SCHEME OF COURSE WORK

Course Details:

Course Title	: **Structural Optimization**			
Course Code	: **13CE2202**	**L P C**		**: 4 0 3**
Program:	: **M. Tech.**			
Specialization:	: **Structural Engineering**			
Semester	: **I**			
Prerequisites	: **Structural Analysis.**			
Courses to which it is a prerequisite		**: None**		

Course Outcomes (COs):
At the end of the course, the student will be able to:

1	Gain knowledge on problem formulation for a given structure and learn to analyse by classical method.
2	Understand formulation and solution techniques for non-linear problems.
3	Get knowledge on the basics and application of Genetic Algorithm for structural optimization.
4	Obtain skills in use of Simulated Annealing technique in structural optimization.
5	Obtain knowledge on the use of Artificial Neural Networks in structural application.

Program Outcomes (POs):
Post graduates will be able to:

1	Synthesize existing and new knowledge in various sub areas of structural engineering
2	Analyse complex engineering problems critically with adequate theoretical background for practical applications.
3	Evaluate a wide range of feasible and optimal solutions after considering safety and environmental factors.
4	Demonstrate the ability to pursue research by conducting experiments and extract the relevant information through literature surveys.
5	Use state –of- the- art of modern tools for interpreting the behavior and modeling of complex engineering structures.
6	Attain the capability to work in multi disciplinary teams to achieve common goals.
7	Demonstrate the knowledge to perform the projects efficiently in multi disciplinary environments after consideration of economical and financial matters.
8	Communicate effectively on complex engineering activities to prepare reports and make presentations.
9	Engage in life-long learning independently to improve knowledge.
10	Understand the responsibility of carrying out professional practices ethically for sustainable development of society.
11	Examine critically and independently one's actions and take corrective measures by learning from mistakes.

Course Outcome versus Program Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO-1	S	S	M			M					
CO-2	S	S	M	M							
CO-3	S	S	M	M			S				M
CO-4	S	S	M	M			S				M
CO-5	S	S	S	M	S		S				M

S - Strongly correlated, M - Moderately correlated, *Blank - No correlation*

Assessment Methods:	Assignment / Seminar / Mid-Test / End Exam

Teaching-Learning and Evaluation

Week No.	TOPIC / CONTENTS	Course Outcomes	Sample questions	TEACHING-LEARNING STRATEGY	Assessment Method & Schedule
1	Introduction to optimization techniques and defining basic terms for problem formulation	CO-1	What are the traditional methods of optimization Formulate the problem for a water tank design.	▫ Lecture/ Discussion ▫ Problem solving	Assignment
2	Description of design variable, objective function and constraints with example	CO-1	Define design variables Define objective function and constraint	▫ Lecture	
3	Description of classical methods of optimization and numerical on the solution of the problem of optimization	CO-1	Using Lagrange multiplier method solve a minimization problem	▫ Lecture ▫ Problem solving	Assignment
4	Formulation of Kuhn Tucker Condition for the given problem Solving an Optimization problem using Kuhn Tucker Condition	CO-1 CO-1	Write Kuhn Tucker Conditions for minimization problem. Solve an Optimization problem using Kuhn Tucker Condition	▫ Lecture ▫ Problem solving	Assignment
5	Description of unconstraint optimization and constraint optimization with structural example Description of various direct and indirect search methods in unconstraint optimization	CO-2 CO-2	Give the example of constraint optimization problem List out direct methods of unconstraint optimization	▫ Lecture ▫ Lecture	
6	Basic approach to penalty function methods Interior and exterior penalty function methods description	CO-2 CO-2	What is penalty function method Differentiate between inter and exterior penalty function method Write algorithms for interior and exterior penalty function method	▫ Lecture ▫ Lecture	

7	Formulation of problem of welded beam, three bar truss etc using penalty function method	CO-2	Formulate the 3-bar truss using penalty function method	▫ Lecture	Assignment
	Solving optimization problem on penalty function method	CO-2	Minimize a given function subjected constraints using penalty function method.	▫ Problem solving	
8	Introduction to Genetic Algorithms, advantages and terminology.	CO-3	Define terms involved in GA	Lecture	
	Description of procedure to encoding of design variable	CO-3	Explain binary coding.	▫ Lecture	
9	**MID TEST - I**				
10	Description of GA parameters	CO-3	Discuss various methods of selection Explain 2-point crossover What is mutation rate	▫ Lecture	
11	Solving optimization problem of pendulum example and 3-bar truss	CO-3	Formulate pendulum problem using GA Formulate 3-bar truss problem in GA	Problem solving	Assignment
12	Introduction to Simulated Annealing, flowchart Working principles of Simulated Annealing	CO-4 CO-4	What is the basic principle of SA Draw flow chart of SA	▫ Lecture	
13	Explanation of problem formulation in Simulated Annealing for various examples, retaining wall, pre-stressed concrete etc	CO-4	Formulate problem for retaining wall etc.	▫ Lecture ▫ Problem solving	
14	Solving optimization problems of simple objective function using Simulated Annealing	CO-4	Explain the procedure to optimize using SA	Problem solving	
15	Introduction to Artificial Neural Networks and some structural applications Various ANN learning methods	CO-5 CO-5	What is ANN? Give some structural applications of ANN What are various learning methods in ANN?	▫ Lecture	
16	Explanation to Back propagation neural Networks and error and weight adjustment calculation concept.	CO-5	Define back propagation neural network. What is the significance of weight adjustment?	▫ Lecture	Assignment
17	Solving problems on weight adjustment calculation Problem formulation in ANN application to structural engineering	CO-5 CO-5	Define the error in networks What is meant my hidden layer Formulate structural problem in ANN	Problem solving Problem solving	Assignment
18	**MID TEST - II**				
	END EXAM				