DEPARTMENT OF MATHEMATICS

NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

COURSE PLAN – PART I			
Course Title	**Engineering Mathematics**		
Course Code	**MA613**	**No. of Credits**	**3**
Course Code of Pre-requisite subject(s)	**NIL**		
Session	**July, 2021**	**M. Tech.**	**Industrial Metallurgy**
Name of Faculty	**Dr. R. Ponalagusamy**	**Department**	**Mathematics**
Email	**rpalagu@nitt.edu**	**Telephone No.**	**7402448889**
Name of Course Coordinator(s) (if, applicable)	**----------**		
E-mail		**Telephone No.**	
Course Type	**Core Course**		

Syllabus (approved in BoS)

Partial Differential equations – basic concepts – One dimensional heat flow equation - Two dimensional heat flow equation in steady flow in Cartesian and Polar coordinates.

Calculus of variations - Euler's equation - Variational problems in parametric form - Natural boundary condition – Conditional Extremum - Isoperimetric problems.

Numerical Solution of ODE's – Euler's, Taylor's and Runge Kutta methods – Milne's and Adams' predictor-corrector methods.

Finite difference scheme for elliptic, parabolic, and hyperbolic partial differential equations.

Introduction to Finite Element Method - Rules for forming interpolation functions - Shape functions - Application to fluid flow and heat transfer problems.

Reference Books

1. Gerald, C.F. and Wheatley, P.O., Applied Numerical Analysis, Addison Wesley, 2010.
2. Jain, M.K., Iyengar, S.R. and Jain, R.K., Numerical Methods for Scientific and Engineering Computation, Wiley Eastern, 2010.
3. Desai, C.S. and Abel, J. P., Introduction to Finite Element Method; a numerical method for engineering analysis, Van Nostrand Reinhold Co., 1991.

4. Elsegolts, L., Differential Equations and the Calculus of Variations, Mir Publishers, 1977.
5. Grewal, B.S., Higher Engineering Mathematics, Khanna Publishers, 2017.
6. Veerarajan, T., Numerical Methods, Volume III, Tata McGraw Hill Edition, New Delhi, 2009.
7. Reddy, J.N., Introduction to Finite Element Method, Mcgraw Hill, 2016.

COURSE OBJECTIVES

1. To make the students mathematically strong for solving engineering and scientific problems.
2. To solve variational problems in parametric form with the calculus of variation and Eulers equation.
3. To learn various numerical computational techniques and apply to engineering problems.
4. To train students with mathematical aspects so as to comprehend, analyze, design and create novel products and solution for the real life problems.

COURSE OUTCOMES (CO)

Course Outcomes	**Aligned Programme Outcomes (PO)**
1. To be knowledgeable about partial differential equations (PDEs) and how they serve as mathematical models for physical processes such as heat transfer problems in one-dimensional and two-dimensional cases.	The engineering post graduates will apply their knowledge in solving engineering problems.
2. To be familiar with calculus of variations and Euler's equation and to solve variational problems in parametric form, Ostrogradsky equation and isoparimetric problems.	"
3. To be knowledgeable about the basic concepts of numerically solving ODEs and its applications to Engineering problems.	Students will apply their knowledge of Numerical techniques to solve industrially applicable problems.
4. Understanding and applying the numerical methods to compute the numerical solutions of Partial Differential Equations with error controls and their applications to thermal, fluid and general engineering problems.	"
5. To be familiar with usage of advanced numerical method such as finite element method to solve heat transfer problems.	"

COURSE PLAN – PART II			
COURSE OVERVIEW			
• To understand the Mathematical applications to Engineering problems using PDE. • To have general awareness and understanding of variations of several types of functional and their applications. • To understand and obtain various numerical solutions of ODEs. • To understand and compute numerical solutions of PDEs by using Finite Difference and Finite Element Techniques.			
COURSE TEACHING AND LEARNING ACTIVITIES			
S.No.	**Week/Contact Hours**	**Topic**	**Mode of Delivery**
1	**Week-1**	Partial Differential Equations(PDE), Classifications of PDE, One dimensional heat flow equation Solution of one-dimensional heat flow equation by the method of separation of variables.	**Online class**
2	**Week-2**	Some problems in one-dimensional heat flow equation, Analytic solution of Two dimensional heat flow equation in steady flow in Cartesian coordinates and some problems.	**Online class**
3	**Week-3**	Analytic solution of Two dimensional heat flow equation in steady flow in Polar coordinates and some problems. Introduction to Calculus of variation and its applications, Variational notations and first variation.	**Online class**
4	**Week-4**	Euler's equation derivation and problems and Variational problems involving several unknown dependent functions. Derivation of Euler Poisson Equation and Problems. Variational problems in parametric form.	**Online class**
5	**Week-5**	Derivation of Ostrogradsky equation and Derivation of Natural boundary conditions. Problems on Natural boundary conditions.	**Online class**
6	**Week-6**	Conditional Extremum – Isoperimetric Problems. Introduction to numerical solution of ordinary differential equations (ODE's), Euler's method, Taylor's series method and some problems.	**Online class**

