Ref No:

SRI KRISHNA INSTITUTE OF TECHNOLOGY, BANGALORE

COURSE PLAN

Academic Year 2020

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:	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.

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-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	Numerical methods	L3
-	**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.

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	Understand the physical interpretation of properties of vector fields and evaluation of line, surface and volume integrals.	10	Vector Differentiation	Lecture	Assignment and slip test	L2
2	18MAT21	Understand to generate solutions to various types of differential equations its applications to engineering.	10	Ordinary Differential equations	Lecture	Assignment and slip test	L3
3	18MAT21	Construct a variety of partial differential equations and solution by exact methods/method of separation of variables.	10	Partial Differential equations	Lecture	Assignment and slip test	L3
4	18MAT21	Understand the nature of infinite series and obtain the series solution of ordinary differential equation.	10	Infinite series	Lecture	Assignment and slip test	L3
5	18MAT21	To solve algebraic and transcendental equations and obtain intermediate values using Numerical methods.	10	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.	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 diffusion.	3	L3

3	It is used to describe a wide variety of phenomena such as electrostatics,electrodynamics and quantum mechanics.	3	L3
4	It is used for analysis of current flow and sound waves in electric circuits.	4	L3
4	It is used in nuclear engineering analysis.	4	L3
5	Used in network simulation and weather prediction	5	L3
5	Used in computer science for root algorithm and multidimensional root 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.

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 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.

-	-	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	Understand the physical interpretation of properties of vector fields and evaluation of line, surface and volume integrals.	3	3	2	2					2			2				L3
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 partial differential equations and solution by exact methods/method of separation of variables.	3	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.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,	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***	**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).	CO1	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 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 $\phi=x^2 yz+4xz^2$ 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 $\iint_S \vec{F}\cdot\hat{n}\,ds$. 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 $\vec{F}=2xyi+yz^2 j+xzk$	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.	CO2	L3

b	*Course Schedule*	-	-
Class No	**Portion covered per hour**	**-**	**-**
1	Second order Linear ODE's with constant coefficients Inverse differential operators,	CO2	L3
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
c	**Application Areas**	**CO**	**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 $y'' - 4y = \cosh(2x-1) + 3^x + 2$.	CO2	L3
3	Solve $6y'' + 17y' + 12y = e^{-x}$	CO2	L3
4	Solve $y'' + 3y' + 2y = 1 + 3x + x^2$	CO2	L3
5	Solve $y'' + 2y' + 5y = e^{-x} Sin2x$.	CO2	L3
6	Solve the equation $y'' - 4y' + 4y = 8(e^{2x} + \sin 2x)$	CO2	L3
7	Solve $y''' + y'' - 4y' - 4y = 3e^{x} - 4x - 6$.	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 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 $\frac{dx}{dt}(0) = 15$				CO2	L3	6
	b	Solve the equation $y'' - 4y' + 4y = 8(e^{2x} + \sin 2x)$				CO2	L3	6
	c	Solve by the method of variation of parameters $\frac{d^2y}{dx^2} - 6\frac{dy}{dx} + 9y = \frac{e^{3x}}{x^2}$				CO2	L3	6
	d	Solve $x^2 y'' + 5xy' + 13y = logx + x^2$				CO2	L3	7
		OR						
2	a	Solve $\frac{d^2y}{dx^2} + 3\frac{dy}{dx} + 2y = 1 + 3x + x^2$				CO2	L3	6
	b	Solve by the method of variation of parameters $y'' - y = \frac{2}{1+e^x}$				CO2	L3	6
	c	Solve $(D^4 + 8D^2 + 16)y = 2\cos^2 x$				CO2	L3	6
	d	Solve $(3x+2)^2 y'' + 3(3x+2)y' - 36y = 8x^2 + 4x + 1$				CO2	L3	7

