TRIBHUVAN UNIVERSITY

INSTITUTE OF ENGINEERING

CURRICULUM

BACHELOR'S DEGREE IN MECHANICAL ENGINEERING

2014

CONTENTS

1. INTRODUCTION

The Institute of Engineering (IOE) is offering this course with the objective of producing high level technical manpower capable of undertaking works in the Mechanical Engineering field. The details of the course are as follows:

1.1 Title of the Course

Bachelor of Engineering in **Mechanical Engineering**.

1.2 Duration of the Course

The total duration of the course is 4 years. Each year consists of two parts **I** and **II**, each part having a duration of 90 working days (15 weeks).

2. COURSE STRUCTURE

The course is divided into 8 parts. The first year courses include fundamental common subjects. The second and third year generally include specific courses of the related discipline. The final year include professional and application type courses.

The course structure attached in the later section of this book provides information about lecture, tutorial and practical hours per week, full marks and pass marks for internal assessment and final examination, and the duration of final examination of each subject.

3. COURSE CODE

Each subject is specified by a unique code consisting of two letters followed by three digit number for core courses and five digit numbers for elective courses. The first two letters denote the department which offers the subject (SH: Science and Humanities, AE: Agricultural Engineering, AR: Architecture, CE: Civil Engineering, CT: Computer Engineering, EE: Electrical Engineering, EX: Electronics and Communication Engineering, GE: Geomatics Engineering, IE: Industrial Engineering, ME: Mechanical Engineering). The first digit of the number denotes the year on which the subject is offered (4 for first year, 5 for second year, 6 for third year and 7 for fourth year respectively for Bachelor' level course). The remaining two digits 01 to 49 are used for the core subjects offered in odd parts and 51 to 99 are used for the core subjects offered in even parts. Two extra digits from 01 to 99 are used for the elective courses.

Core Courses:

AB	DEF

AB: Offering Department (SH, AE, AR, CE, CT, EE, EX, GE or ME)

D: Year (4 for first year, 5 for second year, and so on).
EF: 01- 49 for courses offered in odd parts and 51 to 99 for courses offered in even parts

Elective Courses:

AB	DEFGH

GH: 01 to 99 specific numbers to each elective course

For example, ME 751 is the code for the core course "Finite Element Method" which is offered in fourth year second part by Department of Mechanical Engineering.

4. INSTRUCTION METHODS

The method of teaching is lectured augmented by tutorials and/or practical, whichever is relevant. Tutorials are used to enlarge and develop the topic and concepts stated in the lecture. Practical classes in the form of laboratory works and design/drawing practices are used to verify the concepts and to develop necessary basic skills. Each course is specified with certain lecture, tutorial and practical hour(s) per week. The hours specified as 3/2 in practical means 3 laboratory hours in each two weeks.

The use of multimedia and interactive mode (presentations) is encouraged for conducting fourth year courses.

5. INTERNAL ASSESSMENT AND FINAL EXAMINATION

The students' achievement in each subject is evaluated by internal assessment and final examination.

5.1 Internal Assessment

20 % of the total marks is allocated for internal assessment for theory part of all subjects. Internal assessment mark should include class performance, timely submissions and correctness of assignments, class tests, quizzes, etc.

Evaluation of practical part of most of the subjects are done through continuous assessment. It includes lab performance, report submission, presentation, viva etc. However, for few courses final examinations are also conducted.

70 % attendance is mandatory to qualify for the final examination.

5.2 Final Examination

Final examinations of 3 hours for theoretical subjects with full mark of 80 and 1.5 hours for theoretical subjects with full mark of 40 are conducted as per academic calendar of IOE.

The distribution of mark for each subject is given at the end of course content. For evaluation purpose, all theoretical subjects are divided into 5 units. Each unit will carry 20 % of full marks in the final examination. There may be sub questions in each unit but each sub questions can have marks multiple of 4 only.

5.3 Pass Marks

Any student must obtain 40 % in both internal assessment and final examination of each subject to pass in the subject. Only students who have passed the internal assessment of a particular subject are allowed to appear in the final examination of that subject.

6. EVALUATION SYSTEM

Students who have passed all the components of all subjects in all parts are considered to have successfully completed the course. The overall achievement of each student is measured by a final aggregate percentage which is obtained by providing a weight to percentages scored by the students in each part as prescribed below:

First year (both I and II Parts):	20 %
Second year (both I and II Parts):	20 %
Third year (both I and II Parts):	30 %
Fourth years (both I and II Parts):	30 %

Depending upon the final weighted aggregate percentage scored by a student, a division is awarded as follows:

80 % and above:	Distinction
65 % or above and below 80 %:	First
50 % or above and below 65%:	Second
40 % or above and below 50%:	Pass

ENGINEERING MATHEMATICS I
SH 401

Lecture: 3 **Year: I**
Tutorial: 2 **Part: I**
Practical : 0

Course Objective:
To provide students a sound knowledge of calculus and analytic geometry to apply them in their relevant fields.

1. Derivatives and their Applications (14 hours)
- 1.1. Introduction
- 1.2. Higher order derivatives
- 1.3. Mean value theorem
  - 1.3.1. Rolle's Theorem
  - 1.3.2. Lagrange's mean value theorem
  - 1.3.3. Cauchy's mean value theorem
- 1.4. Power series of single valued function
  - 1.4.1. Taylor's series
  - 1.4.2. Maclaurin's series
- 1.5. Indeterminate forms; L'Hospital rule
- 1.6. Asymptotes to Cartesian and polar curves
- 1.7. Pedal equations to Cartesian and polar curves; curvature and radius of curvature

2. Integration and its Applications (11 hours)
- 2.1. Introduction
- 2.2. Definite integrals and their properties
- 2.3. Improper integrals
- 2.4. Differentiation under integral sign
- 2.5. Reduction formula; Beta Gama functions
- 2.6. Application of integrals for finding areas, arc length, surface and solid of revolution in the plane for Cartesian and polar curves

3. Plane Analytic Geometry (8 hours)
- 3.1. Transformation of coordinates: Translation and rotation
- 3.2. Ellipse and hyperbola; Standard forms, tangent, and normal
- 3.3. General equation of conics in Cartesian and polar forms

4. Ordinary Differential Equations and their Applications (12 hours)
- 4.1. First order and first degree differential equations
- 4.2. Homogenous differential equations
- 4.3. Linear differential equations
- 4.4. Equations reducible to linear differential equations; Bernoulli's equation
- 4.5. First order and higher degree differential equation; Clairaut's equation
- 4.6. Second order and first degree linear differential equations with constant coefficients.
- 4.7. Second order and first degree linear differential equations with variable coefficients; Cauchy's equations
- 4.8. Applications in engineering field

References:

1. Erwin Kreyszig, "Advance Engineering Mathematics" , John Wiley and Sons Inc
2. Thomas,Finney, "Calculus and Analytical Geometry" Addison- Wesley
3. M. B. Singh, B. C. Bajrachrya, "Differential Calculus", Sukunda Pustak Bhandar,Nepal
4. M. B. Singh, S. P. Shrestha, "Applied Mathematics", RTU, Department of Engineering Science and Humanities.
5. G.D. Pant, G. S. Shrestha, "Integral Calculus and Differential Equations", Sunila Prakashan, Nepal
6. M. R. Joshi, "Analytical Geometry", SukundaPustak Bhandar,Nepal
7. S. P. Shrestha, H. D. Chaudhary, P. R. Pokharel, "A Textbook of Engineering Mathematics - Vol I", Vidyarthi Pustak Bhandar.
8. Santosh Man Maskey, "Calculus", Ratna Pustak Bhandar, Nepal

Evaluation Scheme:

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Unit	Chapter	Topics	Marks
1	1	1.1 to 1.5	**16**
2	1	1.6 to 1.7	**16**
	2	2.1 to 2.3	
3	2	2.4 to 2.6	**16**
4	3	3.1 to 3.3	**16**
5	4	4.1 to 4.8	**16**
Total			**80**

COMPUTER PROGRAMMING
CT 401

Lecture : 3 **Year : I**
Tutorial : 0 **Part : I**
Practical : 3

Course Objective:
To familiarize the student with computer software and high level programming languages and to develop the programming skill using C language

1. Overview of computer software & programming languages (3 hours)
- 1.1. System software
- 1.2. Application software
- 1.3. General software features and recent trends
- 1.4. Generation of programming languages
- 1.5. Categorization of high level languages

2. Problem solving using Computer (3 hours)
- 2.1. Problem analysis
- 2.2. Algorithm development and Flowchart
- 2.3. Compilation and Execution
- 2.4. Debugging and Testing
- 2.5. Programming Documentation

3. Introduction to 'C' programming (4 hours)
- 3.1. Character set, Keywords, and Data types
- 3.2. Preprocessor Directives
- 3.3. Constants and Variables
- 3.4. Operators and statements

4. Input and Output (3 hours)
- 4.1. Formatted input/output
- 4.2. Character input/output
- 4.3. Programs using input/output statements

5. Control statements (6 hours)
- 5.1. Introduction
- 5.2. The goto, if, if … … else, switch statements
- 5.3. The while, do … while, for statements

6. User-Defined Functions (4 hours)
- 6.1. Introduction
- 6.2. Function definition and return statement
- 6.3. Function Prototypes
- 6.4. Function invocation, call by value and call by reference, Recursive Functions

7. Arrays and Strings (5 hours)
- 7.1. Defining an Array
- 7.2. One-dimensional Arrays
- 7.3. Multi-dimensional Arrays
- 7.4. Strings and string manipulation
- 7.5. Passing Array and String to function

8. Structures (4 hours)
- 8.1. Introduction
- 8.2. Processing a Structure
- 8.3. Arrays of Structures
- 8.4. Arrays within Structures
- 8.5. Structures and Function

9. Pointers (4 hours)
- 9.1. Introduction
- 9.2. Pointer declaration
- 9.3. Pointer arithmetic
- 9.4. Pointer and Array
- 9.5. Passing Pointers to a Function
- 9.6. Pointers and Structures

10. Data Files (5 hours)
- 10.1. Defining opening and closing a file
- 10.2. Input/Output operations on Files
- 10.3. Error handling during input/output operations

11. Introduction to other Programming Languages (4 hours)
- 11.1. FORTRAN
- 11.2. C++
- 11.3. Java
- 11.4. C#

Practical

- Minimum 7 lab works on programming with C should be done individually which should include at least followings: (30 marks out of 50 marks)
  1. Input/output operations
  2. Control statements
  3. User defined functions
  4. Arrays & strings
  5. Pointers
  6. Structure and union
  7. Data files
- Student (maximum 4 persons in a group) should submit a mini project at the end of course. (20 marks out of 50 marks)

References:

1. Kelly & Pohl, "A Book on C", Benjamin/Cumming
2. Brian W. Keringhan & Dennis M. Ritchie, "The 'C' Programming Language", PHI
3. Daya Sagar Baral, Diwakar Baral and Sharad Kumar Ghimire "The Secrets of C Programming Language", Bhundipuran Publication
4. Bryons S. Gotterfried, "Programming with C", TMH
5. Yashavant Kanetkar, "Let Us C", BPB
6. Alexis Leon, Mathews Leon, "Fundamentals of Information Technology", Leon Press and Vikas Publishing House

Evaluation Scheme

There will be questions covering all the chapters in the syllabus. The evaluation scheme for the course is as indicated in the table below:

Unit	Chapter	Topics	Marks
1	1, 2 & 3	all	**16**
2	4 & 5	all	**16**
3	6 & 7	all	**16**
4	8 & 9	all	**16**
5	10 & 11	all	**16**
Total			**80**

ENGINEERING DRAWING I
ME 401

Lectures : 1 **Year : I**
Tutorial : 0 **Part : I**
Practical : 3

Course Objective:
To develop basic projection concepts with reference to points, lines, planes and geometrical solids. Also to develop sketching and drafting skills to facilitate communication.

