Name of Institute: Institute of Technology & Engineering, Indus University
Name of Faculty: Dr. Mitesh J Mungla

Course code:
Course name: Optimization Techniques

Pre-requisites: Operations Research
Credit points: 5
Offered Semester: 7th

Course Coordinator
Full Name: Dr. Mitesh J Mungla
Department with sitting location: SoM lab, First floor, Bhanwar Building
Telephone: 9904405959
Email: miteshmungla.me@indusuni.ac.in
Consultation times: Free lectures as per the university time table

Students will be contacted throughout the Session via Mail with important information relating to this Course.

Course Objectives
By participating in and understanding all facets of this Course a student will:

1. To understand the theory of optimization methods and algorithms developed for solving various types of optimization problems
2. To develop and promote research interest in applying optimization techniques in problems of Engineering and Technology
3. To apply the mathematical results and numerical techniques of optimization theory to concrete Engineering problems

Course Outcomes (CO)

On the completion of this course, students will be able to…

- CO1 - Formulate a problem for determining optimum state of the Mechanical system.
- CO 2 - Apply optimization techniques to simple and moderate systems to determine magnitude of variables for optimum performance of system.
- CO 3 -Use modern methods of optimization. Define the fatigue strength and its different criteria's with respect to component design.

Course Outline
Unit 1 – Introduction to Optimization
Unit 2 – Classical Optimization Techniques, Linear Programming
Unit 3 – Non-Linear Programming-One Dimensional Problems, Non-Linear Programming-Unconstrained Optimization Techniques
Unit 4 – Modern Methods of Optimization

Method of delivery
For this subject face to face lectures are conducted with ppt and conventional method.

CO-PO Mapping (PO: Program Outcomes)

PO1 Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4 Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5 Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6 The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7 Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8 Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9 Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11 Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12 Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Correlations & Mapping: 1- Low, 2-Medium, 3- High

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	2	2	1	2						2	2
CO 2	2	3	2			2						
CO 3	1	3	2									

Study time

1) Three lectures in a week.
2) Two-hour tutorial for each sub group (once in a week).

Blooms Taxonomy and Knowledge retention:

(Blooms taxonomy has been given for reference)

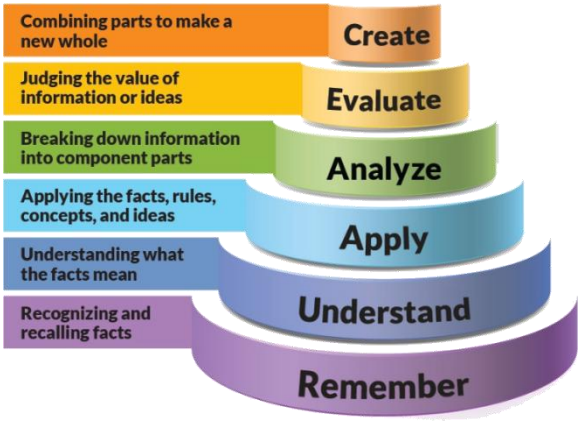

Figure 1: Blooms Taxonomy

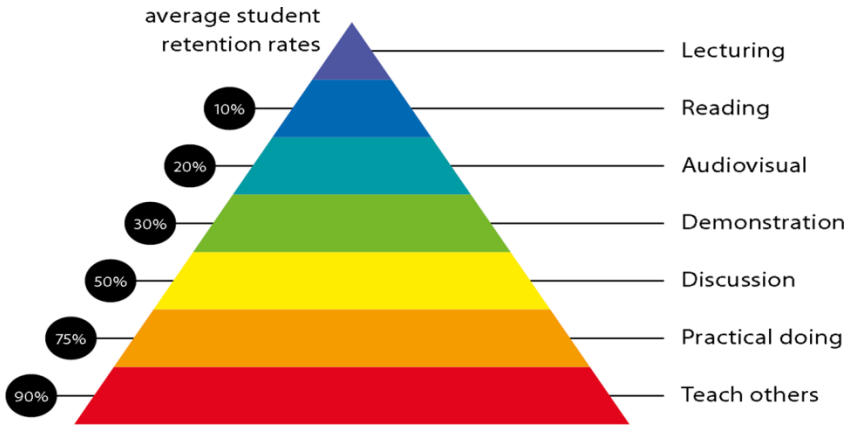

Figure 2: Knowledge retention

Graduate Qualities and Capabilities covered

General Graduate Qualities	Specific Department of Mechanical Graduate Capabilities
Informed Have a sound knowledge of an area of study	**1 Professional knowledge, grounding & awareness**

or profession and understand its current issues, locally and internationally. Know how to apply this knowledge. Understand how an area of study has developed and how it relates to other areas.	
Independent learners Engage with new ideas and ways of thinking and critically analyze issues. Seek to extend knowledge through ongoing research, enquiry and reflection. Find and evaluate information, using a variety of sources and technologies. Acknowledge the work and ideas of others.	**2 Information literacy, gathering & processing**
Problem solvers Take on challenges and opportunities. Apply creative, logical and critical thinking skills to respond effectively. Make and implement decisions. Be flexible, thorough, innovative and aim for high standards.	**4 Problem solving skills**
Effective communicators Articulate ideas and convey them effectively using a range of media. Work collaboratively and engage with people in different settings. Recognize how culture can shape communication.	**5 Written communication** **6 Oral communication** **7 Teamwork**
Responsible Understand how decisions can affect others and make ethically informed choices. Appreciate and respect diversity. Act with integrity as part of local, national, global and professional communities.	**10 Sustainability, societal & environmental impact**

Practical work:

NA

Lecture/tutorial times

Lecture:

1) Three lectures in a week.