3	a	$\frac{d^2y}{dx^2}+2\frac{dy}{dx}+10y+37\sin 3x=0. Find\ y$	CO2	L3	6
	b	Obtain the PDE by eliminating the arbitrary function z=f(x+at)+g(x-at)	CO3	L3	6
	c	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	a	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
	c	Obtain The PDE by eliminating φ and ψ 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 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	Marks	CO	Level
1		Solve $(4D^4-4D^3-23D^2+12D+36)y=0$	5	CO2	L3
2		Solve y11 -4y = cosh(2x-1) +3x+2.	5	CO2	L3
3		Solve $6y''+17y'+12y=e^{-x}$	5	CO2	L3
4		Solve the equation y^{11} $-4y^{1}+4y=8(e^{2x}+\sin 2x)$	5	CO2	L3
5		Solve $y''+2y'+5y=e^{-x}Sin2x$.	5	CO2	L3
6		Solve $y^{11}+3y^{1}+2y=1+3x+x^{2}$.	5	CO2	L3
7		Solve $y^{111}+y^{11}-4y^{1}-4y=3e^{x}-4x-6$.	5	CO2	L3
8		Solve $\frac{d^3y}{dx^3}+y=Cos(\pi/2-x)+e^x$	5	CO2	L3
9		Solve $\frac{d^2x}{dt^2}+4\frac{dx}{dt}+29x=0$. Find y when x(0)=0 and $\frac{dx}{dt}(0)=15$	5	CO2	L3
10		Solve $(D^3+D^2-4D-4)y=3e^{-x}-4x-6$	5	CO2	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	CO2	L3
12		Solve $x^2y''+5xy'+13y=logx+x^2$	5	CO2	L3
13		Solve $\frac{d^2y}{dx^2}+3\frac{dy}{dx}+2y=1+3x+x^2$	5	CO2	L3
14		Solve by the method of variation of parameters $y''-y=\frac{2}{1+e^x}$	5	CO2	L3
15		Solve $(D^4+8D^2+16)y=2\cos^2x$	5	CO2	L3
		Solve $(3x+2)^2y''+3(3x+2)y'-36y=8x^2+4x+1$	5	CO2	L3
3		$\frac{d^2y}{dx^2}+2\frac{dy}{dx}+10y+37\sin 3x=0. Find\ y$	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 φ and ψ 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

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	CO3	L3
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
c	**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. $z = y^2 + 2f\left(\frac{1}{x} + \log y)\right)$, 2. $z = yf(x) + x\phi(y)$	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 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	CO3	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 $y(x,t) = a\sin\left(\frac{\Pi x}{l}\right)\cos\left(\frac{\Pi ct}{l}\right)$	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 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',	CO3	L3
12	Solve by direct integration $\frac{\partial z}{\partial y} = -2Siny$	CO3	L3

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 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	CO4	L3
b	***Course Schedule***		
Class No	**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
c	**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	Test the convergence of $\sum_{n=1}^{\infty} \frac{n^n x^n}{(n+1)^n}$,x>0	CO4	L3
2	Obtain the range of convergence of the series $\frac{2x}{1^2} + \frac{3^2 x^2}{2^3} + \frac{4^3 x^3}{3^4} + \frac{5^4 x^4}{4^5} + \ldots\ldots\ldots;\ x>0$	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 $\frac{1}{2\sqrt{1}} + \frac{x^2}{3\sqrt{2}} + \frac{x^4}{4\sqrt{3}} + \ldots\ldots\ldots\ldots,\ x>0$	CO4	L3
5	Test the convergence of the series: $1 + \frac{2^2}{2!} + \frac{3^2}{3!} + \frac{4^2}{4!} + \ldots\ldots\ldots\ldots$	CO4	L3
6	Test the convergence of the series: $\left[\frac{2^2}{1^2} - \frac{2}{1}\right]^{-1} + \left[\frac{3^3}{2^3} - \frac{3}{2}\right]^{-2} + \left[\frac{4^4}{3^4} - \frac{4}{3}\right]^{-3} + \ldots\ldots\ldots\ldots$	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 α and β are the roots of $J_n(x)=0$ then $\int_0^1 xJ_n(\alpha x)J_n(\beta x)dx=0 ; if\ \alpha\neq\beta$	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 $J_{-1/2}(x)=\sqrt{\frac{2}{\pi x}}cosx$	CO4	L3
17	Derive series solution of Bessels DE leading to Bessel functions.	CO4	L3

Module – 5

Title:	Numerical Methods	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	CO5	L3
b	***Course Schedule***		
Class No	**Portion covered per hour**	**-**	**-**
1	Finite diferences	CO5	L3
2	Newtons forward and backward difference formula	CO5	L3
3	Newtons divdede difference formula	CO5	L3
4	Lagranges formula	CO5	L3
5	Newton raphson	CO5	L3
6	Regula falsi method	CO5	L3
7	Numerical integrations,	CO5	L3
8	Simpsons 1/3 rd rule problems	CO5	L3
9	Simpsons 3/8 th rule problems	CO5	L3
10	Weddles rule and problems	CO5	L3
c	**Application Areas**	**-**	**-**
5	Used in network simulation and weather prediction	CO5	L3
5	Used in computer science for root algorithm and multidimensional root finding.	CO5	L3
d	**Review Questions**	-	-
1	From the following table find the number of students who have obtained less than 45	CO5	L3