1. Instrumental Drawing, Technical Lettering Practices and Techniques (2 hours)

1.1. Equipment and materials
1.2. Description of drawing instruments, auxiliary equipment and drawing materials
1.3. Techniques of instrumental drawing
1.4. Pencil sharpening, securing paper, proper use of T- squares, triangles, scales dividers, compasses, erasing shields, French curves, inking pens
1.5. Lettering strokes, letter proportions, use of pencils and pens, uniformity and appearance of letters, freehand techniques, inclined and vertical letters and numerals, upper and lower cases, standard English lettering forms

2. Dimensioning (2 hours)

2.1. Fundamentals and techniques
2.2. Size and location dimensioning, SI conversions
2.3. Use of scales, measurement units, reducing and enlarging drawings
2.4. Placement of dimensions: aligned and unidirectional

3. Applied Geometry (6 hours)

3.1. Plane geometrical construction: Proportional division of lines, arc & line tangents
3.2. Methods for drawing standard curves such as ellipses, parabolas, hyperbolas, involutes, spirals, cycloids and helices (cylindrical and conical)
3.3. Techniques to reproduce a given drawing (by construction)

4. Basic Descriptive Geometry (14 hours)

4.1. Introduction to Orthographic projection, Principal Planes, Four Quadrants or Angles
4.2. Projection of points on first, second, third and fourth quadrants

4.3. Projection of Lines: Parallel to one of the principal plane, Inclined to one of the principal plane and parallel to other, Inclined to both principal planes
4.4. Projection Planes: Perpendicular to both principal planes, Parallel to one of the principal planes and Inclined to one of the principal planes, perpendicular to other and Inclined to both principal planes
4.5. True length of lines: horizontal, inclined and oblique lines
4.6. Rules for parallel and perpendicular lines
4.7. Point view or end view of a line
4.8. Shortest distance from a point to a line
4.9. Edge View and True shape of an oblique plane
4.10. Angle between two intersecting lines
4.11. Intersection of a line and a plane
4.12. Angle between a line and a plane
4.13. Dihedral angle between two planes
4.14. Shortest distance between two skew lines
4.15. Angle between two non- intersecting (skew) lines

5. Multi view (orthographic) projections (18 hours)

5.1. Orthographic Projections
5.1.1. First and third angle projection
5.1.2. Principal views: methods for obtaining orthographic views, Projection of lines, angles and plane surfaces, analysis in three views, projection of curved lines and surfaces, object orientation and selection of views for best representation, full and hidden lines
5.1.3. Orthographic drawings: making an orthographic drawing, visualizing objects (pictorial view) from the given views
5.1.4. Interpretation of adjacent areas, true-length lines , representation of holes, conventional practices
5.2. Sectional Views: Full, half, broken revolved, removed (detail) sections, phantom of hidden section, Auxiliary sectional views, specifying cutting planes for sections, conventions for hidden lines, holes, ribs, spokes
5.3. Auxiliary views: Basic concept and use, drawing methods and types, symmetrical and unilateral auxiliary views. Projection of curved lines and boundaries, line of intersection between two planes, true size of dihedral angles, true size and shape of plane surfaces

6. Developments and Intersections (18 hours)

6.1. Introduction and Projection of Solids
6.2. Developments: general concepts and practical considerations, development of a right or oblique prism, cylinder, pyramid, and cone, development of truncated pyramid and cone, Triangulation method for approximately developed surfaces, transition pieces for connecting different shapes, development of a sphere
6.3. Intersections: lines of intersection of geometric surfaces, piercing point of a line and a geometric solid, intersection lines of two planes, intersections of -prisms and pyramids, cylinder and an oblique plane. Constructing a development using auxiliary views, intersection of - two cylinders, a cylinder & a cone

Practical:

1. Drawing Sheet Layout, Freehand Lettering, Sketching of parallel lines, circles, Dimensioning
2. Applied Geometry(Sketch and Instrumental Drawing)
3. Descriptive Geometry I: Projection of Point and Lines (4.1 to 4.3)(Sketch and Instrumental Drawing)
4. Descriptive Geometry II: Projection of Planes (4.4) (Sketch and Instrumental Drawing)
5. Descriptive Geometry III: Applications in Three dimensional Space (4.5 to 4.15) (Sketch and Instrumental Drawing)
6. Multiview Drawings (5.1) (Sketch and Instrumental Drawing)
7. Multiview, Sectional Drawings and Dimensioning I (5.2)(Sketch and Instrumental Drawing)
8. Multiview, Sectional Drawings and Dimensioning II (5.2) (Sketch and Instrumental Drawing)
9. Auxiliary View, Sectional Drawings and Dimensioning (5.3) (Sketch and Instrumental Drawing)
10. Projection of Regular Geometrical Solids (Sketch and Instrumental Drawing)
11. Development and Intersection I (6.1) (Sketch and Instrumental Drawing)
12. Development and Intersection II (6.2) (Sketch and Instrumental Drawing)
13. Development and Intersection III (6.3) (Sketch and Instrumental Drawing)

References:

1. W. J. Luzadder, “Fundamentals of Engineering Drawing”, Prentice Hall.
2. T. E. French, C. J. Vierck, and R. J. Foster, “Engineering Drawing and Graphic Technology”, Mc Graw Hill Publshing Co.
3. A . Mitchell, H. C. Spencer and J. T. Dygdone, “Technical Drawing”, F. E. Giescke, Macmillan Publshing Co.
4. N. D. Bhatt, “Elementary Engineering Drawing”, Charotar Publshing House, India.
5. P. S. Gill, “A Text Book of Engineering Drawing”, S. K. Kataria and Sons, India
6. R. K. Dhawan, “A Text Book of Engineering Drawing”, S. Chand and Company Limited, India

Evaluation Scheme:

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Unit	Chapter	Topics	Marks
1	3	all	**4**
2	4	all	**8**
3	1, 2 & 5	all	**14**
4	6	all	**14**
Total			**40**

ENGINEERING CHEMISTRY
SH 403

Lecture : 3 **Year : I**
Tutorial : 1 **Part : I**
Practical : 3

Course Objective:
To develop the basic concepts of Physical Chemistry, Inorganic Chemistry and Organic Chemistry relevant to problems in engineering.

1. Electro-chemistry and Buffer (6 hours)
- 1.1. Electro-chemical cells
- 1.2. Electrode Potential and Standard Electrode Potential
- 1.3. Measurement of Electrode Potential
- 1.4. Nernst equation
- 1.5. EMF of Cell
- 1.6. Application of Electrochemical and Electrolytic cells
- 1.7. Electrochemical Series and its Application
- 1.8. Buffer: its type and mechanism
- 1.9. Henderson's equation for pH of buffer and related problems
- 1.10. Corrosion and its type
- 1.11. Factors influencing corrosion
- 1.12. Prevention of corrosion

2. Catalyst (4 hours)
- 2.1. Introduction
- 2.2. Action of Catalyst (Catalytic Promoters and Catalytic Poisons)
- 2.3. Characteristics of Catalyst
- 2.4. Types of Catalyst
- 2.5. Theories of Catalysis
- 2.6. Industrial Applications of Catalysts

3. Environmental Chemistry (5 hours)
- 3.1. Air Pollution
- 3.2. Air Pollutants i) gases SO_x,NO_x,CO,CO_2,O_3 and hydrocarbons ii)particulates dust, smoke and fly ash
- 3.3. Effects of Air Pollutants on human beings and their possible remedies
- 3.4. Ozone depletion and its photochemistry
- 3.5. Water Pollution (Ref of surface water and pound water)
- 3.6. Water Pollutants (Ref of surface water) their adverse effect and remedies
- 3.7. Soil pollution
- 3.8. Pollutants of soil their adverse effects and possible remedies

4. Engineering Polymers (6 hours)

4.1. Inorganic polymers
4.2. General properties of inorganic polymers
4.3. Polyphosphazines
4.4. Sulpher Based Polymers
4.5. Chalcogenide Glasses
4.6. Silicones
4.7. Organic Polymers
4.8. Types of Organic Polymers
4.9. Preparation and application of
i) Polyurethane ii) Polystyrene iii) Polyvinylchloride iv) Teflon
v) Nylon 6,6 and vi) Bakelite vii) Epoxy Resin viii) Fiber Reinforced Polymer
4.10. Concept of bio-degradable, non-biodegradable and conducting polymers

5. 3-d Transition elements and their applications (5 hours)

5.1. Introduction
5.2. Electronic Configuration
5.3. Variable oxidation states
5.4. Complex formation tendency
5.5. Color formation
5.6. Magnetic properties
5.7. Alloy formation
5.8. Applications of 3-d transition elements

6. Coordination Complexes (5 hours)

6.1. Introduction
6.2. Terms used in Coordination Complexes
6.3. Werner's Theory Coordination Complexes
6.4. Sidgwick's model and Sidgwick's effective atomic number rule
6.5. Nomenclature of coordination compounds (Neutral type, simple cation and complex anion and complex cation and simple anion type)
6.6. Valence Bond Theory of Complexes
6.7. Application of valence bond theory in the formation of i) Tetrahedral Complexes
ii) Square planar Complexes and iii) Octahedral Complexes
6.8. Limitations of Valence Bond Theory
6.9. Applications of Coordination Complexes

7. Explosives (3 hours)

7.1. Introduction
7.2. Types of explosives: Primary, Low and High explosives
7.3. Preparation and application of TNT, TNG, Nitrocellulose and Plastic explosives

8. Lubricants and Paints (2 hours)

8.1. Introduction
8.2. Function of Lubricants
8.3. Classification of Lubricants (Oils, Greases and Solid)
8.4. Paints
8.5. Types of Paint
8.6. Application of Paints

9. Stereochemistry (4 hours)

9.1. Introduction
9.2. Geometrical Isomerism (Cis Trans Isomerism) Z and E concept of Geometrical Isomerism
9.3. Optical Isomerism with reference to two asymmetrical carbon center molecules
9.4. Terms Optical activity, Enantiomers, Diastereomers, Meso structures, Racemic mixture and Resolution

10. Reaction Mechanism in Organic reactions (4 hours)

10.1. Substitution reaction
10.2. Types of substitution reaction SN^1 and SN^2
10.3. Elimination reaction
10.4. Types of elimination reaction El and E2
10.5. Factors governing SN^1, SN^2, El and E2 reaction mechanism path

References:

1. Jain and Jain, "Engineering Chemistry", Dhanpat Rai Publishing Co.
2. Shashi Chawala, "A Text Book of Engineering Chemistry", Dhanpat Rai Publishing Co.
3. J. D. Lee, "A New Concise Inorganic Chemistry", Wiley India Pvt. Limited.
4. Marron and Prutton, "Principles of Physical Chemistry", S. Macmillan and Co. Ltd.
5. Bahl and Tuli, "Essential of Physical Chemistry", S. Chand and Co. Ltd.
6. Satya Prakash and Tuli, "Advanced Inorganic Chemistry Vol 1 and 2", S. Chand and Co. Ltd
7. Morrison and Boyd, "Organic chemistry", ……
8. Moti Kaji Sthapit, "Selected Topics in Physical Chemistry", Taleju Prakashan, Kathmandu.
9. Peavy, Rowe and Tchobanoglous, "Environmental Engineering", McGraw-Hill, New York.
10. R. K. Sharma, B. Panthi and Y. Gotame, "Textbook of Engineering Chemistry", Athrai Publication.

