary Differential equations	Lecture	Assignment and slip test	L3
2	18MAT21	To study the behaviour of LCR circuits and oscillations of springs using Ordinary differential equation..	5	Ordinary Differential equations	Lecture	Assignment and slip test	L3
3	18MAT21	Construct a variety of partial differential equations.	6	Partial Differential equations	Lecture	Assignment and slip test	L3
3	18MAT21	To find solution by exact methods/method of separation of variables.	4	Partial Differential equations	Lecture	Assignment and slip test	L3
4	18MAT21	To explain the applications of infinite series.	5	Infinite series	Lecture	Assignment and slip test	L3
4	18MAT21	To obtain series solution 0f Ordinary differential equation.	5	Power series	Lecture	Assignment and slip test	L3

5	18MAT21	Apply the knowledge of numerical methods in the modeling of various physical and engineering phenomena.	5	Numerical methods	Lecture	Assignment and slip test	L3
5	18MAT21	Numerical integration comprises a broad of algorithms for calculating the numerical value of definite integral.	5	Numerical methods	Lecture	Assignment and slip test	L3
-	**-**	**Total**	**50**	**-**	**-**	**-**	

2. Course Applications

Write 1 or 2 applications per CO.
Students should be able to employ / apply the course learnings to . . .

Modules	Application Area Compiled from Module Applications.	CO	Level
1	Used extensively in physics and engineering especially in the description of electromagnetic fields, gravitational fields and fluid flow.	1	L3
1	Used in computational electrodyanmics simulation.	2	L3
2	Used in computational fluid dynamics	3	L3
2	Used in studying the behaviour of LCR circuits and oscillations of springs	4	L3
3	It is used to describe a wide variety of phenomena such as sound,heat and diffusion.	5	L3
3	It is used to describe a wide variety of phenomena such as electrostatics,electrodynamics and quantum mechanics.	6	L3
4	It is used for analysis of current flow and sound waves in electric circuits.	7	L3
4	It is used in nuclear engineering analysis.	8	L3
5	Used in network simulation and weather prediction	9	L3
5	Used in computer science for root algorithm and multidimensional root finding.	10	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.

Modules	Mapping		Mapping Level	Justification for each CO-PO pair	Level
-	**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	L3

				complex engineering problems.	
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	L3

				research based knowledge and research methods in Ordinary differential equations to accomplish solutions to complex engineering problems.	
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	L3

				problems.	
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.

-	-	Course Outcomes	Program Outcomes															-
Modules	CO.#	**At the end of the course student should be able to . . .**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	Level
1	18MAT21.1	Illustrate the applications of multivariate calculus to understand the solenoidal and irrotational vectors.	2.5	2.5	2.5	2.5					2.5		2.5	2.5				L3
1	18MAT21.2	Exhibit the interdependence of line, surface and volume integrals.	2.5	2.5	2.5	2.5						2.5	2.5	2.5				L3
2	18MAT21.3	Demonstrate various physical models through higher order differential equations and solve such linear .Ordinary differential equation.	2.5	2.5	2.5	2.5					2.5		2.5	2.5				L3
2	18MAT21.4	To study the behaviour of LCR circuits and oscillations of springs using Ordinary differential equation..	2.5	2.5	2.5	2.5					2.5		2.5	2.5				L3
3	18MAT21.5	Construct a variety of partial differential equations.	2.5	2.5	2.5	2.5						2.5	2.5	2.5				L3
3	18MAT21.6	To find solution by exact methods/method of separation of variables.	2.5	2.5	2.5	2.5					2.5		2.5	2.5				L3
4	18MAT21.7	To explain the applications of infinite series.	2.5	2.5	2.5	2.5					2.5		2.5	2.5				L3
4	18MAT21.8	To obtain series solution 0f Ordinary differential equation.	2.5	2.5	2.5	2.5					2.5		2.5	2.5				L3
5	18MAT21.9	Apply the knowledge of numerical methods in the modeling of various physical and engineering phenomena.	2.5	2.5	2.5	2.5						2.5	2.5	2.5				L3

5	18MAT21.10	Numericalintegration comprises a broad of algorithms for calculating the numerical value of definite integral.	2.5	2.5	2.5	2.5					2.5		2.5	2.5				L3
-	**CS501PC**	**Average attainment (1, 2, or 3)**																**-**
-	*PO, PSO*	*1.Engineering Knowledge; 2.Problem Analysis; 3.Design / Development of Solutions; 4.Conduct Investigations of Complex Problems; 5.Modern Tool Usage; 6.The Engineer and Society; 7.Environment and Sustainability; 8.Ethics; 9.Individual and Teamwork; 10.Communication; 11.Project Management and Finance; 12.Life-long Learning; S1.Software Engineering; S2.Data Base Management; S3.Web Design*																

5. Curricular Gap and Content

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

Modules	Gap Topic	Actions Planned	Schedule Planned	Resources Person	PO Mapping
1	--	--	--	--	--
2	--	--	--	--	--

6. Content Beyond Syllabus

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

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

Modules	Title	Teach. Hours	No. of question in Exam						CO	Levels
			CIA-1	CIA-2	CIA-3	Asg	Extra Asg	SEE		
1	Vector Calculus	10	2	-	-			2		L3
2	Differential Equations of higher order	10	2	-	-			2		L3
3	Partial Differential equations	10	-	2	-			2		L3
4	Infinite and Power series	10	-	2	-			2		L3
5	Numerical Methods and Integration	10	-	-	4			2		L3
-	**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.

