Course Code	Course Name	L-T-P-Credits	Year of Introduction
CE473	ADVANCED COMPUTATIONAL TECHNIQUES AND OPTIMIZATION	3-0-0-3	2016

Prerequisite : CE306 Computer Programming and Computational Techniques

Course objectives:

- To introduce different numerical solutions and importance of optimization
- To impart ability to apply mathematics and optimizing techniques for finding solutions to real time problems.

Syllabus :

Introduction to numerical methods- errors in numerical methods-Systems of linear algebraic equations- Elimination and factorization methods- Gauss Seidel iteration. Eigen Value problems- power method. General Optimisation procedures - and features of mathematical programming as applicable to Civil engineering problems. Unconstrained and constrained optimization problems - Formulation of objective function and constraints. Lagrangian interpolation- Quadratic and Cubic splines (Problems on quadratic splines only)- Data smoothing by least squares criterion- Non-polynomial models like exponential model and power equation- Multiple linear regression. Numerical integration- Newton – Cotes open quadrature- Linear Programming - Simplex method standard form - Simplex algorithm - Two phase solution by simplex method - Duality of linear programming Formulation of geometric programming. Ordinary differential equations- 1st order equations- Solution by use of Taylor series- Runge- kutta method- Ordinary differential equations of the boundary value type- Finite difference solution- Partial differential equations in two dimensions- Parabolic equations- Explicit finite difference method- Crank-Nicholson implicit method- Ellipse equations Non- Linear Programming problems – one dimensional minimisation. Unconstrained optimization Techniques Direct search method. Random search Univariate pattern search. Descent methods.

Course Outcomes:

The students will be able to:

i. Find different numerical solutions of complicated problems
ii. Determine solutions of real time problems applying numerical methods in mathematics
iii. Understand the importance of optimization and apply optimization techniques in real time problems

Text Books / References:

1. Grewal B.S. “Numerical Methods in Engineering and Science” Khanna Publishers.
2. Chapra S.C. and Canale R.P. “Numerical Methods for Engineers” Mc Graw Hill 2006.
3. Smith G.D. “Numerical solutions for Differential Equations” Mc Graw Hill
4. Ketter and Prawel “Modern Methods for Engineering Computations” Mc Graw Hill
5. Rajasekharan S. “Numerical Methods in Science and Engineering”S Chand & company 2003.
6. Rajasekharan S. “Numerical Methods for Initial and Boundary value problems,” Khanna publishers 1989.
7. Terrence .J.Akai “Applied Numerical Methods for Engineers”, Wiley publishers 1994.
8. R.L. Fox , Optimisation methods in Engineering Design, Addison Wesely
9. S.S. Rao , Optimisation Theory and applications , ,Wiley Eastern.
10. Belegundu., Optimisation concepts and Applications Engineering,

11. Andrew B Templeman, Civil Engineering Systems

COURSE PLAN			
Module	**Contents**	**Hours**	**Sem. Exam Marks %**
I	Introduction to numerical methods- errors in numerical methods- Systems of linear algebraic equations- Elimination and factorization methods- Gauss Seidel iteration. Eigen Value problems- power method.	7	15
II	General Optimisation procedures - and features of mathematical programming as applicable to Civil engineering problems. Unconstrained and constrained optimization problems - Formulation of objective function and constraints.	6	15
FIRST INTERNAL EXAMINATION			
III	Lagrangian interpolation- Quadratic and Cubic splines (Problems on quadratic splines only)- Data smoothing by least squares criterion- Non- polynomial models like exponential model and power equation- Multiple linear regression. Numerical integration- Newton – Cotes open quadrature	7	15
IV	Linear Programming - Simplex method standard form - Simplex algorithm - Two phase solution by simplex method - Duality of linear programming Formulation of geometric programming	6	15
SECOND INTERNAL EXAMINATION			
V	Ordinary differential equations- 1st order equations- Solution by use of Taylor series- Runge- kutta method- Ordinary differential equations of the boundary value type- Finite difference solution- Partial differential equations in two dimensions- Parabolic equations- Explicit finite difference method- Crank-Nicholson implicit method- Ellipse equations	7	20
VI	Non- Linear Programming problems – one dimensional minimisation. Unconstrained optimization Techniques Direct search method. Random search Univariate pattern search. Descent methods	7	20
END SEMESTER EXAMINATION			

QUESTION PAPER PATTERN (External Evaluation) :

Maximum Marks :100 **Exam Duration: 3 Hrs**

Part A -Module I & II : 2 questions out of 3 questions carrying 15 marks each

Part B - Module III & IV: 2 questions out of 3 questions carrying 15 marks each

Part C - Module V & VI : 2 questions out of 3 questions carrying 20 marks each

Note : 1.Each part should have at least one question from each module

2.Each question can have a maximum of 4 subdivisions (a, b, c, d)