Practical:

1. Compare the alkalinity of different water samples by double indicator method
2. Determine the temporary and permanent hardness of water by EDTA Complexo-metric method
3. Determine residual and combined chlorine present in the chlorinated sample of water by Iodometric method
4. Prepare organic polymer nylon 6,6/ Bakelite in the laboratory
5. Determine the pH of different sample of buffer solution by universal indicator method 6 Periods
6. Prepare inorganic complex in the laboratory
7. Determine surface tension of the given detergent solution and compare its cleansing
   power with other detergent solutions
8. Construct an electrochemical cell in the laboratory and measure the electrode potential of it
9. Estimate the amount of iron present in the supplied sample of ferrous salt using standard potassium permanganate solution (redox titration)

Evaluation Scheme:

There will be questions covering all the chapters in the syllabus. The evaluation scheme for the question will be as indicated in the table below:

Unit	Chapter	Topics	Marks
1	1 & 7	all	**16**
2	2 & 3	all	**16**
3	4 & 8	all	**16**
4	5 & 6	all	**16**
5	9 & 10	all	**16**
Total			**80**

FUNDAMENTALS OF THERMODYNAMICS AND HEAT TRANSFER
ME 402

Lectures : 3 **Year : I**
3 Periods
Tutorial : 1 **Part : I**
Practical : 3/2
6 Periods
3 Periods

Course Objective:
To develop basic concepts, laws of thermodynamics and heat transfer and their applications.
3 Periods

1. Introduction **(3 hours)**
6 Periods
1.1. Definition and Scope of Engineering Thermodynamics
1.2. Value of energy to society
1.3. Microscopic versus Macroscopic Viewpoint
3 Periods
1.4. Concepts and Definitions
6 Periods
1.4.1. System, Surroundings, Boundary and Universe; Closed Systems, Open Systems, and Isolated Systems
1.4.2. Thermodynamic Properties: Intensive, Extensive and Specific Properties
1.4.3. Thermodynamic Equilibrium
1.4.4. Thermodynamic State
1.4.5. Thermodynamic Process, Cyclic Process, Quasi-equilibrium Process, Reversible and Irreversible Process
1.5. Common Properties: Pressure, Specific Volume, Temperature
1.6. Zeroth Law of Thermodynamics, Equality of Temperature

2. Energy and Energy Transfer **(3 hours)**
2.1. Energy and its Meaning
2.2. Stored Energy and Transient Energy; Total Energy
2.3. Energy Transfer
2.3.1. Heat Transfer
2.3.2. Work Transfer
2.4. Expressions for displacement work transfer
2.5. Power

3. Properties of Common Substances **(6 hours)**
3.1. Pure Substance and State Postulate
3.2. Ideal Gas and Ideal Gas Relations
3.3. Two Phase (Liquid and Vapor) Systems: Phase Change; Subcooled Liquid, Saturated Liquid, Wet Mixture, Critical Point, Quality, Moisture Content, Saturated Vapor and Superheated Vapor
3.4. Properties of Two Phase Mixtures
3.5. Other Thermodynamic Properties: Internal Energy, Enthalpy, and Specific Heats

3.6. Development of Property Data: Graphical Data Presentation and Tabular Data Presentation

4. First Law of Thermodynamics (9 hours)

4.1. First Law of Thermodynamics for Control Mass; First Law of Thermodynamics for Control Mass Undergoing Cyclic Process
4.2. First Law of Thermodynamics for Control Volume
4.3. Control Volume Analysis: Steady State Analysis and Unsteady State Analysis
4.4. Control Volume Application: Steady and Unsteady Work Applications and Steady and Unsteady Flow Applications
4.5. Other Statements of the First Law

5. Second Law of Thermodynamics (9 hours)

5.1. Necessity of Formulation of Second Law
5.2. Entropy and Second Law of Thermodynamics for an Isolated System
5.3. Reversible and Irreversible Processes
5.4. Entropy and Process Relation for an Ideal Gases and Incompressible Substances
5.5. Control Mass Formulation of Second Law
5.6. Control Volume Formulation of Second Law
5.7. Isentropic Process for an Ideal Gas and for an Incompressible Substances
5.8. Carnot Cycle, Heat Engine, Heat Pump and Refrigerator
5.9. Kelvin-Planck and Clausius Statements of the Second Law of Thermodynamics and their Equivalence

6. Thermodynamic Cycles (9 hours)

6.1. Classification of Cycles
6.2. Air Standard Brayton Cycle
6.3. Rankine Cycle
6.4. Internal Combustion Cycles
  6.4.1 Air standard Analysis
  6.4.2 Air Standard Otto Cycle
  6.4.3 Air Standard Diesel Cycle
6.5. Vapor Compression Refrigeration Cycle

7. Introduction to Heat Transfer (6 hours)

7.1. Basic Concepts and Modes of Heat Transfer
7.2. One dimensional steady state heat conduction through a plane wall
7.3. Radial steady state heat conduction through a hollow cylinder
7.4. Heat flow through composite structures
  7.4.1. Composite Plane Wall
  7.4.2. Multilayer tubes
7.5. Electrical Analogy for thermal resistance
7.6. Combined Heat Transfer and Overall Heat Transfer Coefficient for Plane Wall and Tube
7.7. Nature of Convection; Free and Forced Convection
7.8. Heat Radiation, Stefan's Law, Absorptivity, Reflectivity and Transmissivity; Black Body, White Body and Gray Body

Practical:

1. Temperature Measurements
2. Experiment related to first law
3. Heat Pump
4. Heat Conduction
5. Heat Radiation

References:

1. M. C. Luintel, “Fundamentals of Thermodynamics and Heat Transfer”, Athrai Publication (P) Limited.
2. R. Gurung, A. Kunwar & T. R. Bajracharya, “Fundamentals of Engineering Thermodynamics and Heat Transfer”, Asmita Books Publishers and Distributors (P) Limited.
3. J. R. Howell & R. O. Buckius, “Fundamentals of Engineering Thermodynamics", McGraw Hill Publishers
4. V. Wylen, Sonntag & Borgnakke, “Fundamentals of Thermodynamics”, John Wiley & Sons, Inc.
5. M. J. Moran & H. N. Shapiro, “Fundamentals of Engineering Thermodynamics", John Wiley & Sons, Inc.
6. Y. A. Cengel & M.A. Boles, "Thermodynamics: An Engineering Approach", McGraw-Hill.
7. J. P. Holman, "Heat Transfer", McGraw-Hill
8. Y. A. Cengel, "Heat Transfer: A Practical Approach", McGraw-Hill.

Evaluation Scheme:

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Unit	Chapter	Topics	Marks
1	1 & 3	all	**16**
2	2 & 7	all	**16**
3	4	all	**16**
4	5	all	**16**
5	6	all	**16**

Total	**80**

WORKSHOP TECHNOLOGY
ME 403

Lecture : 1 **Year : I**
Tutorial : 0 **Part : I**
Practical : 3

Course Objective:
To impart knowledge and skill components in the field of basic workshop technology. To be familiar with different hand and machine tools required for manufacturing simple metal components and articles.

1. General Safety Considerations (2 hours)
- 1.1. Bench Tools
- 1.2. Machinist's Hammers
- 1.3. Screw Drivers
- 1.4. Punches
- 1.5. Chisels
- 1.6. Scrapers
- 1.7. Scribers
- 1.8. Files
- 1.9. Pliers and Cutters
- 1.10. Wrenches
- 1.11. Hacksaw
- 1.12. Bench Vise
- 1.13. Hand drill
- 1.14. Taps and Dies
- 1.15. Hand Shears
- 1.16. Rules, Tapes and Squares
- 1.17. Soldering Iron
- 1.18. Rivets

2. Hand Working Operations (1 hours)
- 2.1. Sawing
- 2.2. Filing
- 2.3. Threading
- 2.4. Scribing
- 2.5. Shearing
- 2.6. Soldering
- 2.7. Riveting

3. Measuring and Gauging (1hours)
- 3.1. Introduction
- 3.2 Semi – Precision Tools – Calipers, depth Gauge, Feeler Gauge
- 3.3 Precision Tools – Micrometers, Vernier Calipers, Vernier Height Gauge, Telescopic Gauge, Hole Gauge, Bevel Protractor, Dial Indicator, Gauge Blocks and Surface Plate

4. Drills and Drilling Processes (1 hours)
- 4.1 Introduction
- 4.2 Types of Drill Presses
- 4.3 Work Holding Devices and Accessories
- 4.4 Cutting Tools
- 4.5 Geometry of Drill Bits
- 4.6 Grinding of Drill Bits
- 4.7 Operations – Drilling, Counter - boring, Counter - sinking, Reaming, Honning, Lapping
- 4.8 Cutting Speeds
- 4.9 Drilling Safety

5. Machine Tools (4 hours)
- 5.1. General Safety Considerations
- 5.2 Engine Lathes
  - 5.2.1 Introduction
  - 5.2.2 Physical Construction
  - 5.2.3 Types of Lathe
  - 5.2.4 Lathe Operations – Facing, Turning, Threading
- 5.3 Shapers
  - 5.3.1 Introduction
  - 5.3.2 Types of Shapers
  - 5.3.3 Physical Construction
  - 5.3.4 General Applications
- 5.4 Milling Machines
  - 5.4.1 Introduction
  - 5.4.2 Types of Milling Machines
  - 5.4.3 Physical Construction
  - 5.4.4 Milling Cutters – Plain, Side, Angle, End, Form
  - 5.4.5 Milling Operations – Plain, Side, Angular, Gang, End, Form, Keyway
  - 5.4.6 Work Holding Devices
  - 5.4.7 Cutter Holding Devices
- 5.5 Grinding Machines
  - 5.5.1 Abrasives, Bonds, Grinding Wheels
  - 5.5.2 Rough Grinders – Portable Grinders, Bench Grinders, Swing Frame Grinders, Abrasive Belt Grinders
  - 5.5.3 Precision Grinders – Cylindrical Grinders, Surface Grinders

6. Material Properties (1 hours)

6.1. Tool materials – Low, medium and high carbon steels; Hot and cold rolled steels; Alloy steels; Carbide and Ceramic materials
6.2. Heat treating methods for steels – Annealing, Tempering, Normalizing, Hardening and Quenching
6.3. Non – ferrous metals – Brass, Bronze, Aluminum – Comparative Properties

7. Sheet Metal Works (1 hours)
7.1. Introduction
7.2. Sheet Metal Tools
7.3. Marking and Layout
7.4. Operations – Bending, Cutting, Rolling

