TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING

COURSE OUTLINES

OF

M. SC. ENGINEERING
IN
MECHANICAL SYSTEMS DESIGN AND ENGINEERING
(MS-MSDE)

January 2017

1. Introduction

The Institute of Engineering, Tribhuvan University has initiated a 2-year full-time masters program in mechanical engineering, titled M.Sc. Engineering in Mechanical Systems Design and Engineering (MS-MSDE), from April/May2017. Engineers completing four years course in Bachelor in Mechanical/Industrial/Automobile/Aeronautical Engineering, or equivalent to Mechanical Engineering, will be eligible to apply for this program. This program will be run under Department of Mechanical Engineering, Pulchowk Campus, Lalitpur, Nepal.

The students in this program will develop high levels of analytical and critical skills and learn about the core mechanical methods, tools and techniques, understand their applications and limitations, and indulge in research in the fields of mechanical design, advanced numerical/computational techniques, energy engineering, mechanics and materials, air conditioning and refrigeration, automobile and heavy-equipment engineering, aerospace and aviation, project planning, industrial methods, and management, through highly progressive and innovative learning methods.

2. Admission Requirement

2.1 Program entry requirements

In order to be eligible for admission for M.Sc. Mechanical Systems Design and Engineering (MS-MSDE), a candidate must have:

i. Bachelors' degree from a 4-year engineering program in Mechanical, Industrial, Aeronautical, and Automobile Engineering, or equivalent, from Tribhuvan University and other recognized universities as well as degree equivalent to any of the aforementioned branches of engineering.
ii. Secure at least a minimum score as prescribed by the faculty board in the admission test conducted by the Institute of Engineering.

2.2 Entrance examination

The nature of entrance examination will be decided by the Entrance Examination Board of the Institute of Engineering, Tribhuvan University.

2.3 Selection

Candidate fulfilling the program entry requirements will be selected for admission on the basis of merit based on entrance examination.

2.4 Category of Students

The following category of students will be enrolled in the MS-MSDE programs to fulfill its quota of 20 students.

1. Regular students who have been selected through the IOE post-graduate entrance examination for the MS-MSDE program, complying with the rules and regulations of Pulchowk Campus to qualify as regular students.
2. Full-fee or self-sponsored students who have been selected through the IOE post-graduate entrance examination for the MS-MSDE program, and falling in the full-fee criteria under the rules and regulations of the Pulchowk Campus.
3. Sponsored students from government organizations, industries, INGO/NGO or other entities, selected through the IOE post-graduate entrance examination for the MS-MSDE program, and complying with the rules and regulations of Pulchowk Campus for sponsorship through an external organization or entity.

Table 1: Category of Students

S.N.	Category	No. of Students
1.	Regular	6
2.	Full-Fee	8
3.	Sponsored	6

2.5 Duration of study and barrier

The normal duration of the course for fulfillment of the degree is two academic years. The maximum period within which a student a student is allowed to complete the course is fourth academic year. Each student must take a minimum of 60 credits. Students may take more than 60 credits but the excess will not be counted for.

Only the students who secure minimum 50% of the total credit of any semester will be allowed to admit for the next semester. Unsuccessful students have to repeat the courses in which they failed and should pay course registration fee for those courses.

3. Course Structure/System

The course structure is based on the Semester system. The detailed course structure, examination scheme, marks, etc. are listed in detailed course structure sheet.

Each year is divided into first and second semesters. There are altogether six core courses and four elective courses needed to be taken by each student. In first year first semester, four core courses are offered and two core courses in the second semester. The second year, first semester includes one group project.