Modules	Evaluation	Weightage in Marks	CO	Levels
1	CIA Exam – 1	30	CO1, CO2, CO3,Co4	L3,L3,L3,L3
2	CIA Exam – 2	30	CO5, CO6, CO7, C08	L3,L3,L3,L3
3	CIA Exam – 3	30	CO9, CO10	L3, L3

1	Assignment - 1	10	CO1, CO2, CO3,Co4	L3,L3,L3,L3
2	Assignment - 2	10	CO5, CO6, CO7, C08	L3,L3,L3,L3
3	Assignment - 3	10	CO9, CO10	L3,L3
	Final CIA Marks	**40**	**-**	**-**

D1. TEACHING PLAN - 1

Module - 1

Title:	Vector Calculus	Appr Time:	12 Hrs
a	***Course Outcomes***	**CO**	**Blooms**
	The student should be able to:	-	**Level**
1	Illustrate the applications of multivariate calculus to understand the solenoidal and irrotational vectors and also exhibit the interdependence of line , surface and volume integrals.	CO1	L3
b	***Course Schedule***	-	-
Class No	**Portion covered per hour**	**-**	**-**
1	Scalar and Vector fields,	CO1	L3
2	Gradient, directional derivative	CO1	L3
3	curl and divergence-physical interpretation	CO1	L3
4	solenoidal and irrotational vector fields-illustrative problems.	CO1	L3
5	Line Integrals	CO1	L3
6	Theorems of Green, Gauss and Stokes(without proof).	CO2	L3
7	Applications to work done by force and flux.	CO2	L3
c	**Application Areas**	**-**	**-**
1	Used extensively in physics and engineering especially in the description of electromagnetic fields, gravitational fields and fluid flow.	1	L3
1	Used in computational electrodyanmics simulation.	2	L3
d	**Review 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 $x^2+y^2+z^2=9$ and $z=x^2+y^2-3$ at (2,-1,2)	CO.1	L3
3	Find the directional derivative of $\varphi=x^2 yz+4xz^2$ 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 $\vec{F}=3x^2 i+(2xz-y)j+zk$ along the straight line from (0,0,0) to (2,1,3)	CO.1	L3
5	Use the divergence theorem to evaluate $\iint_S \vec{F}.\hat{n}ds$. 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 $\vec{F}=2xyi+yz^2 j+xzk$	CO.1	L3
6	Evaluate by Stokes theorem $\oint_c (sinzdx-cosxdy+sinydz)$ where c is the boundary in the rectangle $0\leqslant x\leqslant \pi, 0\leqslant y\leqslant 1, z=3$	CO.1	L3
7	Derive an expression for radius of curvature in case of the polar curve r=f(θ).	CO.1	L3
8	Find the radius of curvature at the point ' t ' on the curve x= a(t+sint) ,y= a(1-cost).	CO.1	L3

Module – 2

Title:	Differential Equations of higher order	Appr Time:	7 Hrs
a	***Course Outcomes***	**CO**	**Blooms**
-	The student should be able to:	-	**Level**
1	Demonstrate various physical models through higher order differential equations and solve such linear ordinary differential equations.	CO.3	L3
b	***Course Schedule***	-	-
Class No	**Portion covered per hour**	**-**	**-**
1	Second order Linear ODE's with constant coefficients Inverse differential operators,	CO.3	L3
2	method of variation of parameters	CO.3	L3
3	Cauchy's homogeneous equations	CO.3	L3
4	Cauchy's homogeneous equations	CO.3	L3
5	Legendre homogeneous equations	CO.4	L3
6	Legendre homogeneous equations	CO.4	L3
7	Applications to oscillations of a spring	CO.4	L3
8	Applications to L-C-R circuits.	CO.4	L3
9	Applications to L-C-R circuits.	CO.4	L3
c	**Application Areas**	**CO**	**Level**
2	Used in computational fluid dynamics	3	L3
2	Used in studying the behaviour of LCR circuits and oscillations of springs	4	L3
d	**Review Questions**		
1	Solve $(4D^4 - 4D^3 - 23D^2 + 12D + 36)y = 0$	CO.3	L3
2	Solve $(4D^4 - 8D^3 - 7D^2 + 11D + 6)y = 0$ ..	CO.3	L3
3	Solve $6y'' + 17y' + 12y = e^{-x}$	CO.3	L3
4	Solve $y'' - 4y' + 13y = Cos2x$	CO.3	L3
5	Solve $y'' + 2y' + 5y = e^{-x}Sin2x$.	CO.4	L3
6	Solve $y'' - 2y' + y = xe^{x}Sinx$.	CO.4	L3
7	Solve the equation $\frac{d^2y}{dx^2} - 6\frac{dy}{dx} + 25y = e^{2x} + Sinx + x$.	CO.4	L3
8	Solve $\frac{d^3y}{dx^3} + y = Cos(\pi/2 - x) + e^{x}$	CO.4	L3

E1. CIA EXAM – 1

a. Model Question Paper - 1

Crs Code:	18MAT21	Sem:	I	Marks:	50	Time:	1.30 minutes
Course:	Advanced Calculus and Numerical Methods						

-	-	**Note: Answer any 3 questions, each carry equal marks.**	**CO**	**CO**	**Marks**
1	a	Solve $\frac{d^2x}{dt^2} + 4\frac{dx}{dt} + 29x = 0$. Find y when x(0)=0 and $\frac{dx}{dt}(0) = 15$	CO3	L3	6

	b	Solve $(D^3+D^2-4D-4)y=3e^{-x}-4x-6$	CO3	L3	6
	c	Solve by the method of variation of parameters $\frac{d^2y}{dx^2}-6\frac{dy}{dx}+9y=\frac{e^{3x}}{x^2}$	CO3	L3	6
	d	Solve $x^2y''+5xy'+13y=logx+x^2$	CO3	L3	7
		OR			
2	a	Solve $\frac{d^2y}{dx^2}+3\frac{dy}{dx}+2y=1+3x+x^2$	CO3	L3	6
	b	Solve by the method of variation of parameters $y''-y=\frac{2}{1+e^x}$	CO3	L3	6
	c	Solve $(D^4+8D^2+16)y=2\cos^2x$	CO3	L3	6
	d	Solve $(3x+2)^2y''+3(3x+2)y'-36y=8x^2+4x+1$	CO3	L3	7
3	a	$\frac{d^2y}{dx^2}+2\frac{dy}{dx}+10y+37\sin 3x=0.Find\ y$	CO3	L3	6
	b	Obtain the PDE by eliminating the arbitrary function z=f(x+at)+g(x-at)	CO5	L3	6
	c	Form a PDE by eliminating arbitrary constants $\frac{x^2}{a^2}+\frac{y^2}{b^2}+\frac{z^2}{c^2}=1$	CO5	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.	CO5	L3	7
		OR			
4	a	Solve $(D^3+3D^2)x=1+t$	CO3	L3	6
	b	Obtain the PDE of the function $\varphi(xy+z^2,x+y+z)=0$	CO5	L3	6
	c	Obtain The PDE by eliminating φ and ψ from the relation $z=x\varphi(y)+y\psi(x)$	CO5	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 $\frac{\pi}{2}$	CO5	L3	7