8. Foundry Practice (1 hours)
8.1. Introduction
8.2. Pattern Making
8.3. Foundry Tools
8.4. Core Making
8.5. Melting Furnace – Cupola
8.6. Sand Casting Process

9. Forging Practice (1 hours)
9.1. Introduction
9.2. Forging Tools
9.3. Operations – Upsetting, Drawing, Cutting, Bending, Punching
9.4. Forging Presses and Hammers
9.5. Advantages and Limitations

10. Metal Joining (2 hours)
10.1 Safety Considerations
10.2 Introduction
10.3 Soldering
10.4 Brazing
10.5 Welding – Gas Welding, Arc Welding, Resistance Welding, Tungsten Inert Gas Welding (TIG), Metal Inert Gas Welding (MIG)

Practical:

1. Bench Tools and hand operations: Measuring, Marking, Layout, Cutting, Filling, Drilling, Tapping, Assembly
2. Bench Tools and hand operations: (Contd.)
3. Drilling machines
4. Measuring and Gauging Instruments
5. Engine lathe: Basic operations such as Plain turning, facing, cutting off, knurling.
6. Engine lathe: Taper turning, drilling and boring
7. Basic Shaper Operations
8. Milling Machines
9. Grinding Machines
10. Sheet Metal works
11. Foundry Practice
12. Forging Practice
13. Electric Arc Welding
14. Gas Welding

References:

1. Anderson and E. E. Tatro, “Shop Theory”, JMcGraw – Hill.
2. O. D. Lascoe, C. A. Nelson and H. W. Porter, “Machine shop operations and setups”, American Technical society.
3. “Machine shop Practice – Vol. I” , Industrial Press, New York.
4. “Machine shop Practice – Vol. I” , Industrial Press, New York.
5. Ryerson, “ Technology of Machine Tools”, Mc Graw Hill.
6. Oberg, Jones and Horton, “Machinery’s Handbook”, Industrial Press, New York.
7. S. K. Hajra Choudhury and A. K. Hajra Choudhury, “Elements of Workshop Technology - Vol. I (Manufacturing Processes)”, Media Promoters and Publishers Pvt. Ltd. , Bombay, INDIA.
8. S. K. Hajra Choudhury, S. K. Bose and A. K. Hajra Choudhury , “Elements of Workshop Technology - Vol. II: (Machine Tools)” , Media Promoters and Publishers Pvt. Ltd. , Bombay, INDIA.
9. Prof. B. S. Raghuwanshi, “A Course in Workshop Technology - Vol. I” , Dhanpat Rai and Co. (P) Ltd, Delhi, INDIA.
10. Prof. B. S. Raghuwanshi, “A Course in Workshop Technology - Vol. II” , Dhanpat Rai and Co. (P) Ltd, Delhi, INDIA.
11. H. S. Bawa, “Workshop Technology - Vol. I”, Tata Mc – Graw Hill publishing company Limited, New Delhi, INDIA,
12. H. S. Bawa, “Workshop Technology - Vol. II” , Tata Mc – Graw Hill publishing company Limited, New Delhi, INDIA,
13. R. S. Khurmi and J. K. Gupta, “A text book of Workshop Technology”, S. Chand and Company Ltd, New Delhi. INDIA

ENGINEERING MATHEMATICS II
SH 451

Lecture: 3 **Year: I**
Tutorial: 2 **Part: II**
Practical: 0

Course Objective:
To develop the skill of solving differential equations and to provide knowledge of vector algebra and calculus. To make students familiar with calculus of several variables and infinite series.

1. Calculus of Two or More Variables (6 hours)
- 1.1. Introduction: limit and continuity
- 1.2. Partial derivatives
  - 1.2.1. Homogeneous function, Euler's theorem for the function of two and three variables
  - 1.2.2. Total derivatives
- 1.3. Extrema of functions of two and three variables; Lagrange's Multiplier

2. Multiple Integrals (6 hours)
- 2.1. Introduction
- 2.2. Double integrals in Cartesian and polar form; change of order of integration
- 2.3. Triple integrals in Cartesian, cylindrical and spherical coordinates;
- 2.4. Area and volume by double and triple integrals

3. Three Dimensional Solid Geometry (11 hours)
- 3.1. The straight line; Symmetric and general form
- 3.2. Coplanar lines
- 3.3. Shortest distance
- 3.4. Sphere
- 3.5. Plane Section of a sphere by planes
- 3.6. Tangent Planes and lines to the spheres
- 3.7. Right circular cone
- 3.8. Right circular cylinder

4. Solution of Differential Equations in Series and Special Functions (9 hours)
- 4.1. Solution of differential equation by power series method
- 4.2. Legendre's equation
- 4.3. Legendre polynomial function; Properties and applications.
- 4.4. Bessel's equation
- 4.5. Bessel's function of first and second kind. Properties and applications

5. Vector Algebra and Calculus (8 hours)
- 5.1. Introduction
- 5.2. Two and three dimensional vectors
- 5.3. Scalar products and vector products
- 5.4. Reciprocal System of vectors
- 5.5. Application of vectors: Lines and planes
- 5.6. Scalar and vector fields
- 5.7. Derivatives – Velocity and acceleration
- 5.8. Directional derivatives

6. Infinite Series (5 hours)
- 6.1. Introduction
- 6.2. Series with positives terms
- 6.3. convergence and divergence
- 6.4. Alternating series. Absolute convergence
- 6.5. Radius and interval of convergence

References:

1. Erwin Kreyszig, "Advanced Engineering Mathematics ", John Wiley and Sons Inc.
2. Thomas, Finney, "Calculus and Analytical Geometry", Addison- Wesley
3. M. B. Singh, B. C. Bajrachrya, "Differential Calculus", Sukunda Pustak Bhandar,Nepal
4. M. B. Singh, B. C. Bajrachrya, "A Text Book of Vectors", Sukunda Pustak Bhandar,Nepal
5. M. B. Singh, S. P. Shrestha, "Applied Engineering Mathematics", RTU, Department of Engineering Science and Humanities.
6. G.D. Pant, G. S. Shrestha, "Integral Calculus and Differential Equations", Sunila Prakashan,Nepal
7. Y. R. Sthapit, B. C. Bajrachrya, "A Text Book of Three Dimensional Geometry", Sukunda Pustak Bhandar,Nepal
8. Santosh Man Maskey, "Calculus", Ratna Pustak Bhandar, Nepal

Evaluation Scheme:

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Unit	Chapter	Topics	Marks
1	1	all	**16**
	2	2.1 to 2.2	
2	2	2.3 to 2.4	**16**
	3	3.1 to 3.3	
3	3	3.4 to 3.8	**16**
	4	4.1	
4	4	4.2 to 4.5	**16**
	5	5.1 to 5.5	
5	5	5.6 to 5.8	**16**
	6	all	
Total			**80**

ENGINEERING DRAWING II
ME 451

Lecture: 1 **Year: I**
Tutorial: 0 **Part: II**
Practical: 3

Course Objective:
To make familiar with the conventional practices of sectional views. To develop basic concept and skill of pictorial drawing and working drawings. Also to make familiar with standard symbols of different engineering fields.

1. Conventional Practices for Orthographic and Sectional Views (12 hours)
- 1.1 Conventional Practices in Orthographic views: Half Views and Partial Views, Treatment of Unimportant Intersections, Aligned Views, Treatment for Radially Arranged Features, Representation of Fillets and Rounds
- 1.2 Conventional Practices in Sectional views: Conventions for Ribs, Webs and Spokes in Sectional View, Broken Section, Removed Section, Revolved Section, Offset Section, Phantom Section and Auxiliary Sectional Views
- 1.3 Simplified Representations of Standard Machine Elements

2. Pictorial Drawings (20 hours)
- 2.1 Classifications: Advantages and Disadvantages
- 2.2 Axonometric Projection: Isometric Projection and Isometric Drawing
  - 2.2.1 Procedure for making an isometric drawing
  - 2.2.2 Isometric and Non-isometric Lines; Isometric and Non-isometric Surfaces
  - 2.2.3 Angles in Isometric Drawing
  - 2.2.4 Circles and Circular Arcs in Isometric Drawing
  - 2.2.5 Irregular Curves in Isometric Drawing
  - 2.2.6 Isometric sectional Views
- 2.3 Oblique Projection and Oblique Drawing
  - 2.3.1 Procedure for making an Oblique drawing
  - 2.3.2 Rules for Placing Objects in Oblique drawing
  - 2.3.3 Angles, Circles and Circular Arcs in Oblique drawing
- 2.4 Perspective Projection
  - 2.4.1 Terms used in Perspective Projection
  - 2.4.2 Parallel and Angular Perspective
  - 2.4.3 Selection of Station Point

3. Familiarization with Different Components and Conventions (8 hours)
- 3.1 Limit Dimensioning and Machining Symbols
  - 3.1.1 Limit, Fit and Tolerances
  - 3.1.2 Machining Symbols and Surface Finish
- 3.2 Threads, Bolts and Nuts
  - 3.2.1 Thread Terms and Nomenclature, Forms of Screw Threads
  - 3.2.2 Detailed and Simplified Representation of Internal and External Threads
  - 3.2.3 Thread Dimensioning
  - 3.2.4 Standard Bolts and Nuts: Hexagonal Head and Square Head
  - 3.2.5 Conventional Symbols for Bolts and Nuts
- 3.3 Welding and Riveting
  - 3.3.1 Types of Welded Joints and Types of Welds, Welding Symbols
  - 3.3.2 Forms and Proportions for Rivet Heads, Rivet Symbols, Types of Riveted Joints: Lap Joint, Butt Joint
- 3.4 Familiarization with Graphical Symbols and Conventions in Different Engineering Fields
  - 3.4.1 Standard Symbols for Civil, Structural and Agricultural Components
  - 3.4.2 Standard Symbols for Electrical, Mechanical and Industrial Components
  - 3.4.3 Standard Symbols for Electronics, Communication and Computer Components
  - 3.4.4 Topographical Symbols
- 3.5 Standard Piping Symbols and Piping Drawing

4. Detail and Assembly Drawings (20 hours)
- 4.1 Introduction to Working Drawing
- 4.2 Components of Working Drawing: Drawing Layout, Bill of Materials, Drawing Numbers
- 4.3 Detail Drawing
- 4.4 Assembly Drawing
- 4.5 Practices of Detail and Assembly Drawing: V-block Clamp, Centering Cone, Couplings, Bearings, Antivibration Mounts, Stuffing Boxes, Screw Jacks, etc

Practical:

1. Conventional Practices for Orthographic and Sectional Views (Full and Half Section)
2. Conventional Practices for Orthographic and Sectional Views (Other Type Sections)
3. Isometric Drawing
4. Isometric Drawing (Consisting of Curved Surfaces and Sections)
5. Oblique Drawing
6. Perspective Projection
7. Familiarization with Graphical Symbols (Limit, Fit, Tolerances and Surface Roughness Symbols)

8. Familiarization with Graphical Symbols (Symbols for Different Engineering Fields)
9. Detail Drawing
10. Assembly Drawing I
11. Assembly Drawing II
12. Building Drawing

References:

1. W. J. Luzadder, " Fundamentals of Engineering Drawing", Prentice Hall.
2. T. E. French, C. J. Vierck, and R. J. Foster, "Engineering Drawing and Graphic Technology", Mc Graw Hill Publshing Co.
3. F. E. Giescke, A . Mitchell, H. C. Spencer and J. T. Dygdone, "Technical Drawing", Macmillan Publshing Co.
4. N. D. Bhatt, "Machine Drawing", Charotar Publshing House, India.
5. P. S. Gill, "Machine Drawing", S. K. Kataria and Sons, India.
6. R. K. Dhawan "Machine Drawing", S. Chand and Company Limited, India.