Four different elective subjects are offered in second semester and students can opt for two of them. There are four fundamental streams/concentrations of elective courses offered, namely, Engineering Mechanics and Materials (7 courses), Mechanical Design and Manufacturing (6 courses), Thermo-Fluids (5 courses) and Industrial Practices (9 courses), respectively. The first two elective concentrations are offered in the second semester, and students can choose two courses from each stream to study under two groups of two different courses for each elective. Similarly, the third and fourth elective concentrations are offered in the third semester and can be selected as described for first two electives. The second year second semester is entirely allocated

for dissertation work. The dissertation shall be individual's work and be extensive and normally design, simulation, performance characteristics and/or manufacturing based. Students shall be encouraged to publish research papers in national and international journals as an outcome of their dissertation work.

4. Course Overview

Table 2: Credit Distributions

Semester I	Semester II	Semester III	Semester IV
Solid Mechanics 4 Credits General Core Course	Advanced Research Method 4 Credits General Core Course	Project Work 4 Credits General Core Course	Dissertation/Thesis Work 16 Credits
Finite Element Methods and Applications 4 Credits Core Course	Computational Fluid Dynamics 4 Credits Core Course	Elective III 4 Credits Thermo-Fluids	
Advanced Thermodynamics and Heat Engines 4 Credits Core Course	Elective I 4 Credits Engineering Mechanics and Materials	Elective IV 4 Credits Industrial Practices	
Advanced Fluid Mechanics and Machines 4 Credits Core Course	Elective II 4 Credits Mechanical Design and Manufacturing		

Note:

Total Credits = 60 Credits

Course work, directed study and projects = 44 Credits

Dissertation = 16 Credits

Depending on the interest of students only 2 electives are offered from each stream in each semester. Minimum number of students in each elective should be 6.

4.1 Core and elective courses

The course consists of two types of courses: the core courses, which deal with the fundamental theory, and the elective courses, which deal with the specific details of the course.

Similarly, conferences and seminars are organized time to time to familiarized students with the current happenings in design approach and manufacturing technology around the world. Also, students are encouraged to participate in various national and international conferences.

The core courses focus on the fundamentals of engineering mathematics, research methodology, continuum mechanics and numerical methods.

Elective courses chosen will enable students to focus their courses to their technical interests and to specific topics in system design and approach, mechanics, manufacturing and management science. In addition, required project works will provide hands-on real world experience.

4.2 Group project work

The purpose of the group project in second year, first semester is to provide an opportunity from the group of students to investigate analyze and to provide solution to an existing mechanical engineering design and theory related problems. The group project must be completed in the allocated term. The group may be done group normally two to three students per group.

4.3 Dissertation/master's thesis

The main objective of master's degree dissertation is to carry out original research work concerning mechanical engineering and related fields, and solve those problems. Students are encouraged to publish articles in national and international journals/conferences.

5. Credit System

The course curriculum is organized in the overall framework of credit system. Each course has a certain number of credits which indicated the weightage. The number of credits depends on the contact hours for the course and its work load. Course with one credit weightage will have 15 lecture hours in a semester. The tutorials consulting and assessment hours will vary depending on the nature of the course. The total credit for the master's program is 60 credits.

6. Evaluation System

The evaluation system is based on the continuously assessment by the course teacher and the final examination. The students have to pass individually in the assessment as well as the final examination. The minimum pass marks for the assessment and final examination is 50%.

The percentage is calculated from the following criterion:

$$Total\ Percentage = \frac{\sum(Credit \times Marks\ Obtained)}{\sum Credits}$$

Depending upon the total percentage of the marks obtained, the following division shall be awarded:

Table 3: Evaluation System

Percentage	Division
≥ 50 %	Pass
50 % to < 60 %	Second
50 % to < 75 %	First
75 % and above	Distinction

7. Course Code

Each course is identified by a code. Each course will have a three digit number with a prefix of two capital letters. The suffix letters denote the department offering the course. In the three

number central digits, the first digit denotes the level in which the course is offered. For example, the digit 8 and 9 indicate the first and second year respectively of the Master's level course. The second digit is used to designate the semester. The second digit from 51 to 100 for the courses offered in the second and fourth semester respectively.

