NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

This course outline template acts as a guide for writing your course outline. As every course is different, please feel free to amend the template/ format to suit your requirements.

COURSE OUTLINE TEMPLATE			
Course Title	**Numerical Techniques**		
Course Code	**MAIR41**	**No. of Credits**	**3**
Department	**Mathematics**	**Faculty**	**Dr. R. Ponalagusamy**
Pre-requisites Course Code	**MA101 and MA102**		
Course Coordinator(s) (if, applicable)	**NIL**		
Other Course Teacher(s)/Tutor(s) E-mail	**NIL**	**Telephone No.**	**7402448889**
Course Type	**Core course**		

COURSE OVERVIEW

- **To have general awareness and understanding of**
  Various numerical techniques to compute solutions of linear systems, to find the dominant eigenvalue and eigen vector and to find solutions of nonlinear equations .
- **To impart the basic concepts of interpolation of two-dimensional data.**
- **To understand and obtain various numerical solutions of ODEs and PDEs with error analysis.**

COURSE OBJECTIVES

To provide the basic concepts of numerical methods in view of solving linear systems and nonlinear equations.

To introduce several methods for the interpolation of data from chemical engineering problems and understand the techniques of curve fitting.

To learn various numerical computational techniques and apply to engineering problems.

COURSE OUTCOMES (CO)

Course Outcomes	Aligned Programme Outcomes (PO)
1. Understanding and applying the methodologies to solve the system of linear equations numerically for exact/approximate solutions. 2. Understanding and applying the techniques to compute real and complex roots of a given nonlinear equations with error analysis. 3. Understanding and applying methods for the interpolation of engineering data(two dimensional) with equal/unequal interval, numerical differentiation and integration and to find the best fit curve. 4. Understanding the basic concepts of solving ODEs and its applications to Chemical Engineering problems. 5. 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.	The engineering under-graduates will apply their knowledge of Mathematical and numerical techniques to solve industrially applicable problems.

COURSE TEACHING AND LEARNING ACTIVITIES

S.No.	Week	Topic	Mode of Delivery
1.	Week- 1 Week- 2 Week- 3 Week- 4	1. Introduction to numerical methods, explanation Gaussian elimination method and problems. 2. Numerical solutions of several linear systems by using Gauss-Jordan, LU decomposition and Crout's techniques. 3. Explanation of Gauss-Jacobi and Gauss-Siedel iterative methods to solve problems. Sufficient conditions for convergence-Statement. Compute the dominant eigenvalue and eigenvector of a matrix by power method. 4. Introduction to concepts of Bisection, Secant and Regula falsi methods. Derivation of formula of Newton-Raphson method for f(x) = 0 and some problems. Order of convergence.	Chalk and Talk

2.	**Week- 5** **Week- 6** **Week- 7** **Week- 8** **Week- 9** **Week- 10** **Week- 11** **Week- 12** **Week- 13**	**5. Solving f(x,y) = 0 and g(x,y) = 0 by Newton-Raphson method. Finding a root of f(x) = 0 by Horner's method. Computing complex roots of f(x) = 0 by Bairstow's method.** **6. Computing complex roots of f(x) = 0 by Graeffe's method. Introduction to interpolation and its applications, Derivation of Newton's forward and backward formulas.** **7. Newton's divided difference and Lagrange's interpolation formulas, Some problems, Solving problems using numerical differentiation.** **8. Some problems using Trapezoidal rule, Simpson's 1/3 and 3/8 rules, Curve fitting-methods of least squares and group averages.** **9. Introduction to numerical solution of ordinary differential equations (ODE's), Euler's method, Euler's modified method, some problems and Taylor's series method for simultaneous ODEs.** **10. Runge-Kutta method for simultaneous ODEs, Taylor's series and Runge-Kutta methods for simultaneous differential equations and second order ODEs, Some problems to be solved.** **11. 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.** **12. 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.** **13. Numerical solution of Poisson equation by Liebmann's technique, Derivation of explicit formula, Bender-Schmidt recurrence formula and Crank-Nicolson implicit formula for solving one-dimensional heat flow equation and computing numerical solutions.**	**Chalk and Talk**

3.	**Week- 14**	**14. Derivation of explicit scheme to comput numerical solution of one-dimensional wave equation and some problems.**	**Chalk and Talk**

COURSE ASSESSMENT METHODS

S.No.	Mode of Assessment	Week/Date	Duration	% Weightage
1.	Cycle Test – I	7th week	1 Hour	20%
2.	Cycle Test- II	13th week	1 Hour	20%
3.	Retest	15th week	1 Hour	
4.	Assignments			10%
5.	End Semester Exam		3 Hours	50% Total : 100 Marks

ESSENTIAL READINGS : Textbooks, reference books Website addresses, journals, etc

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. Veerarajan, T., Numerical Methods, Volume III, Tata McGraw Hill Edition, New Delhi, 2009.
4. Kandasamy, P., Thilagavathy, K. and Gunavathy, S., Numerical Methods, Chand and Company, 2007.
5. Venkataraman, M.K., Numerical Methods in Science and Engineering, The National Publishing Company, 1999.

COURSE EXIT SURVEY (mention the ways in which the feedback about the course is assessed and indicate the attainment also)

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

COURSE POLICY (including plagiarism, academic honesty, attendance, etc.)

1. **Cycle test-I and Cycle test-II will be conducted in regular class.**
2. **Portions for Cycle test-I are Unit-I and Unit-II (First and Second paragraphs of syllabus).**

3. Portions for Cycle test-II are Unit-III and Unit-IV (Third and Fourth paragraphs of syllabus).

4. Students who have missed the first or second or both cycle test(s) can register with the faculty concerned for the Re-Test examination which shall be conducted soon after the completion of the second cycle test. The Re-Test shall be conducted for 20 marks comprising the syllabus of both first and second cycle tests. The Re-Test shall be conducted before the regular semester examinations.

5. 75% attendance is compulsory for writing the end semester examination.

6. Mandatory classes (after the semester examinations of the current session) should be attended by the students, whose attendance falls below 75% but above 50% in the subject (MAIR41).

7. Students who have less than 50% of attendance have to redo the concerned subject (MAIR41).

8. Students who have failed in the semester examination with F grade, those completed mandatory classes and those have missed the End semester examination shall take Reassessment (supplementary examination).

9. The passing minimum should be $\frac{\bar{x}}{2}$ *or* $\frac{x_{max}}{3}$, whichever is less where $\bar{x}$ is the mean of the class and x_{max} is the maximum marks in the class.

ADDITIONAL COURSE INFORMATION:

Faculty is available for discussion after the class hours at the Department on the first floor of Lyceum. Room No. 222. Faculty can also be contacted over phone: 7402448889

eg.: The Course Coordinator is available for consultation at times that are displayed on the coordinator's office notice board. Queries may also be emailed to the Course Coordinator directly at ----------

FOR SENATE'S CONSIDERATION

2/1/2017

Course Faculty _____ CC-Chairperson _____ HOD _____ 2/1/2017