Evaluation Scheme:

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Unit	Chapter	Topics	Marks
1	1	all	**5**
2	2	all	**15**
3	3	all	**5**
4	4	all	**15**
Total			**40**

BASIC ELECTRONICS ENGINEERING
EX 451

Lecture : 3 **Year : I**
Tutorial : 1 **Part : II**
Practical : 3/2

Course Objectives:

To understand the electronics elements and their functionality, basic understanding of analog and digital systems and their applications

1. Basic Circuits Concepts (4 hours)

1.1 Passive components: Resistance, Inductance, Capacitance; series, parallel combinations; Kirchhoff's law: voltage, current; linearity
1.2 Signal sources: voltage and current sources; nonideal sources; representation under assumption of linearity; controlled sources: VCVS, CCVS, VCCS, CCCS; concept of gain, transconductance, transimpedance.
1.3 Superposition theorem; Thevenin's theorem; Norton's theorem
1.4 Introduction to filter

2. Diodes (6 hours)

2.1 Semiconductor diode characteristics
2.2 Modeling the semiconductor diode
2.3 Diode circuits: clipper; clamper circuits
2.4 Zener diode, LED, Photodiode, varacters diode, Tunnel diodes
2.5 DC power supply: rectifier-half wave, full wave (center tapped, bridge), Zener regulated power supply

3. Transistor (8 hours)

3.1 BJT configuration and biasing, small and large signal model
3.2 T and μ model
3.3 Concept of differential amplifier using BJT
3.4 BJT switch and logic circuits
3.5 Construction and working principle of MOSFET and CMOS
3.6 MOSFET as logic circuits

4. The Operational Amplifier and Oscillator (7 hours)

4.1 Basic model; virtual ground concept; inverting amplifier; non-inverting amplifier; integrator; differentiator, summing amplifier and their applications
4.2 Basic feedback theory; positive and negative feedback; concept of stability; oscillator
4.3 Waveform generator using op-amp for Square wave, Triangular wave Wien bridge oscillator for sinusoidal waveform

5. Communication System (4 hours)

5.1 Introduction
5.2 Wired and wireless communication system
5.3 EMW and propagation, antenna, broadcasting and communication
5.4 Internet / intranet
5.5 Optical fiber

6. Digital Electronics (11 hours)

6.1 Number systems, Binary arithmetic
6.2 Logic gates: OR, NOT, AND NOR, NAND, XOR, XNOR gate; Truth tables
6.3 Multiplexers; Demux, Encoder, Decoder
6.4 Logic function representation
6.5 Combinational circuits: SOP, POS form; K-map;
6.6 Latch, flip-flop: S-R flip-flop; JK master slave flip-flop; D-flip flop
6.7 Sequential circuits: Generic block diagram; sift registers; counters

7. Application of Electronic System (5 hours)

7.1 Instrumentation system: Transducer, strain gauge, DMM, Oscilloscope
7.2 Regulated power supply
7.3 Remote control, character display, clock, counter, measurements, date logging, audio video system

Practical:

1. Familiarization with passive components, function generator and oscilloscope
2. Diode characteristics, rectifiers, Zener diodes
3. Bipolar junction transistor characteristics and single stage amplifier
4. Voltage amplifiers using op-amp, Comparators, Schmitt
5. Wave generators using op-amp
6. Combinational and sequential circuits

References

1. Robert Boylestad and Louis Nashelsky, "Electronic Devices and Circuit Theory" PHI
2. Thomas L. Floyd, "Electronic Devices" Pearson Education, Inc., 2007
3. A.S. Sedra and K.C. Smith, "Microelectronic Circuits", Oxford University Press, 2006

Evaluation Scheme

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Unit	Chapter	Topics	Marks
1	1 & 2	all	**16**
2	3	all	**16**
3	4	all	**16**
4	5 & 7	all	**16**
5	6	all	**16**
Total			**80**

ENGINEERING PHYSICS
SH 452

Lecture	**: 4**	**Year**	**: I**
Tutorial	**: 1**	**Part**	**: II**
Practical	**: 2**		

Course objectives:
To provide the concept and knowledge of physics with the emphasis of present day application.

1. Oscillation: **(7 hours)**
- 1.1. Mechanical Oscillation: Introduction
- 1.2. Free oscillation
- 1.3. Damped oscillation
- 1.4. forced mechanical oscillation
- 1.5. EM Oscillation: Free, damped and Forced electromagnetic oscillation

2. Wave motion **(2 hours)**
- 2.1. Waves and particles,
- 2.2. Progressive wave,
- 2.3. Energy, power and intensity of progressive wave

3. Acoustics **(3 hours)**
- 3.1. Reverberation,
- 3.2. Sabine' Law
- 3.3. Ultrasound and its applications

4. Physical Optics **(12 hours)**

4.1. Interference,
- 4.1.1. Intensity in double slit interference,
- 4.1.2. Interference in thin films,
- 4.1.3. Newton's rings,
- 4.1.4. Hadinger fringes

4.2. Diffraction,
- 4.2.1. Fresnel and Fraunhoffer's diffraction,
- 4.2.2. intensity due to a single slit;
- 4.2.3. diffraction grating,
- 4.2.4. x-ray diffraction, x-ray for material test

4.3. Polarization,
- 4.3.1. double refraction,
- 4.3.2. Nichol prism, wave plates,
- 4.3.3. optical activity, specific rotation

5. Geometrical Optics **(3 hours)**
- 5.1. Lenses, combination of lenses,
- 5.2. cardinal points,
- 5.3. chromatic aberration

6. Laser and Fiber Optics **(4 hours)**

6.1. Laser production,
- 6.1.1. He-Ne laser,
- 6.1.2. Uses of laser

6.2. Fiber Optics,
- 6.2.1. self focusing,
- 6.2.2. applications of optical fiber

7. Electrostatics **(8 hours)**
- 7.1. Electric charge and force,
- 7.2. electric field and potential,
- 7.3. electrostatic potential energy,
- 7.4. capacitors, capacitor with dielectric,
- 7.5. charging and discharging of a capacitor

8. Electromagnetism **(11 hours)**

8.1. **Direct current:** Electric current,
- 8.1.1. Ohm's law, resistance and resistivity,
- 8.1.2. semiconductor and superconductor

8.2. Magnetic fields:
- 8.2.1. Magnetic force and Torque,
- 8.2.2. Hall effect,
- 8.2.3. cyclotron, synchrotron,
- 8.2.4. Biot-Savart law,
- 8.2.5. Ampere's circuit law; magnetic fields straight conductors,
- 8.2.6. Faraday's laws, Induction and energy transformation, induced field,
- 8.2.7. LR circuit, induced magnetic field,
- 8.2.8. displacement current

9. Electromagnetic waves **(5 hours)**
- 9.1. Maxwell's equations,
- 9.2. wave equations, speed,
- 9.3. E and B fields,
- 9.4. continuity equation,
- 9.5. energy transfer

10. Photon and matter waves **(5 hours)**

10.1. Quantization of energy;
10.2. electrons and matter waves;
10.3. Schrodinger wave equation;
10.4. probability distribution;
10.5. one dimensional potential well;
10.6. uncertainty principle;
10.7. barrier tunneling

Practical:

- To determine the acceleration due to gravity and radius of gyration of the bar about an axis passing through its center of gravity.
- To determine the value of modulus of elasticity of the materials given and moment of inertia of a circular disc using torsion pendulum.
- To determine the angle of prism and dispersive power of materials of the prism using spectrometer.
- To determine the wavelength of sodium light by Newton's rings.
- To determine the wavelength of He-Ne laser light and use it to measure the thickness of a thin wire by diffraction of light.
- To study the variation of angle of rotation of plane of polarization using concentration of the cane sugar solution
- To determine the specific rotation of the cane sugar solution using polarimeter.
- To determine the low resistance of a given wire by Carey Foster bridge and to determine the resistance per unit length of the wire of the bridge.
- To determine the capacitance of a given capacitor by charging and discharging through resistor.
- To plot a graph between current and frequency in an LRC series circuit and find the resonant frequency and quality factor.
- To determine dielectric constant of a given substance and study its variation with frequency by resonance method.
- To determine the susceptibility of a solution of given materials by Quinkes method.
- To study the electric field mapping.

References:

1. Halliday, Resnick, Walker, “Fundamentals of Physics”, John Wiley & Sons. Inc.
2. Sapkota, Pokharel, Bhattarai, "Fundamentals of Engineering Physics", Benchmark Publication.
3. Brij Lal and Subrahmanyam, “A text book of Optics”, S. Chand Publisher.
4. A. S. Basudeva, “Modern Engineering Physics”, S. Chand Publisher.
5. R. K. Gaur and S. L. Gupta, “Engineering Physics”, Dhanpat Publisher.
6. Brij Lal and Subrahmanyam, “Waves and Oscillation”, S. Chand Publisher.

Evaluation Scheme:

There will be questions covering all the chapters in the syllabus. The evaluation scheme for the question will be as indicated in the table below:

Unit	Chapter	Topics	Marks
1	1, 2 & 3	all	**16**
2	4	all	**16**
3	5, 6 & 10	all	**16**
4	7 & 8.1	all	**16**
5	8.2, 9	all	**16**
Total			**80**

APPLIED MECHANICS
CE 451

Lecture	**: 3**	**Year**	**: I**
Tutorial	**: 2**	**Part**	**: II**
Practical	**: 0**		

Course Objective:
To provide concept and knowledge of engineering mechanics and help understand structural engineering stress analysis principles in later courses or to use basics of mechanics in their branch of engineering. Emphasis has been given to Statics.