8. Instructional Methods

Conventional lectures and seminars in the taught course components (core and elective courses) of the program are reinforced by other approaches to teaching and learning process:

i. Use of case studies (video and text-based) to highlights key issues and management practices.
ii. Training by using electronic sources.
iii. Training in team work, group work, presentations and project management.

Each course is coordinated by a member of the faculty or the visiting faculty from outside who is expert in a given subject. The course faculty has the full responsibility for the conduction of the particular course. The courses comprise of lectures tutorials, laboratory works, group discussions and project works if applicable. The course contents are designed in such a way that considerable self-learning efforts should be used by the students.

Each student will be assigned a counselor. The main function of the counselor will be to guide the students throughout the 2-year program.

9. Qualifying Criteria

To qualifying for the M.Sc. Mechanical Engineering, the student must satisfactory complete the program consisting of course work and projects of 46 credits, and individual thesis of 16 credits.

10. Registration

Students must register for their course every semester. They must seriously attempt to complete the masters' program in 2 years. In all the four semesters, a total of 46 credits will be offered which will consist of core and elective courses. The credits for the thesis will be 16. The total credit for the complete program is 62.

11. Other Academic Rules and Regulations

11.1 Elective registration

Students should register themselves in the elective courses offered by the programs in that semester before the beginning of the class. For the open elective students of each program should apply of each program should apply to their respective program coordinator and he/she will precede it to the related program/department. Elective registration should be finalized by the

program coordinator within first weak from the beginning of the semester. Minimum number of students for each elective course should not be less than 6.

11.2 Thesis registration

Students should pass all the core courses before registering for the thesis but have to pass all the courses including elective courses before defending the thesis. Students should submit thesis proposals to the respective Program Coordinator. They can consult available faculties for the preparation of thesis proposal. Minimum gap between the midterm thesis defense and the final thesis defense should not be less than 4 weeks.

11.3 Thesis evaluation

i. Midterm Evaluation (40%)
   - Committee Member 40%
   - Supervisor 40%
   - External Examiner 20%

ii. Final Evaluation (60%)
   - Committee Member 30%
   - Supervisor 40%
   - External Examiner 30%

12. Fee Structure

The fee structure for all the category of students listed in **Table 1** is as per the existing rule and regulations of IOE, Pulchowk Campus.

13. Marks Distributions

M.Sc.
in
Mechanical Systems Design and Engineering

Year: I Part: I

Teaching Schedule				Examination Scheme				
				Theory				
S.N.	Course Code	Course Title	Credit	Assessment Marks	Final		Total	Remark
					Duration Hours	Marks		
1.		Solid Mechanics	4	40	3	60	100	
2.		Advanced Thermodynamics and Heat Engines	4	40	3	60	100	
3.		Finite Element Methods and Applications	4	40	3	60	100	
4.		Advanced Fluid Mechanics and Machines	4	40	3	60	100	
			16	160	12	240	400	

Year: I Part: II

Teaching Schedule				Examination Scheme				
S.N.	Course Code	Course Title	Credit	Theory			Total	Remark
				Assessment Marks	Final			
					Duration Hours	Marks		
1.		Advanced Research Methods	4	40	3	60	100	
2.		Computational Fluid Dynamics	4	40	3	60	100	
3.		Elective I	4	40	3	60	100	
4.		Elective II	4	40	3	60	100	
			16	160	12	240	400	

Elective I	Elective II
Mechanics of Materials	Modern Design Theory and Methodology
Vibration Theory	Modern Manufacturing Technologies
Fracture Mechanics	Advanced Computer Aided Design and Manufacturing
Multibody Dynamics	Hydraulic and Pneumatic Systems Design
Mechatronics	Heavy Equipment Engineering
Dynamic Systems and Control	Automotive Design and Manufacturing
Composite Materials	

Year: II Part: I

Teaching Schedule				Examination Scheme				
S.N.	Course Code	Course Title	Credit	Theory			Total	Remark
				Assessment Marks	Final			
					Duration Hours	Marks		
1.		Project Work	4	40		60	100	
2.		Elective III	4	40	3	60	100	
3.		Elective IV	4	40	3	60	100	
			12	120	6	180	300	