b. Assignment -1

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

Model Assignment Questions							
Crs Code:	18MAT21	Sem:	II	Marks:	10	Time:	
Course:	Advanced Calculus and Numerical Methods						
Note: Each student to answer 3 assignments. Each assignment carries equal mark.							
SNo	**USN**	**Assignment Description**			**Mark**	**CO**	**Level**

			s		
1		Solve $(4D^4 - 4D^3 - 23D^2 + 12D + 36)y = 0$	5	CO.3	L3
2		Solve $(4D^4 - 8D^3 - 7D^2 + 11D + 6)y = 0$ ..	5	CO.3	L3
3		Solve $6y'' + 17y' + 12y = e^{-x}$	5	CO.3	L3
4		Solve $y'' - 4y' + 13y = Cos2x$	5	CO.3	L3
5		Solve $y'' + 2y' + 5y = e^{-x}Sin2x$.	5	CO.4	L3
6		Solve $y'' - 2y' + y = xe^{x}Sinx$.	5	CO.4	L3
7		Solve the equation $\frac{d^2y}{dx^2} - 6\frac{dy}{dx} + 25y = e^{2x} + Sinx + x$.	5	CO.4	L3
8		Solve $\frac{d^3y}{dx^3} + y = Cos(\pi/2 - x) + e^{x}$	5	CO.4	L3
9		Solve $\frac{d^2x}{dt^2}+4\frac{dx}{dt}+29x=0$. Find y when x(0)=0 and $\frac{dx}{dt}(0)=15$	5	CO4	L3
10		Solve $(D^3+D^2-4D-4)y=3e^{-x}-4x-6$	5	CO3	L3
11		Solve by the method of variation of parameters $\frac{d^2y}{dx^2}-6\frac{dy}{dx}+9y=\frac{e^{3x}}{x^2}$	5	CO4	L3
12		Solve $x^2y''+5xy'+13y=logx+x^2$	5	CO3	L3
13		Solve $\frac{d^2y}{dx^2}+3\frac{dy}{dx}+2y=1+3x+x^2$	5	CO3	L3
14		Solve by the method of variation of parameters $y''-y=\frac{2}{1+e^x}$	5	CO4	L3
15		Solve $(D^4+8D^2+16)y=2\cos^2 x$	5	CO3	L3
		Solve $(3x+2)^2y''+3(3x+2)y'-36y=8x^2+4x+1$	5	CO3	L3
3		$\frac{d^2y}{dx^2}+2\frac{dy}{dx}+10y+37\sin 3x=0. Find\ y$	5	CO3	L3
16		Obtain the PDE by eliminating the arbitrary function z=f(x+at)+g(x-at)	5	CO5	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	CO5	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	CO5	L3
19		Solve $(D^3+3D^2)x=1+t$	5	CO3	L3

20		Obtain the PDE of the function $\varphi(xy+z^2, x+y+z)=0$	5	CO5	L3
21		Obtain The PDE by eliminating φ and ψ from the relation $z=x\,\varphi(y)+y\,\psi(x)$	5	CO5	L3
22		Solve $\frac{\partial^2 z}{\partial x \partial y}=sinxsiny$ given that $\frac{\partial z}{\partial y}=-2\,siny$ when x=0 & z=0 when y is an odd multiple of $\frac{\pi}{2}$	5	CO5	L3

D2. TEACHING PLAN - 2

Module – 3

Title:	Partial differential equations	Appr Time:	12 Hrs
a	***Course Outcomes***	**CO**	**Blooms**
-	The student should be able to:	-	**Level**
1	Construct a variety of partial differential equations and solution by exact methods/method of separation of variables	CO.5	L3
b	***Course Schedule***		
Class No	**Portion covered per hour**	**-**	**-**
1	Formation of PDE’s by elimination of arbitrary constants	CO.5	L3
2	Formation of PDE’s by elimination of arbitrary functions	CO.5	L3
3	Solution of non-homogeneous PDE by direct integration	CO.5	L3
4	Homogeneous PDEs involving derivative with respect to one independent variable only	CO.5	L3
5	Solution of Lagrange’s linear PDE.	CO.5	L3
6	Derivative of one dimensional heat equations	CO.6	L3
7	Derivative of one dimensional wave equations	CO.6	L3
8	solutions by the method of separation of variables.	CO.6	L3
c	**Application Areas**	**-**	**-**
3	It is used to describe a wide variety of phenomena such as sound,heat and diffusion.	CO.5	L3
3	It is used to describe a wide variety of phenomena such as electrostatics,electrodynamics and quantum mechanics.	CO.6	L3
d	**Review Questions**	-	-
-		-	-
1	Solve by eliminating arbitrary constants a) $2z = \frac{x^2}{a^2} + \frac{y^2}{b^2}$, b). $(x-a)^2 + (y-b)^2 = z^2 Cot^2\alpha$	CO.5	L3
2	Solve by eliminating arbitrary functions 1. $z = y^2 + 2f\left(\frac{1}{x} + \log y)\right)$, 2. $z = yf(x) + x\varphi(y)$	CO.5	L3
3	Find the solution of the heat equation by the method of separation of variables.	CO.6	L3
4	Find the solution of the wave equation by the method of separation of variables.	CO.6	L3
5	Derive D’Alemberts solution of the wave equation.	CO.6	L3

6	A tightly stretched string with fixed end points at x=0, $x = l$ is initially in 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	CO.6	L3
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 $y(x,t) = a\sin\left(\frac{\Pi x}{l}\right)\cos\left(\frac{\Pi ct}{l}\right)$	CO.6	L3
8	Derive one dimentional Heat equation.	CO.6	L3
9	Derive one dimensional wave equation.Find the solution of two – dimentional Laplace equation by the method of separation of variables.	CO.6	L3
10	Find the solution of two – dimentional Laplace equation by the method of separation of variables.	CO.6	L3
11	An insulated rod of length l has its end Aand B maintained at 0^0 c and 100^0 c respectively until steady state condition prevail. If B is suddenly reduce to 0^0 c and maintained at 0^0 c .find the temperature at a distance x from A at time 't',	CO.6	L3
12	Solve by direct integration $\frac{\partial z}{\partial y} =- 2Siny$	CO.5	L3
13	Solve by direct integration $\frac{\partial^2 z}{\partial x^2} + 4z = 0$	CO.5	L3
14	Solve by direct integration $\frac{\partial^3 z}{\partial x^2 \partial y} = Cos(2x + 3y)$	CO.5	L3