1. Introduction (2 hours)
- 1.1 Definitions and scope of Applied Mechanics
- 1.2 Concept of Rigid and Deformed Bodies
- 1.3 Fundamental concepts and principles of mechanics: Newtonian Mechanics

2. Basic Concept in Statics and Static Equilibrium (4 hours)
- 2.1 Concept of Particles and Free Body Diagram
- 2.2 Physical meaning of Equilibrium and its essence in structural application
- 2.3 Equation of Equilibrium in Two Dimension

3. Forces Acting on Particle and Rigid Body (6 hours)
- 3.1 Different types of Forces: Point, Surface Traction and Body Forces - Translational Force and Rotational Force: Relevant Examples
- 3.2 Resolution and Composition of Forces: Relevant Examples
- 3.3 Principle of Transmissibility and Equivalent Forces: Relevant Examples
- 3.4 Moments and couples: Relevant Examples
- 3.5 Resolution of a Force into Forces and a Couple: Relevant Examples
- 3.6 Resultant of Force and Moment for a System of Force: Examples

4. Center of Gravity, Centroid and Moment of Inertia (6 hours)
- 4.1 Concepts and Calculation of Centre of Gravity and Centroid: Examples
- 4.2 Calculation of Second Moment of Area / Moment of Inertia and Radius of Gyration: And Relevant usages
- 4.3 Use of Parallel axis Theorem: Relevant Examples

5. Friction (2 hours)
- 5.1 Laws of Friction, Static and Dynamic Coefficient of Friction, Angle of Friction: Engineering Examples of usage of friction
- 5.2 Calculations involving friction in structures: Example as High Tension Friction Grip bolts and its free body diagram

6. Analysis of Beams and Frames (9 hours)
- 6.1 Introduction to Structures: Discrete and Continuum
- 6.2 Concept of Load Estimating and Support Idealizations: Examples and Standard symbols
- 6.3 Use of beams/frames in engineering: Concept of rigid joints/distribute loads in beams/frames.
- 6.4 Concept of Statically/Kinematically Determinate and Indeterminate Beams and Frames: Relevant Examples
- 6.5 Calculation of Axial Force, Shear Force and Bending Moment for Determinate Beams and Frames
- 6.6 Axial Force, Shear Force and Bending Moment Diagrams and Examples for drawing it.

7. Analysis of Plane Trusses (4 hours)
- 7.1 Use of trusses in engineering: Concept of pin joints/joint loads in trusses.
- 7.2 Calculation of Member Forces of Truss by method of joints: Simple Examples
- 7.3 Calculation of Member Forces of Truss by method of sections: Simple Examples

8. Kinematics of Particles and Rigid Body (7 hours)
- 8.1 Rectilinear Kinematics: Continuous Motion
- 8.2 Position, Velocity and Acceleration of a Particle and Rigid Body
- 8.3 Determination of Motion of Particle and Rigid Body
- 8.4 Uniform Rectilinear Motion of Particles
- 8.5 Uniformly Accelerated Rectilinear Motion of Particles
- 8.6 Curvilinear Motion: Rectangular Components with Examples of Particles

9. Kinetics of Particles and Rigid Body: Force and Acceleration (5 hours)
- 9.1 Newton's Second Law of Motion and momentum
- 9.2 Equation of Motion and Dynamic Equilibrium: Relevant Examples
- 9.3 Angular Momentum and Rate of Change
- 9.4 Equation of Motion-Rectilinear and Curvilinear
- 9.5 Rectangular: Tangential and Normal Components and Polar Coordinates: Radial and Transverse Components

Tutorial:

There shall be related tutorials exercised in class and given as regular homework exercises. Tutorials can be as following for each specified chapters.

1. **Introduction** **(1 hour)**
   A. Theory; definition and concept type questions.
2. **Basic Concept in Statics and Static Equilibrium** **(2 hours)**
   A. Theory; definition and concept type questions.
3. **Concept of Force acting on structures** **(3 hours)**
   A. Practical examples; numerical examples and derivation types of questions.
   B. There can be tutorials for each sub-section.
4. **Center of Gravity, Centroid and Moment of Inertia** **(4 hours)**
   A. Concept type; numerical examples and practical examples type questions.
5. **Friction** **(2 hours)**
   A. Definition type; Practical example type and numerical type questions.
6. **Analysis of Beam and Frame** **(5 hours)**
   A. Concept type; definition type; numerical examples type with diagrams questions.
   B. There can be tutorials for each sub-section.
7. **Analysis of Plane Trusses** **(5 hours)**
   A. Concept type; definition type; numerical examples type questions.
   B. There can be tutorials for each sub-section.
8. **Kinematics of Particles and Rigid Body** **(4 hours)**
   A. Definition type; numerical examples type questions.
   B. There can be tutorials for each sub-section.
9. **Kinetics of Particles and Rigid Body: Force and Acceleration** **(4 hours)**
   A. Concept type; definition type; numerical examples type questions.
   B. There can be tutorials for each sub-section.

References:

1. F.P. Beer and E.R.Johnston, Jr. ,"Mechanics of Engineers- Statics and Dynamics", Mc Graw-Hill.
2. R.C. Hibbeler, Ashok Gupta, "Engineering Mechanics-Statics and Dynamics", New Delhi, Pearson.
3. I.C. Jong and B.G. Rogers, "Engineering Mechanics- Statics and Dynamics",
4. D.K. Anand and P.F. Cunnif, "Engineering Mechanics- Statics and Dynamics",
5. R.S. Khurmi, "A Text Book of Engineering Mechanics",
6. R.S.Khurmi, "Applied Mechanics and Strength of Materials",
7. I.B.Prasad, "A Text Book of Applied Mechanics",
8. Shame, I.H., "Engineering Mechanics-Statics and Dynamics", Prentice Hall of India, New Delhi.

Evaluation Scheme

The questions will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below:

Unit	Chapter	Topics	Marks
1	1 & 2	all	**16**
	3	3.1 to 3.3	
2	4 & 5	all	**16**
3	6	all	**16**
4	7 & 8	all	**16**
5	3	3.4 to 3.6	**16**
	9	all	
Total			**80**

BASIC ELECTRICAL ENGINEERING
EE 451

Lecture : 3 **Year : I**
Tutorial : 1 **Part : II**
Practical : 3/2

Course Objectives:

To provide the fundamental concept of DC, AC & 3-phase electrical circuits

1. General Electric System (6 hours)
- 1.1. Constituent parts of an electrical system (source, load, communication & control)
- 1.2. Current flow in a circuit
- 1.3. Electromotive force and potential difference
- 1.4. Electrical units
- 1.5. Ohm's law
- 1.6. Resistors, resistivity
- 1.7. Temperature rise & temperature coefficient of resistance
- 1.8. Voltage & current sources

2. DC circuits (4 hours)
- 2.1. Series circuits
- 2.2. Parallel networks
- 2.3. Krichhhof's laws
- 2.4. Power and energy

3. Network Theorems (12 hours)
- 3.1. Application of Krichhof's laws in network solution
  - 3.1.1. Nodal Analysis
  - 3.1.2. Mesh analysis
- 3.2. Star-delta & delta-star transformation
- 3.3. Superposition theorem
- 3.4. Thevninn's theorem
- 3.5. Nortan's theorem
- 3.6. Maximum power transfer theorem
- 3.7. Reciprocity theorem

4. Inductance & Capacitance in electric circuits (4 hours)
- 4.1. General concept of capacitance
  - 4.1.1. Charge & voltage
  - 4.1.2. Capacitors in series and parallel
- 4.2. General concept of inductance
  - 4.2.1. Inductive & non-inductive circuits
  - 4.2.2. Inductance in series & parallel

5. Alternating Quantities (3 hours)
- 5.1. AC systems
- 5.2. Wave form, terms & definitions
- 5.3. Average and rms values of current & voltage
- 5.4. Phasor representation

6. Single-phase AC Circuits (6 hours)
- 6.1. AC in resistive circuits
- 6.2. Current & voltage in an inductive circuits
- 6.3. Current and voltage in an capacitive circuits
- 6.4. Concept of complex impedance and admittance
- 6.5. AC series and parallel circuit
- 6.6. RL, RC and RLC circuit analysis & phasor representation

7. Power in AC Circuits (4 hours)
- 7.1. Power in resistive circuits
- 7.2. Power in inductive and capacitive circuits
- 7.3. Power in circuit with resistance and reactance
- 7.4. Active and reactive power
- 7.5. Power factor, its practical importance
- 7.6. Improvement of power factor
- 7.7. Measurement of power in a single-phase AC circuits

8. Three-Phase Circuit Analysis (6 hours)
- 8.1. Basic concept & advantage of Three-phase circuit
- 8.2. Phasor representation of star & delta connection
- 8.3. Phase and line quantities
- 8.4. Voltage & current computation in 3-phase **balance & unbalance** circuits
- 8.5. Real and reactive power computation
- 8.6. Measurements of power & power factor in 3-phase system

Practical:

1. Measurement of Voltage, current& power in DC circuit
   Verification of Ohm's Law
   Temperature effects in Resistance
2. Krichoff's Voltage & current Law
   Evaluate power from V & I
   Note loading effects of meter
3. Measurement amplitude, frequency and time with oscilloscope
   Calculate & verify average and rms value
   Examine phase relation in RL & RC circuit
4. Measurements of alternating quantities
   R, RL,RC circuits with AC excitation
   AC power, power factor, VARs, phasor diagrams
5. Three-phase AC circuits
   Measure currents and voltages in three-phase balanced AC circuits
   Prove Y-Δ transformation
   Exercise on phasor diagrams for three-phase circuits
6. Measurement of Voltage, current & power in a three-phase circuit
   Two-wattmeter method of power measurement in R, RL and RC three phase circuits
   Watts ratio curve

References:

1. J. R. Cogdell, " Foundations of Electrical Engineering", Prentice Hall, Englewood Chiffs, New Jersy, 1990.
2. I. M. Smith," Haughes Electrical Technology", Addison-Wesley, ISR Rprint,2000

Evaluation Scheme

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Unit	Chapter	Topics	Marks
1	1 & 2	all	**16**
2	3	all	**16**
3	4, 5 & 7	all	**16**
4	6	all	**16**
5	8	all	**16**
Total			**80**

ENGINEERING MATHEMATICS III
SH 501

Lecture : 3 **Year : II**
Tutorial : 2 **Part : I**
Practical : 0

Course Objective:

To round out the students' preparation for more sophisticated applications with an introduction to linear algebra, Fourier series, Laplace Transforms, integral transformation theorems and linear programming.

1. Determinants and Matrices (11 hours)

1.1. Determinant and its properties
1.2. Solution of system of linear equations
1.3. Algebra of matrices
1.4. Complex matrices
1.5. Rank of matrices
1.6. System of linear equations
1.7. Vector spaces
1.8. Linear transformations
1.9. Eigen value and Eigen vectors
1.10. The Cayley-Hamilton theorem and its uses
1.11. Diagonalization of matrices and its applications

2. Line, Surface and Volume Integrals (12 hours)

2.1. Line integrals
2.2. Evaluation of line integrals
2.3. Line integrals independent of path
2.4. Surfaces and surface integrals
2.5. Green's theorem in the plane and its applications
2.6. Stoke's theorem (without proof) and its applications
2.7. Volume integrals; Divergence theorem of Gauss (without proof) and its applications

3. Laplace Transform (8 hours)

3.1. Definitions and properties of Laplace Transform
3.2. Derivations of basic formulae of Laplace Transform
3.3. Inverse Laplace Transform: Definition and standard formulae of inverse Laplace Transform
3.4. Theorems on Laplace transform and its inverse
3.5. Convolution and related problems
3.6. Applications of Laplace Transform to ordinary differential equations

4. Fourier Series (5 hours)

4.1. Fourier Series
4.2. Periodic functions
4.3. Odd and even functions
4.4. Fourier series for arbitrary range
4.5. Half range Fourier series

5. Linear Programming (9 hours)

5.1. System of Linear Inequalities in two variables
5.2. Linear Programming in two dimensions: A Geometrical Approach
5.3. A Geometric introduction to the Simplex method
5.4. The Simplex method: Maximization with Problem constraints of the form "≤"
5.5. The Dual: Maximization with Problem Constraints of the form "≥"
5.6. Maximization and Minimization with mixed Constraints. The two- phase method

(An alternative to the Big M Method)

References:

1. S. K. Mishra, G. B. Joshi, V. Parajuli, "Advance Engineering Mathematics", Athrai Publication.
2. E. Kreszig, "Advance Engineering Mathematics", Willey, New York.
3. M.M Gutterman and Z.N.Nitecki, "Differential Equation, a First Course", Saunders, New York.