Marks	30-40	40-50	50-60	60-70	70-80
No. of students	31	42	51	35	31

2	Using Lagranges formula find the value of y at x=6 by the following table	CO5	L3

x	0	1	2	5
y	2	3	12	147

<table>
<tr><td>3</td><td>Find $\int_{4}^{5.2} (\log x)\, dx$ using weddles rule taking the step size of 0.2</td><td>CO5</td><td>L3</td></tr>
<tr><td>4</td><td>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 $\log\sqrt{2}$</td><td>CO5</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>CO5</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>CO5</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>
<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>CO5</td><td>L3</td></tr>
<tr><td>7</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>CO5</td><td>L3</td></tr>
<tr><td>8</td><td>Using the Newtons Raphson method find the real root of the equation 3x=sinx+1</td><td>CO5</td><td>L3</td></tr>
</table>

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)	CO1	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)	CO1	L3	6
	c	Find the directional derivative of $\phi=x^2yz+4xz^2$ at(1, -2, -1) in the direction of 2i-j-2k.	CO1	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 $\vec{F}=\nabla\phi$	CO1	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)	CO1	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 $\vec{F}=2xyi+yz^2j+xzk$	CO1	L3	6
	c	Evaluate by Stokes theorem $\oint_c (sinzdx-cosxdy+sinydz)$ where c is the boundary in the rectangle $0\leqslant x\leqslant\pi, 0\leqslant y\leqslant 1, z=3$	CO1	L3	6
	d	By using Greens theorem evaluate $\int_c ((y-sinx)dx+cosxdy)$ where c is	CO1	L3	7

<table>
<tr><td></td><td></td><td>the triangle in the xy-plane bounded by the lines x=0, y=0, x=π/2, y=2x/π</td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>3</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>
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<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>CO5</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>CO5</td><td>L3</td><td>6</td></tr>
<tr><td></td><td>d</td><td>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 $\log\sqrt{2}$</td><td>CO5</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>CO5</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>CO5</td><td>L3</td><td>6</td></tr>
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</table>
Find the area corresponding to diameter 105 using an appropriate interpolation formula.</td><td>CO5</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>CO5</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.

Model Assignment Questions

Crs Code:	18MAT21	Sem:	II	Marks:	10	
Course:	Advanced Calculus and Numerical Methods			Module : 3, 4		

Note: Each student to answer 2-3 assignments. Each assignment carries equal mark.

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	CO4	L3
2		Obtain the range of convergence of the series $\frac{2x}{1^2}+\frac{3^2x^2}{2^3}+\frac{4^3x^3}{3^4}+\frac{5^4x^4}{4^5}+.........;x>0$	5	CO4	L3
3		Test for convergence or divergence of the series $\sum_{n=1}^{\infty} \frac{n!}{(n^n)^2}$	5	CO4	L3

4		Test for convergence or divergence of the series $\frac{1}{2\sqrt{1}}+\frac{x^2}{3\sqrt{2}}+\frac{x^4}{4\sqrt{3}}+.........,x>0$	5	CO4	L3
5		Test the convergence of the series: $1+\frac{2^2}{2!}+\frac{3^2}{3!}+\frac{4^2}{4!}+.........$	5	CO4	L3
6		Test the convergence of the series: $\left[\frac{2^2}{1^2}-\frac{2}{1}\right]^{-1}+\left[\frac{3^3}{2^3}-\frac{3}{2}\right]^{-2}+\left[\frac{4^4}{3^4}-\frac{4}{3}\right]^{-3}+.........$	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 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	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 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	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
	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	CO1	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	CO1	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	CO1	L3
	c	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	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	CO2	L3
	b	Solve $(D^3+D^2-4D-4)y=3e^{-x}-4x-6$	7	CO2	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	CO2	L3
		OR			
4	a	Solve $\frac{d^2y}{dx^2}+3\frac{dy}{dx}+2y=1+3x+x^2$	6	CO2	L3
	b	Solve by the method of variation of parameters $y''-y=\frac{2}{1+e^x}$	7	CO2	L3
	c	Solve $(D^4+8D^2+16)y=2\cos^2 x$	7	CO2	L3
5	a	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
		OR			
6	a	Obtain the PDE of the function $\phi(xy+z^2, x+y+z)=0$	6	CO3	L3
	b	Obtain The PDE by eliminating φ and ψ from the relation $z=x\phi(y)+y\psi(x)$	7	CO3	L3
	c	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 multiple of $\frac{\pi}{2}$			
7	a	Test the convergence of $\sum_{n=1}^{\infty} \frac{n^n x^n}{(n+1)^n}$,x>0	6	CO4	L3
	b	Obtain the range of convergence of the series $\frac{2x}{1^2}+\frac{3^2x^2}{2^3}+\frac{4^3x^3}{3^4}+\frac{5^4x^4}{4^5}+\ldots\ldots\ldots;x>0$	7	CO4	L3
	c	Prove that $J_{1/2}(x)=\sqrt{\frac{2}{\pi x}}\sin x$	7	CO4	L3
		OR			
8	a	Test for convergence or divergence of the series $\sum_{n=1}^{\infty} \frac{n!}{(n^n)^2}$	6	CO4	L3
	b	Test for convergence or divergence of the series $\frac{1}{2\sqrt{1}}+\frac{x^2}{3\sqrt{2}}+\frac{x^4}{4\sqrt{3}}+\ldots\ldots\ldots,x>0$	7	CO4	L3
	c	If α and β are the roots of $J_n(x)=0$ then $\int_0^1 xJ_n(\alpha x)J_n(\beta x)dx=0;\, if\ \alpha\neq\beta$	7	CO4	L3
9	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 No. of students | 31 | 42 | 51 | 35 | 31	6	CO5	L3
	b	Using Lagranges formula find the value of y at x=6 by the following table x | 0 | 1 | 2 | 5 y | 2 | 3 | 12 | 147	7	CO5	L3
	c	Find $\int_4^{5.2}(\log x)dx$ using weddles rule taking the step size of 0.2	7	CO5	L3
		OR			
10	a	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 $x\log_{10}x=1.2$	7	CO5	L3
	c	The area of a circle (A) corresponding to the diameter (D) is given below. D | 80 | 85 | 90 | 95 | 100 A | 5026 | 5674 | 6362 | 7088 | 7854 Find the area corresponding to diameter 105 using an appropriate interpolation formula.	7	CO5	L3