Module – 4

Title:	Infinite series and Power series solutions	Appr Time:	13 Hrs
a	***Course Outcomes***	**CO**	**Blooms**
-	The student should be able to:	-	**Level**
1	Explain the applications of infinite series and obtain series solution of ordinary differential equation	CO.7	L3
b	***Course Schedule***		
Class No	**Portion covered per hour**	**-**	**-**
1	Series of positive terms-convergence and divergence.	CO.7	L3
2	Cauchy's root test	CO.7	L3
3	D'Alembert's ratio test(without proof)-illustrative examples.	CO.7	L3
4	Series solution of Bessel's differential equation	CO.8	L3
5	Bessel's function of first kind-orthogonality	CO.8	L3
6	Series solution of Legendre differential equation	CO.8	L3
7	Legendre polynomial	CO.8	L3
8	Rodrigue's formula	CO.8	L3
c	**Application Areas**	**-**	**-**
4	It is used for analysis of current flow and sound waves in electric circuits.	7	L3
4	It is used in nuclear engineering analysis.	8	L3
d	**Review Questions**	-	-

1	Test the convergence of $\sum_{n=1}^{\infty}\frac{n^n x^n}{(n+1)^n}$,x>0	CO7	L3
2	Obtain the range of convergence of the series $\frac{2x}{1^2}+\frac{3^2x^2}{2^3}+\frac{4^3x^3}{3^4}+\frac{5^4x^4}{4^5}+........;x>0$	CO7	L3
3	Test for convergence or divergence of the series $\sum_{n=1}^{\infty}\frac{n!}{(n^n)^2}$	CO7	L3
4	Test for convergence or divergence of the series $\frac{1}{2\sqrt{1}}+\frac{x^2}{3\sqrt{2}}+\frac{x^4}{4\sqrt{3}}+.........,x>0$	CO7	L3
5	Test the convergence of the series: $1+\frac{2^2}{2!}+\frac{3^2}{3!}+\frac{4^2}{4!}+.........$	CO7	L3
6	Test the convergence of the series: $\left[\frac{2^2}{1^2}-\frac{2}{1}\right]^{-1}+\left[\frac{3^3}{2^3}-\frac{3}{2}\right]^{-2}+\left[\frac{4^4}{3^4}-\frac{4}{3}\right]^{-3}+.........$	CO7	L3
7	Let us discuss the convergence of the series $\sum_{n=1}^{\infty}\frac{(n+1)^n x^n}{n^{n+1}}$	CO7	L3
8	Prove that $J_{1/2}(x)=\sqrt{\frac{2}{\pi x}}sinx$	CO.8	L3
9	Express $f(x)=x^4+3x^3-x^2+5x-2$ in terms of legendres polynomials.	CO.8	L3
10	Express the following polynomials in terms of legendres polynomials $(x+1)(x+2)(x+3)$	CO.8	L3
11	If α and β are the roots of $J_n(x)=0$ then $\int_0^1 xJ_n(\alpha x)J_n(\beta x)dx=0;if\ \alpha\neq\beta$	CO.8	L3
12	Using Rodrigues formula, obtain the expressions for $P_2(\cos\theta),P_3(\cos\theta)$	CO8	L3
13	Use Rodrigue's formula to find $P_n(x)$ for n=0,1,2,3,4	CO.8	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	CO.8	L3
15	Let us discuss the convergence of the series $\sum_{n=1}^{\infty}\frac{(n+1)^n x^n}{n^{n+1}}$	CO.8	L3
16	Prove that $J_{-1/2}(x)=\sqrt{\frac{2}{\pi x}}cosx$	CO.8	L3
17	Derive series solution of Bessels DE leading to Bessel functions.	CO.8	L3

Module – 5

Title:	Numerical Methods	Appr Time:	13 Hrs
a	***Course Outcomes***	**CO**	**Blooms**
-	The student should be able to:	-	**Level**

<table>
<tr><td>1</td><td>Explain the applications of infinite series and obtain series solution of ordinary differential equation</td><td>CO.9</td><td>L3</td></tr>
<tr><td>b</td><td><i>Course Schedule</i></td><td></td><td></td></tr>
<tr><td>Class No</td><td>Portion covered per hour</td><td>-</td><td>-</td></tr>
<tr><td>1</td><td>Finite diferences</td><td>CO.9</td><td>L3</td></tr>
<tr><td>2</td><td>Newtons forward and backward difference formula</td><td>CO.9</td><td>L3</td></tr>
<tr><td>3</td><td>Newtons divdede difference formula</td><td>CO.9</td><td>L3</td></tr>
<tr><td>4</td><td>Lagranges formula</td><td>CO.9</td><td>L3</td></tr>
<tr><td>5</td><td>Newton raphson</td><td>CO.9</td><td>L3</td></tr>
<tr><td>6</td><td>Regula falsi method</td><td>CO.9</td><td>L3</td></tr>
<tr><td>7</td><td>Numerical integrations,</td><td>CO.10</td><td>L3</td></tr>
<tr><td>8</td><td>Simpsons 1/3 rd rule problems</td><td>CO.10</td><td>L3</td></tr>
<tr><td>9</td><td>Simpsons 3/8 th rule problems</td><td>CO.10</td><td>L3</td></tr>
<tr><td>10</td><td>Weddles rule and problems</td><td>CO.10</td><td>L3</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td>c</td><td>Application Areas</td><td>-</td><td>-</td></tr>
<tr><td>5</td><td>Used in network simulation and weather prediction</td><td>9</td><td>L3</td></tr>
<tr><td>5</td><td>Used in computer science for root algorithm and multidimensional root finding.</td><td>10</td><td>L3</td></tr>
<tr><td>d</td><td>Review Questions</td><td>-</td><td>-</td></tr>
<tr><td>1</td><td>From the following table find the number of students who have obtained less than 45
<table>
<tr><td>Marks</td><td>30-40</td><td>40-50</td><td>50-60</td><td>60-70</td><td>70-80</td></tr>
<tr><td>No. of students</td><td>31</td><td>42</td><td>51</td><td>35</td><td>31</td></tr>
</table></td><td>CO.9</td><td>L3</td></tr>
<tr><td>2</td><td>Using Lagranges formula find the value of y at x=6 by the following table
<table>
<tr><td>x</td><td>0</td><td>1</td><td>2</td><td>5</td></tr>
<tr><td>y</td><td>2</td><td>3</td><td>12</td><td>147</td></tr>
</table></td><td>CO.9</td><td>L3</td></tr>
<tr><td>3</td><td>Find $\int_{4}^{5.2} (logx) dx$ using weddles rule taking the step size of 0.2</td><td>CO.10</td><td>L3</td></tr>
<tr><td>4</td><td>Evaluate $\int_{0}^{1} (\frac{x}{1+x^2}) dx$ by using simpson’s (1/3) rd rule dividing the interval into 6 equal parts.Hence find an approximate value of $\log\sqrt{2}$</td><td>CO.10</td><td>L3</td></tr>
<tr><td>5</td><td>Using the Newtons Raphson method find the real root of the equation 3x=cosx+1</td><td>CO.10</td><td>L3</td></tr>
<tr><td>6</td><td>Using Regula-falsi method find the real root of the equation $x \log_{10} x = 1.2$</td><td>CO.10</td><td>L3</td></tr>
<tr><td>7</td><td>The area of a circle (A) corresponding to the diameter (D) is given below.
<table>
<tr><td>D</td><td>80</td><td>85</td><td>90</td><td>95</td><td>100</td></tr>
</table></td><td>CO.10</td><td>L3</td></tr>
</table>