Evaluation Scheme

The questions will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below:

Unit	Chapter	Topics	Marks
1	1	1.1 to 1.8	**16**
2	1	1.9 to 1.11	**16**
	2	2.1 to 2.4	
3	2	2.5 to 2.7	**16**
	3	3.1 to 3.2	
4	3	3.3 to 3.6	**16**
	4	4.1 to 4.3	
5	4	4.4 to 4.5	**16**
	5	all	
Total			**80**

MATERIAL SCIENCE
ME 501

Lecture : 4 **Year : II**
Tutorials : 0 **Part : I**
Practical : 3/2

Course Objective:

To analyze the relationship between the structure and properties of ferrous alloys, non-ferrous alloys, polymer, ceramic and composite materials. Students will be able to select suitable material for different applications on the basis of their properties.

1. Introduction to Materials (1 hour)
- 1.1 Types of Materials
- 1.2 Relationship among structures, processing and properties
- 1.3 Material selection for design

2. Atomic Structure, arrangement of atoms (8 hours)
- 2.1 Structure of atom, periodic table, binding energy and bonds
- 2.2 Atomic arrangements
  - 2.2.1 Crystal and amorphous
  - 2.2.2 Crystal geometry
  - 2.2.3 Unit cell
  - 2.2.4 Lattices, points, directions, planes in a unit cell
  - 2.2.5 Millers' indices
  - 2.2.6 Allotropic and polymorphic transformation
- 2.3 Imperfections in the atomic arrangement
  - 2.3.1 Imperfections
  - 2.3.2 Point defects, surface defects, dislocation
  - 2.3.3 Deformation by slip and twinning
  - 2.3.4 Schmid's Law
- 2.4 Movement of atoms in materials
  - 2.4.1 Fick's First Law
  - 2.4.2 Fick's Second Law

3. Mechanical Properties and their tests (9 hours)
- 3.1 Tensile Test
  - 3.1.1 Load- Deformation Diagrams
  - 3.1.2 Engineering stress-strain diagram for ductile and brittle materials
  - 3.1.3 True stress-strain diagram
  - 3.1.4 Properties tested from tensile test, temperature effects
  - 3.1.5 Brittle behavior and notch effects.
- 3.2 Hardness Test
  - 3.2.1 Main hardness testing methods
  - 3.2.2 Brinell, Rockwell, Vickers, Knoop test
  - 3.2.3 Microhardness test, Hardness conversion table
- 3.3 Impact Test
  - 3.3.1 Toughness
  - 3.3.2 Types of impact test, Charpy and Izod test
  - 3.3.3 Significance of Transition - Temperature curve, Notch sensitivity
- 3.4 Fatigue Test
  - 3.4.1 Fatigue failure
  - 3.4.2 S-N curve, Endurance limit, Fatigue strength versus fatigue limit
  - 3.4.3 Preventions
- 3.5 Creep Test
  - 3.5.1 Creep failure
  - 3.5.2 Creep and stress rupture curve
  - 3.5.3 Effect of temperature and stress level on creep life
  - 3.5.4 Preventions

4. Deforming process for materials (6 hours)
- 4.1 Cold work
  - 4.1.1 Cold work and its types
  - 4.1.2 Strain Hardening and the stress-strain curve
  - 4.1.3 Properties versus degree of Cold-work
  - 4.1.4 Microstructure and residual stress in cold worked metals
- 4.2 Treatment after Cold-work
  - 4.2.1 Annealing
  - 4.2.2 Three stages of annealing (recovery, recrystallization and grain growth)
- 4.3 Hot-work
  - 4.3.1 Hot-work process and its types
  - 4.3.2 Comparison between Hot-work and Cold-work

5. Solidification, Phase Relations and Strengthening Mechanism (7 hours)
- 5.1 Solidification
  - 5.1.1 Nucleation and grain growth
  - 5.1.2 Dendrite formation
  - 5.1.3 Cooling curve
  - 5.1.4 Under-cooling Cast structure
  - 5.1.5 Solidification defect
  - 5.1.6 Solid solutions, Solid solutions strengthening
- 5.2 Phase relations and equilibrium
  - 5.2.1 Phase, phase rule
  - 5.2.2 Phase diagram containing three- phase reactions
  - 5.2.3 Lever rule, four important three phase reactions, and Eutectic phase diagram
- 5.3 Strengthening Mechanism
  - 5.3.1 Alloys strengthening by exceeding solubility limit
  - 5.3.2 Age hardening or precipitation hardening

5.3.3 Residual stress during quenching and heating

6. Iron – Iron Carbide diagram and Heat Treatment of Steels (10 hours)

6.1 Iron – Iron Carbide Diagram
- 6.1.1 Applications and limitations of Iron– Iron Carbide Diagram
- 6.1.2 Different mixtures and phases (ferrite, austenite, pearlite, martensite)
- 6.1.3 Classification of steels and cast iron referring to Iron- Iron Carbide Phase diagram

6.2 Simple Heat Treatments
- 6.2.1 Annealing and its types (Full annealing, homogenizing, spheroidizing), their method, applications
- 6.2.2 Normalizing method and its application, comparison between annealing and normalizing.
- 6.2.3 Quenching (method and application), quenching medium, hardenability, Jominy test, TTT diagram, CCT diagram
- 6.2.4 Tempering, its types, applications
- 6.2.5 Different types of surface hardening processes, nitriding, carburizing, cyaniding

7. Types of steels and cast iron (3 hours)

7.1 Types of alloy steels
- 7.1.1 High-strength Low Alloy (HSLA) steel, Stainless steel, Tool Steel
- 7.1.2 Weldability of steels, Embrittlement phenomenon of steels

7.2 Cast Iron
- 7.2.1 Types of Cast Iron (gray, white, malleable, ductile)
- 7.2.2 Properties and application of Cast Iron

8. Environmental Effects (1 hour)

8.1 Galvanic and Stress corrosion, Corrosion protection

9. Non-ferrous Alloys (3 hours)

9.1 Aluminum alloys
9.2 Magnesium alloys
9.3 Copper alloys
9.4 Nickel alloys
9.5 Cobalt alloys
9.6 Titanium alloys, their properties and applications
9.7 Refractory metals and their alloys

10. Organic and Composite Materials (12 hours)

10.1 Polymers
- 10.1.1 Types of Polymer (thermoplastic, thermosetts, elastomers),
- 10.1.2 Comparison between them by structure, properties and applications
- 10.1.3 Chain formation (addition, condensation)
- 10.1.4 Degree of polymerization
- 10.1.5 Forming of polymers
- 10.1.6 Additives to polymers
- 10.1.7 Adhesives to polymers

10.2 Ceramic Materials
- 10.2.1 Crystalline Ceramic Structures and imperfections in it
- 10.2.2 Silicate Structures
- 10.2.3 Glasses and other non- crystalline ceramic materials
- 10.2.4 Deformation and failures, Processing of Ceramics, Applications of ceramics

10.3 Composite Materials
- 10.3.1 Dispersion strengthening
- 10.3.2 True particulate composites
- 10.3.3 Fiber- Reinforced composites
- 10.3.4 Laminar composite materials, examples and their application
- 10.3.5 Wood, Concrete, Asphalt, types and uses
- 10.3.6 Nanocomposites, types, examples and applications

Practical:

1. Macro examination of metals: Macrography to determine uniformity of composition, method of manufacture, physical defects.
2. Micro examination (metallography)
   - A. Selection and preparation of the specimen.
   - B. Application of heat treatment (full annealing, normalizing, quenching, tempering), etching, observation through metallurgical microscope to different specimens of ferrous and non-ferrous alloys.
3. Examination of Failure: Fatigue, Creep
4. Tests: Hardness Test (Brinell, Rockwell, Micro-hardness)
5. Mechanical Testing (tensile, compressive, impact) for ceramics and polymers
6. Strength Testing of Adhesives

References:

1. D. R. Askeland, "The Science and Engineering of Materials", PWS- Kent Publishing Co., Boston,
2. Westerman Table (IS Standard)

Evaluation Scheme:

The questions will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below:

Unit	Chapter	Topics	Marks
1	1, 2 & 7	all	**16**
2	3 & 9	all	**16**
3	4 & 5	all	**16**

4	6 & 8	all	**16**
5	10	all	**16**
Total			**80**

ENGINEERING MECHANICS
ME 502

Lecture : 3 **Year : II**
Tutorial : 1 **Part : I**
Practical : 0

Course Objective:

To provide the fundamental principles, concepts and application of mechanics for solving engineering problems. To become familiar with the analytical/graphical methods for solving problems of mechanics, mainly of dynamics.

1. Virtual Work (2 hours)
- 1.1 Definition of Work and Virtual Work
- 1.2 Principal of Virtual Work for a Particle and a Rigid Body
- 1.3 Uses of the Principal of Virtual Work
- 1.4 Virtual Work Done by Moments

2. Kinetics of Particles: Force, Mass and Acceleration (6 hours)
- 2.1 Newton's Second Law of Motion
- 2.2 Consistent System of Units
- 2.3 Equations of Motion: Radial and Transverse Components
- 2.4 Dynamic Equilibrium: Inertia Force
- 2.5 Principle of Motion of the Mass Centre
- 2.6 Motion due to a Central Force, Conservation of Momentum
- 2.7 Newton's Law of Gravitation

3. Kinetics of Particles: Work Energy Principles (4 hours)
- 3.1 Work Done by a Force
- 3.2 Kinetic Energy of a Particle
- 3.3 Principle of Work and Energy, Applications
- 3.4 Power and Efficiency
- 3.5 Potential Energy
- 3.6 Conservation of Energy

4. Kinetics of Particles: Impulse and Momentum (6 hours)
- 4.1 Principle of Impulse and Momentum
- 4.2 Impulsive Motion and Impact
- 4.3 Direct Central Impact
- 4.4 Oblique Central Impact

5. Kinematics of Rigid Bodies (7 hours)
- 5.1 Introduction to Plane Kinematics of Rigid Bodies
- 5.2 Translation, Rotation and General Plane Motion
- 5.3 Absolute and Relative Velocity in Plane Motion
- 5.4 Instantaneous Centre of Rotation
- 5.5 Absolute and Relative Acceleration in Plane Motion
- 5.6 6.6 Motion Relative to Rotating Axis; Coriolis Acceleration

6. Plane Kinetics of Rigid Bodies: Force, Mass and Acceleration (8 hours)
- 6.1 Mass Moment of Inertia
  - 6.1.1 Moment of Inertia of Mass
  - 6.1.2 Radius of Gyration
  - 6.1.3 Parallel Axis Theorem
  - 6.1.4 Mass moment of inertia of Composite Bodies
- 6.2 Force and Acceleration
  - 6.2.1 Equations of Motion for a Rigid Body
  - 6.2.2 Angular Momentum of a Rigid Body in Plane Motion
  - 6.2.3 Plane Motion of a Rigid Body: D'Alembert's Principle
  - 6.2.4 Application of Rigid Body Motion in the Plane
  - 6.2.5 Constrained Motion in the Plane

7. Plane Motion of Rigid Bodies: Work and Energy Method (4 hours)
- 7.1 Work Energy Relations
- 7.2 Work of a Force on a Rigid Body
- 7.3 Kinetic Energy of a Rigid Body
- 7.4 Principle of Work and Energy for a Rigid Body
- 7.5 Acceleration from Work Energy Method

8. Plane Motion of Rigid Bodies: Impulse and Momentum Method (4 hours)
- 8.1 Impulse and Momentum of a Rigid Body
- 8.2 Conservation of Angular and Linear Momentum
- 8.3 Impulsive Motion and Eccentric Impact of Rigid Bodies

9. Lagrangian Dynamics (4 hours)
- 9.1 Degree of Freedom in mechanical systems and Generalized Coordinates
- 9.2 D'Alembert's – Lagrange Principle and Lagrange Equations of motion
- 9.3 Differential equation of motion for a system of particles
- 9.4 Conservation Theorems

Tutorials

There should be at least one assignment from each chapter and 2 assessment tests during the semester.