Elective III	Elective IV
Advanced Aerothermodynamics	Maintenance and Reliability Engineering
Heat and Mass Transfer	Human Factors Engineering
Performance Analysis of Thermo-Fluid Systems	Vehicle Communication and Navigation Systems
Hydrodynamics and Fluid Structure Interaction	Heating, Ventilation and Air Conditioning
Applied Combustion Theory and Simulation	Building Services and Equipments †
	Fault Monitoring and Diagnosis
	Tribology and Lubrication †
	Industrial Pollution Control
	Total Quality Management

Year: II Part: II

Teaching Schedule				Examination Scheme				
S.N.	Course Code	Course Title	Credit	Theory			Total	Remark
				Assessment Marks	Final			
					Duration Hours	Marks		
1.		Thesis Work	16	100		100	100	
			16	100		100	400	

14. Course Outline

The course outlines of the core courses are provided below. The course outlines of elective courses are subject to development and changes from respective teaching faculties.

1. Advanced Research Methods

Types of Research, Defining Research Problem, Research Design, Sampling, Measurement and Scaling Technique, Methods of Data Collection, Processing and Analysis, Testing of Hypothesis, Analysis of Variance, Multivariate Analysis Technique, Proposal Writing, Thesis Writing, Preparation of Research Paper.

2. Advanced Fluid Mechanics and Machines

Derivation of Finite Volume Continuity, Momentum and Energy Equations, Boundary Conditions, Surface and Volume Integrals, Incompressible Flows, Circulation, Lifting Line Theory, Compressible Flows and Aerothermodynamics, Viscous Flow Theory, Chemically Reacting Viscous Flows, Examples in Applications of Fluid Mechanics, Design of Fluid Machines.

3. Computational Fluid Dynamics

Finite Volume Treatment for Continuity, Momentum and Energy Equations, Incompressible and Compressible Flow Solutions, Viscous Flow Solutions, Application of CFD, Conditioning and Solution Formulation of Full Set of Navier-Stokes Equations, Treatments for Incompressible and Compressible Flows, Solution Formulation of unsteady, convection, viscous stress and diffusion, and source terms, Solving basic flows with simple computational schemes, Mesh Generation, Examples in FLUENT, Introduction to OpenFOAM.

4. Finite Element Methods and Application

Introduction, Matrix Algebra, Trusses, Axial Members, Beams, and Frames, One-dimensional Elements, Analysis of One-Dimensional Problem, Two-Dimensional Elements, ANSYS, Analysis of Two-Dimensional Heat Transfer Problems, Analysis of Two-dimensional Solid Mechanics Problems, Dynamic Problems, Analysis of Fluid Mechanics Problems, Three-Dimensional Elements, Design and Material Selection, Design Optimization.

5. Advanced Thermodynamics and Heat Engines

Basic Concepts and Definitions, Reviews of the First, Second and Third Laws of Thermodynamics, Reversible Work, Irreversibility and Second-Law Efficiency for a Closed System, Steady-State Control Volume, Analysis of Simple Cycles, Ideal and Non-Ideal Mixtures and their Thermodynamic Properties, Variation of Specific Heats, Chemical Reactions, Combustion and Fuel Cells, Chemical and Multiphase Equilibria, Discussion on Compression and Absorption Cycles and Working Fluids.

6. Solid Mechanics

Vector Algebra, Forces Resultants and Moments, Equilibrium of Rigid Bodies, Free Body Diagrams, Center of Gravity, Centroids and Moments of Inertia, Tension, Compression and Shear, Axially Loaded Members, Torsion, Advanced Shear Force, Combined Loading, Bending Moments, Stresses in Beams, Stress Transformation, Deflection of Beams, Analysis of Stress and Strain, Failure Criteria, Pressure Vessels, Column Analysis.