	A 5026 5674 6362 7088 7854 Find the area corresponding to diameter 105 using an appropriate interpolation formula.		
7	Evaluate $\int_0^{0.3}\sqrt{1-8x^3}dx$ by using simpson's (3/8) th rule by taking 7 ordinates.	CO.10	L3
8	Using the Newtons Raphson method find the real root of the equation 3x=sinx+1	CO.10	L3

E2. CIA EXAM – 2

a. Model Question Paper - 2

Crs Code:	18MAT21	Sem:	II	Marks:	50	Time:	1.30 minutes
Course:	Advanced Calculus and Numerical Methods						

-	-	**Note: Answer all questions, each carry equal marks. Module : 3, 4**	**CO**	**Level**	**Marks**
1	a	If $\vec{F}=\nabla(xy^3z^2)$ Find div$\vec{F}$ and curl$\vec{F}$ at the point (1, -1, 1)	CO.1	L3	6
	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)	CO.1	L3	6
	c	Find the directional derivative of $\varphi=x^2yz+4xz^2$ at(1, -2, -1) in the direction of 2i-j-2k.	CO.2	L3	6
	d	Show that $\vec{F}=(y+z)i+(z+x)j+(x+y)k$ is irrotational. Also find a scalar function φ such that $\vec{F}=\nabla\varphi$	CO.2	L3	7
		OR			
2	a	Find the work done in moving a particle in the force field $\vec{F}=3x^2i+(2xz-y)j+zk$ along the straight line from (0,0,0) to (2,1,3)	CO.1	L3	6
	b	Use the divergence theorem to evaluate $\iint_S \vec{F}.\hat{n}ds$. 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 $\vec{F}=2xyi+yz^2j+xzk$	CO.1	L3	6
	c	Evaluate by Stokes theorem $\oint_c (sinzdx-cosxdy+sinydz)$ where c is the boundary in the rectangle $0\leqslant x\leqslant\pi, 0\leqslant y\leqslant 1, z=3$	CO.2	L3	6
	d	By using Greens theorem evaluate $\int_c ((y-sinx)dx+cosxdy)$ where c is the triangle in the xy-plane bounded by the lines x=0, y=0, x=π/2, y=2x/π	CO.2	L3	7
3	a	From the following table find the number of students who have obtained less than 45 Marks 30-40 40-50 50-60 60-70 70-80	CO.9	L3	6

<table>
<tr><td></td><td></td><td><table><tr><td>No. of students</td><td>31</td><td>42</td><td>51</td><td>35</td><td>31</td></tr></table></td><td></td><td></td><td></td></tr>
<tr><td></td><td>b</td><td>Using Lagranges formula find the value of y at x=6 by the following table<table><tr><td>x</td><td>0</td><td>1</td><td>2</td><td>5</td></tr><tr><td>y</td><td>2</td><td>3</td><td>12</td><td>147</td></tr></table></td><td>CO.9</td><td>L3</td><td>6</td></tr>
<tr><td></td><td>c</td><td>Find $\int_{4}^{5.2} (log x)\, dx$ using weddles rule taking the step size of 0.2</td><td>CO.10</td><td>L3</td><td>6</td></tr>
<tr><td></td><td>d</td><td>Evaluate $\int_{0}^{1} (\frac{x}{1+x^2})\, dx$ by using simpson’s (1/3) rd rule dividing the interval into 6 equal parts.Hence find an approximate value of $\log\sqrt{2}$</td><td>CO.10</td><td>L3</td><td>7</td></tr>
<tr><td></td><td></td><td>OR</td><td></td><td></td><td></td></tr>
<tr><td>4</td><td>a</td><td>Using the Newtons Raphson method find the real root of the equation 3x=cosx+1</td><td>CO.9</td><td>L3</td><td>6</td></tr>
<tr><td></td><td>b</td><td>Using Regula-falsi method find the real root of the equation $x\log_{10}x=1.2$</td><td>CO.9</td><td>L3</td><td>6</td></tr>
<tr><td></td><td>c</td><td>The area of a circle (A) corresponding to the diameter (D) is given below.<table><tr><td>D</td><td>80</td><td>85</td><td>90</td><td>95</td><td>100</td></tr><tr><td>A</td><td>5026</td><td>5674</td><td>6362</td><td>7088</td><td>7854</td></tr></table>Find the area corresponding to diameter 105 using an appropriate interpolation formula.</td><td>CO.9</td><td>L3</td><td>6</td></tr>
<tr><td></td><td>d</td><td>Evaluate $\int_{0}^{0.3} \sqrt{1-8x^3}\, dx$ by using simpson’s (3/8) th rule by taking 7 ordinates.</td><td>10</td><td>L3</td><td>7</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

b. Assignment – 2

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

<table>
<tr><td colspan="8">Model Assignment Questions</td></tr>
<tr><td>Crs Code:</td><td>18MAT21</td><td>Sem:</td><td>II</td><td>Marks:</td><td>10</td><td></td><td></td></tr>
<tr><td>Course:</td><td colspan="4">Advanced Calculus and Numerical Methods</td><td colspan="2">Module : 3, 4</td><td></td></tr>
<tr><td colspan="8">Note: Each student to answer 2-3 assignments. Each assignment carries equal mark.</td></tr>
</table>