7	**Week-7**	Taylor's series method and Runge-Kutta method of the fourth order for simultaneous ordinary differential equations and second order ODEs, Some problems to be solved.	**Online class**
8	**Week-8**	Introduction to multistep methods and their advantages, Derivation of Milne's predictor-corrector formula, error term, some problems, Adam's predictor-corrector method and solving some problems.	**Online class**
9	**Week-9**	Introduction to Finite difference method, Derivation of finite difference formulas and the errors involved in these formulas and Computing numerical solutions of Laplace equation by Liebmann's procedure.	**Online class**
10	**Week-10**	Numerical solution of Poisson equation by Liebmann's technique, Derivation of explicit formula, Bender-Schmidt recurrence formula for solving one-dimensional heat flow equation and computing numerical solutions.	**Online class**
11	**Week-11**	Derivation of explicit scheme to comput numerical solution of one-dimensional wave equation and some problems. Introduction to Finite Element Method and its applications.	**Online class**
12	**Week-12**	The basic steps involved in Finite Element Method (FEM), Rules for forming Interpolation Function and Shape Function for one and two dimensional problems.	**Online class**
13	**Week-13**	Global function for one dimensional problems. Application of FEM to one-dimensional Heat Transfer problems.	**Online class**
14	**Week-14**	Application of FEM to two dimensional problems.	**Online class**

COURSE ASSESSMENT METHODS (shall range from 4 to 6)

S.No.	Mode of Assessment	Week/Date	Duration	% Weightage
1	**Assessment-I**	7th **Week**	1 Hour	20%

2	**Assessment-II**	12th **Week**	1 Hour	20%
3	**Compensation Assessment: Retest**	14th **Week**	1 Hour	20%
4	**Quiz**	13th **Week**	15 Minutes	10%
5	**Seminar**			20%
6	**Final Assessment**	16th **Week**	2 Hours	30% Total:100 Marks

***mandatory; refer to guidelines on page 4**

COURSE EXIT SURVEY (mention the ways in which the feedback about the course shall be assessed)

1. Feedback from students during class committee meeting.
2. Anonymous feedback through questionnaire (as followed previously by the Institute).

COURSE POLICY (preferred mode of correspondence with students, policy on attendance, compensation assessment, , academic honesty and plagiarism etc.)

1. **Faculty can also be contacted over phone: 7402448889. E-mail: rpalagu@nitt.edu**
2. **Assessment-I and Assessment-II will be conducted through online mode.**
3. **Portions for Assessment-I (Cycle test-I) are Unit-I and Unit-II (First and Second paragraphs of the syllabus).**
4. **Portions for Assessment-II (Cycle test-II) are Unit-III and Unit-IV (Third and Fourth paragraphs of the syllabus).**
5. **Portions for Quiz are Units I-IV.**
6. **Students who have missed the first or second or both Assessment(s) can register with the faculty concerned for the Re-Test examination which shall be conducted soon after the completion of the Assessment-II (second cycle test). The Re-Test shall be conducted for 20 marks comprising the syllabus of both Assessment-I and Assessment-II. The Re-Test shall be conducted before the regular semester examination (Final Assessment).**
7. **At least 75% attendance in each course is mandatory. Students with less than 75% in any course by the end of 9th week will be identified and alerted by the class committee.**
8. **A maximum of 10% shall be allowed under On Duty (OD) category.**
9. **Students with less than 65% of attendance shall be prevented from writing the final assessment and shall be awarded 'V' grade.**

10. **Students who have failed in the End semester examination (final assessment) with F grade and those have missed the End semester examination due to genuine/medical reason shall take Reassessment (supplementary examination).**

11. **Students awarded 'V' grade must compulsorily redo the course.**

12. **The passing minimum should be 40%.**

ATTENDANCE POLICY (A uniform attendance policy as specified below shall be followed)

- **At least 75% attendance in each course is mandatory.**
- **A maximum of 10% shall be allowed under On Duty (OD) category.**
- Students with **less than 65% of attendance** shall be prevented from writing the final assessment and **shall be awarded 'V' grade.**

ACADEMIC DISHONESTY & PLAGIARISM

- Possessing a mobile phone, carrying bits of paper, talking to other students, copying from others during an assessment will be treated as punishable dishonesty.
- Zero mark to be awarded for the offenders. For copying from another student, both students get the same penalty of zero mark.
- The departmental disciplinary committee including the course faculty member, PAC chairperson and the HOD, as members shall verify the facts of the malpractice and award the punishment if the student is found guilty. The report shall be submitted to the Academic office.

  The above policy against academic dishonesty shall be applicable for all the programmes.

ADDITIONAL INFORMATION

Faculty is available for discussion after the class hours at the Department on the first floor of Lyceum. Room No. 222.

FOR APPROVAL

Course Faculty 6/9/2021 (DR. R. PONALAGUSAMY) CC-Chairperson 6/9/2021 HOD 09.09.21