Tutorial:

1) Two hours tutorial (once in a week).

Attendance Requirements

The University norms states that it is the responsibility of students to attend all lectures, tutorials, seminars and practical work as stipulated in the Course outline. Minimum attendance requirement as per university norms is compulsory for being eligible for mid and end semester examinations.

Details of referencing system to be used in written work

Text books

1. Engineering Optimization: Theory and Practice, Singiresu S. Rao, John Wiley & Sons, 2007
2. Multi-objective optimization using evolutionary algorithms, K Deb John Wiley Publications, 2011
3. Optimization Techniques – C.S. Rao – Dhanpat Rai & Sons, New Delhi, 2012

Reference Books

1. Introduction to Optimum Design, J S Arora, Mc-Graw Hill, 2007
2. Optimization Methods for Engineering Design, Fox, R. L., Addison Wesley, 2001
3. Foundation of Mathematical optimization – Pallaschke – Kluwer Academic Publishers 2005

ASSESSMENT GUIDELINES

1) **Theory Assessment:**
   a) **CIE theory will contains 60 marks and the distribution of marks will be as follows:**

Distribution	Marks	Remarks
Assignment	**20**	**Four Assignments will be shared with the students.** - **Assignment 1- Unit 1 (05 marks)** - **Assignment 2- Unit 2 (05 marks)** - **Assignment 3- Unit 3 (05 marks)** - **Assignment 4- Unit 4 (05 marks)**
Mid-Semester Examination	**40**	
Total marks	**60**	

   b) **ESE theory will contain 40 marks.**

SUPPLEMENTARY ASSESSMENT

Students who receive an overall mark less than 40% in mid semester or end semester will be considered for supplementary assessment in the respective components (i.e. mid semester or end semester) of semester concerned. Students have to remain present during the supplementary examination period to take up the respective components (mid semester or end semester) and need to obtain the required minimum 40% marks to clear the concerned components.

Late Work

Late assignments will not be accepted without supporting documentation. Late submission of the reports will result in a deduction of marks based on number of days after due date.

Format

All assignments must be presented in a neat, legible format with all information sources correctly referenced. **Assignment material handed in throughout the session that is not neat and legible will not be marked and will be returned to the student.**

Retention of Written Work

Written assessment work will be retained by the Course coordinator/lecturer for two weeks after marking to be collected by the students.

University and Faculty Policies

Students should make themselves aware of the University and/or Faculty Policies regarding plagiarism, special consideration, supplementary examinations and other educational issues and student matters.

Plagiarism - Plagiarism is not acceptable and may result in the imposition of severe penalties. Plagiarism is the use of another person's work, or idea, as if it is his or her own - if you have any doubts at all on what constitutes plagiarism, please consult your Course coordinator or lecturer. Plagiarism will be penalized severely.

Do not copy the work of other students.
Do not share your work with other students (except where required for a group activity or assessment)

Course schedule

	Week #	Topic & contents	CO Addressed	Teaching Learning Activity (TLA)
	Weeks 1	Classification of Optimization, Design vector and constraints,	1	Chalk and talk
	Weeks 2	Constraint surface, Objective function, Classification of Optimization Problems.	1	Chalk and talk
	Issue of Assignment 1			
	Week 3	Single variable optimization, Multi-variable: Direct substitution method,	1	Chalk and talk
	Week 4	Lagrange's method of multipliers, Karush-Kuhn-Tucker conditions	1	Chalk and talk
	Week 5	Statement of an LP problem, Simplex method, Dual simplex method	1, 2	Chalk and talk
	Submission of Assignment 1 & Issue of Assignment 2			
	Week 6	Unimodal function, Unrestricted search, Exhaustive search, Dichotomous search,	1, 2	Chalk and talk
	Week 7	Interval halving method, Fibonacci method, Golden section method,	1, 2	Chalk and talk
	Week 8	Direct root methods: Newton-Raphson and Quasi Newton methods.	1, 2	
	Submission of Assignment 2, & Issue of Assignment 3			
	Week 9	Direct Search Methods: Random search methods, Grid search method,	3	Chalk and talk
	Week 10	Univariate method, Hooke's and Jeeves' method, Powell's method	3	Chalk and talk
	Submission of Assignment 3 & Issue of Assignment 4			
	Week 11	Genetic algorithms,	4	Chalk and talk
	Week 12	simulated annealing,	1, 4	Chalk and talk
	Week 13	fuzzy optimization,	1, 4	Chalk and talk
	Week 14	neural-network based methods	1, 4	Chalk and talk

Submission of Assignment 4 &
Schedule of Extra lectures for any common difficulties/advance learners