SNo	**USN**	**Assignment Description**	**Marks**	**CO**	**Level**
1		Test the convergence of $\sum_{n=1}^{\infty}\frac{n^n x^n}{(n+1)^n}$,x>0	5	CO7	L3
2		Obtain the range of convergence of the series $\frac{2x}{1^2}+\frac{3^2x^2}{2^3}+\frac{4^3x^3}{3^4}+\frac{5^4x^4}{4^5}+\ldots\ldots\ldots;x>0$	5	CO7	L3

3		Test for convergence or divergence of the series $\sum_{n=1}^{\infty} \frac{n!}{\left(n^n\right)^2}$	5	CO7	L3
4		Test for convergence or divergence of the series $\frac{1}{2\sqrt{1}}+\frac{x^2}{3\sqrt{2}}+\frac{x^4}{4\sqrt{3}}+.........., x>0$	5	CO7	L3
5		Test the convergence of the series: $1+\frac{2^2}{2!}+\frac{3^2}{3!}+\frac{4^2}{4!}+..........$	5	CO7	L3
6		Test the convergence of the series: $\left[\frac{2^2}{1^2}-\frac{2}{1}\right]^{-1}+\left[\frac{3^3}{2^3}-\frac{3}{2}\right]^{-2}+\left[\frac{4^4}{3^4}-\frac{4}{3}\right]^{-3}+..........$	5	CO7	L3
7		Let us discuss the convergence of the series $\sum_{n=1}^{\infty} \frac{(n+1)^n x^n}{n^{n+1}}$	5	CO7	L3
8		Prove that $J_{1/2}(x)=\sqrt{\frac{2}{\pi x}} sinx$	5	CO.8	L3
9		Express $f(x)=x^4+3x^3-x^2+5x-2$ in terms of legendres polynomials.	5	CO.8	L3
10		Express the following polynomials in terms of legendres polynomials $(x+1)(x+2)(x+3)$	5	CO.8	L3
11		If α and β are the roots of $J_n(x)=0$ then $\int_0^1 xJ_n(\alpha x)J_n(\beta x)dx=0; if\ \alpha\neq\beta$	5	CO.8	L3
12		Using Rodrigues formula, obtain the expressions for $P_2(\cos\theta), P_3(\cos\theta)$	5	CO.8	L3
13		Use Rodrigue’s formula to find $P_n(x)$ for n=0,1,2,3,4	5	CO.8	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	CO.8	L3
15		Let us discuss the convergence of the series $\sum_{n=1}^{\infty} \frac{(n+1)^n x^n}{n^{n+1}}$	5	CO.7	L3
16		Prove that $J_{-1/2}(x)=\sqrt{\frac{2}{\pi x}} cosx$	5	CO.8	L3
17		Derive series solution of Bessels DE leading to Bessel functions.	5	CO.8	L3

F. EXAM PREPARATION

1. University Model Question Paper

Course:	Advanced calculus and Numerical methods					Month / Year	May /2018
Crs Code:	18MAT21	Sem:	II	Marks:	100	Time:	180 minutes

Module	Note	Answer all FIVE full questions. All questions carry equal marks.	Marks	CO	Level
1	a	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	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	CO.1	L3
	C	Evaluate by Stokes theorem $\oint_c (sinzdx-cosxdy+sinydz)$ where c is the boundary in the rectangle $0\leqslant x\leqslant \pi, 0\leqslant y\leqslant 1, z=3$	7	CO.2	L3
		OR			
2	a	Find the work done in moving a particle in the force field $\vec{F}=3x^2 i+(2xz-y)j+zk$ along the straight line from (0,0,0) to (2,1,3)	6	CO.1	L3
	b	Use the divergence theorem to evaluate $\iint_S \vec{F}.\hat{n}\,ds$. 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 $\vec{F}=2xyi+yz^2 j+xzk$	7	CO.2	L3
	c	Find the directional derivative of $\varphi=x^2yz+4xz^2$ at(1, -2, -1) in the direction of 2i-j-2k.	7	CO.1	L3
3	a	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	CO3	L3
	b	Solve $(D^3+D^2-4D-4)y=3e^{-x}-4x-6$	7	CO.3	L3
	c	Solve by the method of variation of parameters $\frac{d^2y}{dx^2}-6\frac{dy}{dx}+9y=\frac{e^{3x}}{x^2}$	7	CO4	L3
		OR			
4	a	Solve $\frac{d^2y}{dx^2}+3\frac{dy}{dx}+2y=1+3x+x^2$	6	CO.3	L3
	b	Solve by the method of variation of parameters $y''-y=\frac{2}{1+e^x}$	7	CO.4	L3
	c	Solve $(D^4+8D^2+16)y=2\cos^2 x$	7	CO.3	L3
5	a	Obtain the PDE by eliminating the arbitrary function z=f(x+at)+g(x-at)	6	CO.5	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	CO5	L3