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 $\phi=x^2yz+4xz^2$ at(1, -2, -1) in the direction of 2i-j-2k.	7	CO1	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	CO1	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	CO2	2013	
	b	Solve $(D^3+D^2-4D-4)y=3e^{-x}-4x-6$	7	CO2	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	CO2	2013	
		OR				
4	a	Solve $\frac{d^2y}{dx^2}+3\frac{dy}{dx}+2y=1+3x+x^2$	6	CO2	2013	
	b	Solve by the method of variation of parameters $y''-y=\frac{2}{1+e^x}$	7	CO2	2012	
	c	Solve $(D^4+8D^2+16)y=2\cos^2 x$	7	CO2	2012	
					2012	
5	a	$\frac{d^2y}{dx^2}+2\frac{dy}{dx}+10y+37\sin 3x=0. Find\ y$	6	C03	2010	
	b	Solve $x^2y''+5xy'+13y=logx+x^2$	7	C03	2010	
	c	Solve $(3x+2)^2y''+3(3x+2)y'-36y=8x^2+4x+1$	7	C03	2012	
		OR			2012	
6	a	Solve $x^2y''+5xy'+13y=sinx+x^2$	6	C03		
	b	Solve $(3x+2)^2y''+3(3x+2)y'-36\ y=8x^3+2x2sinx$	7	C03	2012	
	c	$\frac{d^2y}{dx^2}+2\frac{dy}{dx}+10y+37\sin 3x=0.\ Find\ y$	7	C03	2013	

7	a	Obtain the PDE by eliminating the arbitrary function z=f(x+at)+g(x-at)	6	CO3	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	CO3	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	CO3	2015
		OR			
7	a	Test the convergence of $\sum_{n=1}^{\infty}\frac{n^n x^n}{(n+1)^n}$,x>0	6	CO4	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	CO4	2008
	c	Prove that $J_{1/2}(x)=\sqrt{\frac{2}{\pi x}}sinx$	7	CO4	2016
		OR			
8	a	Test for convergence or divergence of the series $\sum_{n=1}^{\infty}\frac{n!}{(n^n)^2}$	6	CO4	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	CO4	2006
	c	If α and β are the roots of $J_n(x)=0$ then $\int_0^1 xJ_n(\alpha x)J_n(\beta x)dx=0;if\ \alpha\neq\beta$	7	CO4	2014
9	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 No. of students: 31, 42, 51, 35, 31	6	C05	2013
	b	Using Lagranges formula find the value of y at x=6 by the following table x: 0, 1, 2, 5 y: 2, 3, 12, 147	7	C05	2015
	c	Find $\int_4^{5.2}(logx)dx$ using weddles rule taking the step size of 0.2	7	C05	2016
		OR			
10	a	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 $x\log_{10}x=1.2$	7	C05	2016
	c	The area of a circle (A) corresponding to the diameter (D) is given below. D: 80, 85, 90, 95, 100	7	C05	2015

Table in 9a:

Marks	30-40	40-50	50-60	60-70	70-80
No. of students	31	42	51	35	31

Table in 9b:

x	0	1	2	5
y	2	3	12	147

Table in 10c:

D	80	85	90	95	100

		A	5026	5674	6362	7088	7854			
		Find the area corresponding to diameter 105 using an appropriate interpolation formula.								

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 coefficients-Inverse differential operators, method of variation of parameters.	4	- L3 - L3	L3	-apply -	- 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	PDE	Partial Differential equations	Construct a variety of partial differential equations.	Partial Differential equations	Analyze Partial Differential equations

	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.					
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	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(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