SCHEME OF COURSE WORK

Course Details:

Course Title	: Optimization Methods in Engineering		
Course Code	:19ME2105	L P C	3 - 0 - 3
Program:	: M.Tech.		
Specialization:	: CAD/CAM		
Semester	. 1st		
Prerequisites	: ---		
Courses to which it is a prerequisite	:		

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

CO-1	Solve optimization problems using classical optimization techniques
CO-2	Solve simple non-linear multivariable optimization problems
CO-3	Solve optimization problems using geometric programming
CO-4	Explain the working of different operators used in genetic algorithms for optimization
CO-5	Explain the basic concepts of stochastic programming; formulate and outline a suitable optimization technique in basic engineering applications.

Program Outcomes (POs)

At the end of the program, the students in CAD/CAM will be able to

1. acquire fundamentals in the areas of computer aided design and manufacturing
2. apply innovative skills and analyze computer aided design and manufacturing problems critically
3. identify, formulate and solve design and manufacturing problems
4. carry out research related to design and manufacturing
5. use existing and recent CAD/CAM software
6. collaborate with educational institutions, industry and R&D organizations in multidisciplinary teams
7. apply project and finance management principles in engineering projects
8. prepare technical reports and communicate effectively
9. engage in independent and life-long learning and pursue professional practice in their specialized areas of CAD/CAM
10. exhibit accountability to society while adhering to ethical practices
11. act independently and take corrective measures where necessary

Course Outcome Versus **Program Outcomes:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
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 / Seminar / Test / End Exam

Teaching-Learning and Evaluation

Week	Topic / Contents	Course Outcomes	Sample questions	Teaching-Learning Strategy	Assessment and 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 of given function f(x)	▫ Lecture/ Discussion ▫ Problem solving	Assignment (Week5-12)
2	One dimensional unconstrained optimization: Unimodal function, Bisection method, Quadratic search,	CO-1	▫ Minimize the given function f(x) by bisection method	▫ Lecture/ Discussion ▫ Problem solving	Assignment (Week5-12) Test 1 (Week 9)
3	One dimensional unconstrained optimization: Cubic search, unrestricted search, Dichotomous search	CO-1	▫ Minimize the given function f(x) by Quadratic search, Cubic search	▫ Lecture/ Discussion ▫ Problem solving	Assignment (Week5-12)
4	Fibonacci method, Golden Section method, Newtons method, Modified Newtons method	CO-1	▫ Minimize the given function f(x) by ▫ Fibonacci method / Golden section method / Newtons method	▫ Lecture/ Discussion ▫ Problem solving	Assignment (Week5-12) Test 1 (Week 9)
5	Non- linear multivariable optimization without constraints – Univariate method, Pattern search method, Rosenbrock's rotating coordinates method	CO-2	▫ Outline of Univariate method, Pattern search method, Rosenbrock's rotating coordinates method	▫ Lecture/ Discussion ▫ Problem solving	Q&A session (Week 6)
6	Non- linear multivariable optimization without constraints – Hooke & Jeeves method and Powells method, Newtons method and steepest descent method	CO-2	▫ Minimize f(X) by Newtons method ▫ Minimize f(X) by steepest descent method	▫ Lecture/ Discussion ▫ Problem solving	Test 1 (Week 9)
7	Multivariable with equality constraints, direct substitution method, method of Lagrange multipliers	CO-2	▫ Minimize f(X) subject to constraint h(X)=0 by direct substitution method ▫ Minimize f(X) subject to constraint h(X)=0 by method of Lagrange multipliers	▫ Lecture/ Discussion ▫ Problem solving	Assignment (Week5-12) Test 1 (Week 9)
8	Non-linear multivariable optimization with constraints: Penalty approach- Interior and exterior penalty function methods	CO-2	▫ Compare the exterior and interior penalty function methods ▫ Minimize given f(X) subject to constraints using interior penalty function approach	▫ Lecture/ Discussion ▫ Problem solving	Assignment (Week5-12) Test 2 (Week 18)
9	**Test 1**				
10	Geometric programming (GP): Solution by differential calculus; GP: Arithmetic-geometric inequality; Optimization of zero degree difficulty problems without constraints	CO-3	▫ Give examples of polynomial functions ▫ Derive orthogonality and normality conditions in solving GP problem	▫ Lecture/ Discussion ▫ Problem solving	Assignment (Week5-12)
11	Optimization of zero degree difficulty problems with constraints	CO-3	▫ Minimize the given function f(X) subject to the given constraints using GP	▫ Lecture ▫ Problem solving	Assignment (Week5-12) Test 2 (Week 18)
12	Optimization of single degree difficulty problems without constraints	CO-3	▫ Minimize the given function f(X) subject to the given constraints using GP	▫ Problems solving ▫ Seminars	Assignment (Week5-12)
13	Genetic algorithms (GA): Principle, reproduction & crossover operators, mutation, termination criteria	CO-4	▫ Discuss the basic operations used in GAs	▫ Lecture ▫ Power Point Presentation	Test 2 (Week 18)
14	GA for constrained optimization, drawbacks of GA	CO-4	▫ Discuss in detail how the operations are performed for constrained optimization	▫ Lecture ▫ Power Point Presentation	Report (Week 14 - 18)
15	Basic concepts of stochastic programming	CO-5	▫ Demonstrate stochastic dynamic programming	▫ Lecture/Discussion ▫ Power Point Presentation	Report (Week 14 - 18)
16	Basic concepts of Multi-stage optimization and Multi-objective optimization	CO-5	▫ Outline the basic concepts of Multi-stage optimization and Multi-objective optimization	▫ Discussion ▫ Problems solving ▫ Seminars	Report (Week 14 - 18)
17	Engineering applications: Minimization of weight of a cantilever beam, truss, shaft; optimal design of springs	CO-5	▫ Design optimization of springs ▫ Design of a truss for minimum weight ▫ Design of a beam/shaft for minimum weight	▫ Discussion ▫ Problems solving ▫ Seminars	Report (Week 14 - 18) Test 2 (Week 18)
18	**Test 2**				
19/20	**END EXAM**				