SCHEME OF COURSE WORK

Course Details:

Course Title	**: Optimization Methods in Engineering**		
Course Code	**:13ME2104**	**L P C**	**:4 -- 3**
Program:	**: M.Tech.**		
Specialization:	**: CAAD**		
Semester	**: 1st**		
Prerequisites	**:**		
Courses to which it is a prerequisite	**:**		

Course Outcomes (COs): The student will be able to

1	Explain the importance and basic principles of optimization
2	Apply the theory to formulate design problems as mathematical optimization problems
3	Solve optimization problems using different methods or algorithms
4	Learn different methods of solving unconstrained and constrained optimization problems
5	Select a suitable technique for a specific engineering problem

Program Outcomes (POs): A postgraduate of CAAD will have the

1	Ability to apply fundamental principles in the areas of analysis and design of mechanical components and systems
2	Ability to apply creative and innovative skills in the area of mechanical design
3	Ability to identify, formulate and solve complex mechanical design problems
4	Ability to carry out the research related to computer aided analysis and design
5	Knowledge of advanced modeling and analysis tools
6	Ability to function in multidisciplinary teams during collaboration with educational institutions, industry and R&D organizations
7	Ability to apply knowledge of the engineering, financial and management principles to execute projects
8	Ability to effectively convey technical material through oral and/or written communication
9	Recognition of the need for and ability to engage in lifelong learning
10	Understanding of professional and ethical responsibility
11	Ability to conduct a thorough survey and analyze critically to plan, design, and test components and systems implementing new thoughts

Course Outcome Versus **Program Outcomes:**

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO-1	S			M								
CO-2			M	M								
CO-3	M						M					
CO-4	M						M					
CO-5			S	M								

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

Assessment Methods:	Assignment / Quiz / Seminar / Case Study / Mid-Test / End Exam

Teaching-Learning and Evaluation

Week	TOPIC / CONTENTS	Course Outcomes	Sample questions	TEACHING-LEARNING STRATEGY	Assessment Method & Schedule
1	Basic principles of optimization Classification of optimization methods, Classical optimization techniques-Single variable optimization methods	CO-1	▫ Explain the following terms: Design Vector, Design constraint ▫ Find the maxima and minima, if any, of (any) given function f(x)	▫ Lecture / Discussion	Assignment (Week 5 - 7) Mid-Test 1 (Week 9)
2	Classical optimization techniques-Multi variable optimization methods	CO-1 & CO-2	▫ Construct a Lagrange function for a problem with two variables ▫ Give the necessary conditions for its extremum	▫ Lecture / Discussion ▫ Problem solving	Assignment (Week 5 - 7) Mid-Test 1 (Week 9)
3	One dimensional unconstrained optimization	CO-3,CO-4	▫ Minimize the given function *f(x)* by ▫ Golden section method in the interval ▫ Newton method	▫ Lecture ▫ Problem solving	Assignment (Week 5 - 7) Mid-Test 1 (Week 9)
4	Non- linear multivariable optimization without constraints-Univariate, Pattern search methods	CO-3,CO-4	▫ Minimize given *f(X)* using Univariate method ▫ Determine if the given two vectors serve as conjugate directions for minimizing the given function f	▫ Lecture ▫ Problem solving	Assignment (Week 5 - 7) Mid-Test 1 (Week 9)
5	Non- linear multivariable optimization without constraints –Steepest descent Non- linear multivariable optimization with constraints-Penalty approach concepts	CO-3,CO-4	▫ Minimize given *f(X)* using steepest descent method ▫ Explain the concept of penalty approach methods in solving non-linear multivariable optimization problems with constraints	▫ Lecture ▫ Problem solving	Assignment (Week 5 - 7) Mid-Test 1 (Week 9)
6	Interior and exterior penalty function methods	CO-3,CO-4	▫ Compare the exterior penalty function method and interior penalty function method used to solve constrained optimization problems ▫ Minimize given f(X) subject to the given constraints using interior penalty function approach	▫ Lecture ▫ Problem solving	Assignment (Week 5 - 7) Mid-Test 1 (Week 9)
7	Problems solving / Seminars	CO-3,CO-4		▫ Problems solving ▫ Seminars	Quiz/Seminar
8	Geometric programming-solution from differential calculus point of view	CO-3,CO-4	▫ Give examples of posynomial functions ▫ Derive orthogonality and normality conditions in solving GP problem	▫ Lecture / Discussion	Mid-Test 1 (Week 9
9	**Mid-Test 1**				
10	Geometric programming-Arithmetic-geometric inequality Optimization of zero degree difficulty problems without constraints	CO-3,CO-4	▫ What is arithmetic-geometric inequality? ▫ Explain the term "degree of difficulty" in G.P.	▫ Lecture ▫ Discussion ▫ Problem solving	Seminar Mid-Test 2 (Week 18)
11	Optimization of zero degree difficulty problems with constraints Optimization of single degree difficulty problems without constraints	CO-3,CO-4	▫ Minimize the given function *f(X)* subject to the given constraints using geometric programming	▫ Lecture ▫ Problem solving	Seminar Mid-Test 2 (Week 18)

12	Problems solving / Seminars	CO-3,CO-4		▫ Problems solving ▫ Seminars	Quiz/ Seminar
13	Genetic algorithms	CO-4	▫ What are the basic operations used in GAs? ▫ Discuss in detail how the operations are performed	▫ Lecture ▫ Discussion ▫ Power Point Presentation	Seminar Mid-Test 2 (Week 18)
14	Genetic algorithms	CO-4	▫ What are the basic operations used in GAs? ▫ Discuss in detail how the operations are performed	▫ Lecture ▫ Discussion ▫ Power Point Presentation	Seminar Mid-Test 2 (Week 18)
15	Basic concepts of stochastic programming	CO-4	○ Explain how a multi stage decision process is represented. ▫ What is stochastic dynamic programming? Explain	▫ Lecture ▫ Discussion ▫ Power Point Presentation	Seminar Mid-Test 2 (Week 18)
16	Engineering applications	CO-5	Write short notes on the following ▫ Design optimization of springs ▫ Design of a two-bar truss for minimum weight	▫ Lecture ▫ Discussion ▫ Power Point Presentation	Case Study Mid-Test 2 (Week 18)
17	Problems solving / Seminars	CO-4,CO-5		▫ Problems solving ▫ Seminars	Seminar
18	**Mid-Test 2**				
19/20	**END EXAM**				