<table>
<tr><td></td><td>c</td><td>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.</td><td>7</td><td>CO.6</td><td>L3</td></tr>
<tr><td></td><td></td><td>OR</td><td></td><td></td><td></td></tr>
<tr><td>6</td><td>a</td><td>Obtain the PDE of the function $\varphi(xy+z^2, x+y+z)=0$</td><td>6</td><td>CO.5</td><td>L3</td></tr>
<tr><td></td><td>b</td><td>Obtain The PDE by eliminating φ and ψ from the relation $z=x\,\varphi(y)+y\,\psi(x)$</td><td>7</td><td>CO6</td><td>L3</td></tr>
<tr><td></td><td>c</td><td>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 $\frac{\pi}{2}$</td><td>7</td><td>CO.6</td><td>L3</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>7</td><td>a</td><td>Test the convergence of $\sum_{n=1}^{\infty}\frac{n^n x^n}{(n+1)^n}$,x>0</td><td>6</td><td>CO.7</td><td>L3</td></tr>
<tr><td></td><td>b</td><td>Obtain the range of convergence of the series
$\frac{2x}{1^2}+\frac{3^2x^2}{2^3}+\frac{4^3x^3}{3^4}+\frac{5^4x^4}{4^5}+.........;x>0$</td><td>7</td><td>CO.7</td><td>L3</td></tr>
<tr><td></td><td>c</td><td>Prove that $J_{1/2}(x)=\sqrt{\frac{2}{\pi x}}sinx$</td><td>7</td><td>CO.8</td><td>L3</td></tr>
<tr><td></td><td></td><td>OR</td><td></td><td></td><td></td></tr>
<tr><td>8</td><td>a</td><td>Test for convergence or divergence of the series $\sum_{n=1}^{\infty}\frac{n!}{(n^n)^2}$</td><td>6</td><td>CO.7</td><td>L3</td></tr>
<tr><td></td><td>b</td><td>Test for convergence or divergence of the series
$\frac{1}{2\sqrt{1}}+\frac{x^2}{3\sqrt{2}}+\frac{x^4}{4\sqrt{3}}+.........., x>0$</td><td>7</td><td>CO.7</td><td>L3</td></tr>
<tr><td></td><td>c</td><td>If α and β are the roots of $J_n(x)=0$ then
$\int_0^1 xJ_n(\alpha x)J_n(\beta x)dx=0; if\ \alpha\neq\beta$</td><td>7</td><td>CO.8</td><td>L3</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>9</td><td>a</td><td>From the following table find the number of students who have obtained less than 45
<table>
<tr><td>Marks</td><td>30-40</td><td>40-50</td><td>50-60</td><td>60-70</td><td>70-80</td></tr>
<tr><td>No. of students</td><td>31</td><td>42</td><td>51</td><td>35</td><td>31</td></tr>
</table></td><td>6</td><td>CO9</td><td>L3</td></tr>
<tr><td></td><td>b</td><td>Using Lagranges formula find the value of y at x=6 by the following table
<table>
<tr><td>x</td><td>0</td><td>1</td><td>2</td><td>5</td><td></td></tr>
<tr><td>y</td><td>2</td><td>3</td><td>12</td><td>147</td><td></td></tr>
</table></td><td>7</td><td>CO9</td><td>L3</td></tr>
<tr><td></td><td>c</td><td>Find $\int_4^{5.2}(logx)\,dx$ using weddles rule taking the step size of 0.2</td><td>7</td><td>CO10</td><td>L3</td></tr>
<tr><td></td><td></td><td>OR</td><td></td><td></td><td></td></tr>
</table>

<table>
<tr><td>10</td><td>a</td><td>Using the Newtons Raphson method find the real root of the equation 3x=cosx+1</td><td>6</td><td>CO9</td><td>L3</td></tr>
<tr><td></td><td>b</td><td>Using Regula-falsi method find the real root of the equation $x\log_{10}x=1.2$</td><td>7</td><td>CO9</td><td>L3</td></tr>
<tr><td></td><td>c</td><td>The area of a circle (A) corresponding to the diameter (D) is given below.
<table>
<tr><td>D</td><td>80</td><td>85</td><td>90</td><td>95</td><td>100</td></tr>
<tr><td>A</td><td>5026</td><td>5674</td><td>6362</td><td>7088</td><td>7854</td></tr>
</table>
Find the area corresponding to diameter 105 using an appropriate interpolation formula.</td><td>7</td><td>C010</td><td>L3</td></tr>
</table>

2. SEE Important Questions

Course:	Advanced calculus and Numerical Methods					Month / Year	May /2018
Crs Code:	18MAT21	Sem:	2	Marks:	100	Time:	180 minutes

	Note	Answer all FIVE full questions. All questions carry equal marks.	-	-	
Module	Qno.	Important Question	**Marks**	**CO**	**Year**
1	a	If $\vec{F}=\nabla(xy^3z^2)$ 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 (2,-1,2)	7	CO1	2015
	c	Find the directional derivative of $\varphi=x^2yz+4xz^2$ at(1, -2, -1) in the direction of 2i-j-2k.	7	CO2	2016
		OR			
2	a	Find the work done in moving a particle in the force field $\vec{F}=3x^2i+(2xz-y)j+zk$ along the straight line from (0,0,0) to (2,1,3)	6	CO1	2014
	b	Use the divergence theorem to evaluate $\iint_S \vec{F}.\hat{n}\,ds$. 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 $\vec{F}=2xyi+yz^2j+xzk$	7	CO1	2016
	c	Evaluate by Stokes theorem $\oint_c (sinzdx-cosxdy+sinydz)$ where c is the boundary in the rectangle $0\leqslant x\leqslant\pi, 0\leqslant y\leqslant 1, z=3$	7	CO2	2017
3	a	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	CO3	2013
	b	Solve $(D^3+D^2-4D-4)y=3e^{-x}-4x-6$	7	CO3	2013
	c	Solve by the method of variation of parameters $\frac{d^2y}{dx^2}-6\frac{dy}{dx}+9y=\frac{e^{3x}}{x^2}$	7	CO4	2013
		OR			

4	a	Solve $\frac{d^2y}{dx^2}+3\frac{dy}{dx}+2y=1+3x+x^2$	6	CO3	2013
	b	Solve by the method of variation of parameters $y''-y=\frac{2}{1+e^x}$	7	CO3	2012
	c	Solve $(D^4+8D^2+16)y=2\cos^2 x$	7	CO4	2012
					2012
5	a	$\frac{d^2y}{dx^2}+2\frac{dy}{dx}+10y+37\sin 3x=0. Find\ y$	6	C05	2010
	b	Solve $x^2y''+5xy'+13y=logx+x^2$	7	CO5	2010
	c	Solve $(3x+2)^2y''+3(3x+2)y'-36y=8x^2+4x+1$	7	CO6	2012
		OR			2012
6	a	Solve $x^2y''+5xy'+13y=sinx+x^2$	6	CO5	
	b	Solve $(3x+2)^2y''+3(3x+2)y'-36y=8x^3+2x\,2\,sinx$	7	CO5	2012
	c	$\frac{d^2y}{dx^2}+2\frac{dy}{dx}+10y+37\sin 3x=0. Find\ y$	7	CO6	2013
7	a	Obtain the PDE by eliminating the arbitrary function z=f(x+at)+g(x-at)	6	CO7	2010
	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	CO7	2014
	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	CO8	2015
		OR			
7	a	Test the convergence of $\sum_{n=1}^{\infty}\frac{n^n x^n}{(n+1)^n}$,x>0	6	CO7	2006
	b	Obtain the range of convergence of the series $\frac{2x}{1^2}+\frac{3^2x^2}{2^3}+\frac{4^3x^3}{3^4}+\frac{5^4x^4}{4^5}+........;x>0$	7	CO7	2008
	c	Prove that $J_{1/2}(x)=\sqrt{\frac{2}{\pi x}}sinx$	7	CO8	2016
		OR			
8	a	Test for convergence or divergence of the series $\sum_{n=1}^{\infty}\frac{n!}{(n^n)^2}$	6	CO7	2008
	b	Test for convergence or divergence of the series $\frac{1}{2\sqrt{1}}+\frac{x^2}{3\sqrt{2}}+\frac{x^4}{4\sqrt{3}}+.........,x>0$	7	CO7	2006
	c	If α and β are the roots of $J_n(x)=0$ then	7	CO8	2014

