SCHEME OF COURSE WORK

Course Details:

Course Title	**: Optimization Techniques and Applications**		
Course Code	**:13ME2314**	**L P C**	**: 4 -- 3**
Program:	**: M.Tech.**		
Specialization:	**: THERMAL ENGINEERING**		
Semester	**: 2nd**		
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)

At the end of the programme, the students in THERMAL ENGINEERING will be able to

PO Code	Program Outcome (PO)
PO 1	exhibit in-depth knowledge in thermal engineering specialization
PO 2	think critically and analyze complex engineering problems to make creative advances in theory and practice
PO 3	solve problem, think originally and arrive at feasible and optimal solutions with due consideration to public health and safety of environment
PO 4	use research methodologies, techniques and tools, and will contribute to the development of technological knowledge
PO 5	apply appropriate techniques, modern engineering tools to perform modeling of complex engineering problems with knowing the limitations
PO 6	understand group dynamics, contribute to collaborative multidisciplinary scientific research

PO 7	demonstrate knowledge and understanding of engineering and management principles and apply the same with due consideration to economical and financial factors
PO 8	communicate complex engineering problems with the engineering community and society, write and present technical reports effectively
PO 9	engage in life-long learning with a high level of enthusiasm and commitment to improve knowledge and competence continuously
PO 10	exhibit professional and intellectual integrity, ethics of research and scholarship and will realize the responsibility towards the community
PO 11	examine critically the outcomes of actions and make corrective measures

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	▫ Lecture / Discussion ▫ Problem solving	Assignment (Week 5 - 7) Mid-Test 1 (Week 9)

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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)
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15	Integer programming- Gomory cutting plane method-branch and bound method	CO-4	▫ Problems on Integer programming	▫ Lecture ▫ Problems solving ▫ Discussion	Seminar Mid-Test 2 (Week 18)

16	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)
17	Problems solving / Seminars	CO-4,CO-5		▫ Problems solving ▫ Seminars	Seminar
18	**Mid-Test 2**				
19/20	**END EXAM**				