<table>
<tr><td></td><td></td><td>$\int_0^1 xJ_n(\alpha x)J_n(\beta x)dx=0; if\ \alpha\neq\beta$</td><td></td><td></td><td></td></tr>
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</table>

G. Content to Course Outcomes

1. TLPA Parameters

Table 1: TLPA – Example Course

Module-#	Course Content or Syllabus (Split module content into 2 parts which have similar concepts)	Content Teaching Hours	Blooms' Learning Levels for Content	Final Blooms' Level	Identified Action Verbs for Learning	Instruction Methods for Learning	Assessment Methods to Measure Learning
A	*B*	*C*	*D*	*E*	*F*	*G*	*H*
1	Scalar and Vector fields, Gradient, directional derivative,curl and divergence-physical interpretation: solenoidal and irrotational vector fields-illustrative problems.	4	- L3	L3	- - understand	- Lecture - -	- Slip Test - -
1	Line Integrals, Theorems of Green, Gauss and Stokes(without proof). Applications to work done by force and flux.	6	- L3	L3	-analyze -	- Lecture - Tutorial -	- Assignment - -
2	Second order Linear ODE's with constant	4	- L3	L3	-apply	-	-

	coefficients-Inverse differential operators, method of variation of parameters.		- L3		-	Lecture -	Assignment -
2	Cauchy's and Legendre homogeneous equations. Applications to oscillations of a spring and L-C-R circuits.	6	- L3	L3	-apply -	- Lecture -	- Slip Test -
3	Formation of PDE's by elimination of arbitrary constants and functions. Solution of non-homogeneous PDE by direct 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.	6	- L3	L3	- understand -	- Lecture -	- Slip Test -
3	Derivative of one dimensional heat and wave equations and solutions by the method of separation of variables.	4	- L3	L3	apply	- Lecture - Tutorial -	- Assignment - -
4	Series of positive terms-convergence and divergence. Cauchy's root test and D'Alembert's ratio test(without proof)-illustrative examples.	5	- L3	L3	analyze	- Lecture - Tutorial -	- Assignment - -
4	Series solution of Bessel's differential equation leading to Jn(x)-Bessel's function of first kind-orthogonality. Series solution of Legendre polynomials. Rodrigue's formula(without proof),problems.	5	- L3	L3	apply	- Lecture - Tutorial -	- Assignment - -
5	Finite differences, Interpolation/extrapolation using Newton's forward and backward difference formulae, Newton's divided difference and Lagrange's formulae(All formulae without proof).	5	- L3	L3	-analyze	- Lecture - -	- Assignment - -
5	Solution of polynomial and transcendental equations- Newton-Raphson and Regula-Falsi methods(only formulae)-illustrative examples.Simpson's $(1/3)^{rd}$ and $(3/8)^{th}$ rules, Weddle's rule(without proof)-Problems.	5	L3	L3	apply	Lecture	Assignment
-	**Total**			**-**			

2. Concepts and Outcomes:

Table 2: Concept to Outcome – Example Course

Module-#	Learning or Outcome from study of the Content or Syllabus	Identified Concepts from Content	Final Concept	Concept Justification (What all Learning Happened from the study of Content / Syllabus. A short word for learning or outcome)	CO Components (1.Action Verb, 2.Knowledge, 3.Condition / Methodology, 4.Benchmark)	Course Outcome **Student Should be able to ...**
A	*I*	*J*	*K*	*L*	*M*	*N*

1	Scalar and Vector fields, Gradient, directional derivative,curl and divergence-physical interpretation: solenoidal and irrotational vector fields-illustrative problems.	Vectors differentiation	Vector Differentiation	Illustrate the applications of multivariate calculus to understand the solenoidal and irrotational vectors.	Vector Differentiation	Illustrate Vector Differentiation
1	Line Integrals, Theorems of Green, Gauss and Stokes(without proof). Applications to work done by force and flux.	integration	Vector Integration	Exhibit the interdependence of line, surface and volume integrals.	Vector Integration	Analyze Vector Integration
2	Second order Linear ODE's with constant coefficients-Inverse differential operators, method of variation of parameters.	ODE	Ordinary Differential equations	Demonstrate various physical models through higher order differential equations and solve such linear.Ordinary differential equation.	Ordinary Differential equations	Analyze Ordinary Differential equations
2	Cauchy's and Legendre homogeneous equations. Applications to oscillations of a spring and L-C-R circuits.	ODE	Ordinary Differential equations	To study the behaviour of LCR circuits and oscillations of springs using Ordinary differential equation..	Ordinary Differential equations	Analyze Ordinary Differential equations
3	Formation of PDE's by elimination of arbitrary constants and functions. Solution of	PDE	Partial Differential equations	Construct a variety of partial differential equations.	Partial Differential equations	Analyze Partial Differential equations

	non-homogeneous PDE by direct 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 solutions by the method of separation of variables.		Partial Differential equations	To find solution by exact methods/method of separation of variables.	Partial Differential equations	Analyze Partial 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	Undrstand Infinite series
4	Series solution of Bessel’s differential equation		Power series	To obtain series solution 0f Ordinary differential equation.	Power series	Analyze Power series

	leading to 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 Newton's forward and backward difference formulae, Newton's divided difference and Lagrange's formulae(All formulae without proof).		Numerical methods	Apply the knowledge of numerical methods in the modeling of various physical and engineering phenomena.	Numerical methods	Analyze Numerical methods
5	Solution of polynomial and transcendental equations-Newton-Raphson and Regula-Falsi methods(only formulae)-illustrative examples.Simpson's $(1/3)^{rd}$ and $(3/8)^{th}$ rules, Weddle's rule(without proof)-Problems.		Numerical methods	Numerical integration comprises a broad of algorithms for calculating the numerical value of definite integral.	Numerical methods	Analyze Numerical methods