References

1. F.P. Beer and E.R. Johnston, "Mechanics for Engineers – Statics and Dynamics", Mc Graw Hill.
2. R.C. Hibbler, "Engineering Mechanics – Dynamics", Pearson, New Delhi.

3. J.C. Jong and B.G. Rogers, “Engineering Mechanics, Statics and Dynamics”- Saunders College Publishing, International Edition
4. Bela I. Sandor, “Engineering Mechanics – Dynamics”, Prectice Hall, Inc.,Englewood Cliffs.
5. J.L. Meriam.,”Engineering Mechanics – Statics and Dynamics”, John Wiley and Sons.

Evaluation Scheme:

The questions will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below:

Unit	Chapter	Topics	Marks
1	2 & 3	all	**16**
2	4 & 7	all	**16**
3	5	all	**16**
4	6	all	**16**
5	1, 8 & 9	all	**16**
Total			**80**

METROLOGY
ME 503

Lectures : 3 **Year : II**
Tutorial : 0 **Part : I**
Practical : 1.5

Course Objective:

To make students understand the concept, principles and purposes of Metrology in Engineering Production. To make them familiar with the principles, construction, application of various measuring instruments, basic concept on principles, methods of various measurements, standards, standardization and standardizing organizations, fundamentals of quality control.

1. Introduction to Metrology (1 hour)
- 1.1 Concept and Scope of Metrology
- 1.2 Objectives of Metrology
- 1.3 Legal Metrology
- 1.4 Dynamic Metrology
- 1.5 Deterministic metrology
- 1.6 Methods of Measurements
- 1.7 Units of Measurements
- 1.8 General Metrological Terms: Accuracy. Precision, Repeatability, Reproducibility, Sensitivity, Resolution, Stability, Readability, Calibration

2. Errors in measurement (2 hours)
- 2.1 Types and Sources of Errors in Measurement
- 2.2 Error Propagation
- 2.3 Effects of Averaging Results
- 2.4 Method of Least Squares
- 2.5 Related problems on Error and Uncertainty Measurement,
- 2.6 Averaging Results and Method of Least Squares

3. Standards, Standardization, Standardizing Organizations (3 hours)
- 3.1 Standards of Measurement
- 3.2 Classification of Standards
- 3.3 Traceability and Hierachy of Standards
- 3.4 Level of Standardization - Company Standardization, International Standardization
- 3.5 Formulation and Implementation of Standards
- 3.6 ISO 9000
- 3.7 National and International Organisations concerning Metrology(Formation, Duties and Responsibilities) – Nepal

4. Linear Measurement (3 hours)
- 4.1 Instruments for Linear Measurements (types, principles, applications, limitations and errors)
  - 4.1.1 Vernier Calliper
  - 4.1.2 External Micrometer
  - 4.1.3 Internal Micrometer
  - 4.1.4 Depth Micrometer
  - 4.1.5 Vernier Height Gauge
  - 4.1.6 Vernier depth Gauge
  - 4.1.7 Slip Gauges
  - 4.1.8 Dial Indicators
  - 4.1.9 Combination Set

5. Angular and Taper Measurement (3 hours)
- 5.1 Instruments for Angular Measurements, types, principles, applications, imitations and errors
  - 5.1.1 Bevel Protractors
  - 5.1.2 Sine Bar
  - 5.1.3 Sine Table
  - 5.1.4 Sine Centre
  - 5.1.5 Angle Gauges
  - 5.1.6 Spirit Level
  - 5.1.7 Clinometers
  - 5.1.8 Auto-collimator
  - 5.1.9 Angle Dekkor
- 5.2 Gauges for Taper Shafts
- 5.3 Measurement for Taper Shafts and Holes

6. Surface Measurement (1 hour)
- 6.1 Instruments for Surface Measurements , types, principles, applications, limitations and errors
  - 6.1.1 Straight Edge
  - 6.1.2 Surface Plate

7. Comparators (2 hours)
- 7.1 Basic Principle of Measurement
- 7.2 Classification of Comparators
- 7.3 Advantages and Disadvantages of Various Types of Comparators

8. Interferometry (3 hours)
- 8.1 Interference of light
- 8.2 Interferomery Applied to Flatness Testing
- 8.3 Flatness Interferometer
- 8.4 Length Interferometer
- 8.5 Related problems on Flatness Testing by Interferometry

9. Limits, Fits and Tolerances (8 hours)

9.1 Basic Terminology related to Limits, Fits and Tolerances
9.2 System of Writing Tolerances- Unilateral and Bilateral Tolerances
9.3 System of Fits - Hole Basis System and Shaft Basis System
9.4 Types of Fits - Interference, Transition and Clearance Fits
9.5 ISO system of Limits and Fits
9.6 Selection and calculation of Fits and Tolerances
9.7 Interchangeable Assembly
9.8 Selective Assembly
9.9 Fits and Tolerances of Ball and Roller Bearings, Screw Threads, Key Joints, and Backlash Tolerances for Spur Gears
9.10 Gauges
- 9.10.1 Classification of Plain Gauges
- 9.10.2 Taylor's Theory for Gauge Design
- 9.10.3 Gauge Design of Workshop Gauge, Inspection Gauge and General Gauge
- 9.10.4 Gauges for Tapers
- 9.10.5 Related problems on Limits, Fits and Tolerances. Selective Assembly and Gauge Design

10. Measurement of Surface Finish (3 hours)

10.1 Effect of Surface Finish on Fatigue Life, Bearing Properties, Wear, Stress, Corrosion, Fit
10.2 Elements of Surface Texture
10.3 Analysis of Surface Traces
10.4 Factors affecting Surface finish and roughness
10.5 Methods of Measuring Surface Finish
10.6 Related problems on Surface Roughness Measurement

11. Gear measurement (2 hours)

11.1 Gear Tooth Terminology(Review)
11.2 Measurement and Testing of Spur Gears
- 11.2.1 Tooth Thickness Measurement
- 11.2.2 Pitch Measurement
- 11.2.3 Tooth Bearing Contact Testing
- 11.2.4 Composite Method of Gear Testing

12. Measurement of Screw Threads (4 hours)

12.1 Terminology of Screw Thread (Review)
12.2 Errors in Threads
12.3 Effects of Pitch Errors
12.4 Measurement of Major, Minor and Effective Diameters of Thread
12.5 Calculation of Best Wire Size
12.6 Measurement of Pitch
12.7 Measurement of Thread angle
12.8 Screw thread gauges

13. Machine Tool Metrology (2 hours)

13.1 Alignment or Geometrical Tests of Machine Tool
13.2 Tests for Level of Installation
13.3 Spindle Tests
13.4 Tests for Straightness, Flatness and Squareness

14. Measuring machines (2 hours)

14.1 Coordinate Measuring Machine (CMM)
14.2 End Bar Measuring Machine
14.3 Universal Measuring Machine
14.4 Computer Controlled Coordinate Measuring Machine

15. Quality Control Management (6 hours)

15.1 Quality, Quality Control, Quality Assurance, Total Quality Control. Total Quality Management
15.2 Statistical Quality Control in Engineering Production - Process Variability, Process Capability, Control Charts Sampling Inspection
15.3 Sampling Plan
15.4 Related problems on Statistical Quality Control (Standard Deviation, Normal Distribution, Probability, Control charts)

Practical:

1. Linear and Angular Measurement
2. Measurement of Screw Thread
3. Surface Finish Measurement
4. Study on the Effect of Cutting Variables on Surface Roughness
5. Machine Tool Alignment Test
6. Compound Error Measurement
7. Statistical Quality Control
8. Determination of Spoilage Percentage by the Area of Distribution Curve
9. Statistical Process Control

References

1. R. K. Jain, “Engineering Metrology”, Khanna Publishers.
2. J. F. W. Gayler and C. R. Shotbolt, “Metrology for Engineers”, Cassell, London. SI Edition.
3. Manohar Mahajan, “A Text book of Metrology”, Dhanapat Rai & Co. (P) Ltd., Delhi,
4. R. K. Rajput, “Engineering Metrology and Instrumentation”, S. K. Kataria and Sons, Delhi.
5. Publications from Nepal Bureau of Standards and Metrology (NBSM).

Evaluation Scheme

The questions will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below:

Unit	Chapter	Topics	Marks
1	1, 2, 3 & 4	all	**16**
2	5, 6, 7 & 8	all	**16**
3	9	all	**16**
4	10, 11 & 12	all	**16**
5	13, 14 & 15	all	**16**
Total			**80**

APPLIED THERMODYNAMICS
ME 504

Lecture : 3 **Year : II**
Tutorials : 1 **Part : I**
Practical : 3/2

Course Objectives:
To understand the diverse fields of applications thermodynamics and to implement the laws of thermodynamics and to analyze the working of various components of mechanical systems using laws of thermodynamics.

1. Boilers (12 hours)

1.1 Introduction and applications
1.2 Classifications and comparison among various types of boilers
1.3 Requirements of an ideal boiler
1.4 Boiler mountings and accessories: water level indicator, feed check valve, Blow off cock, steam separator, safety valves, Feed pump, air preheater, super heater and economizer
1.5 Water conditioning
  1.5.1 Water problems and Benefits of water conditioning
  1.5.2 Constituents and Characteristics of water
  1.5.3 Types and causes of scale and deposits
  1.5.4 Scale deposit prevention methods

2. Air Compressors (9 hours)

2.1 Introduction and classifications of air compressors
2.2 Primary components of a reciprocating compressor
2.3 Processes of a reciprocating compression on P-v diagram, clearance volume, swept volume, total volume, and effective swept volume and work done, effect of clearance volume on performance of compressor
2.4 Volumetric, adiabatic and isothermal efficiencies
2.5 Multi stage compression and its advantages, inter-cooling, work done of multi stage compression with and without clearance volume on representation of processes on P-v and T-s diagrams
2.6 Other types of air compressors: Centrifugal type, axial type, Roots blower, Rotary type, screw type
2.7 Comparison among various type of air compressor

3. Refrigeration (10 hours)

3.1 Definition and applications of refrigeration
3.2 Simple and modified vapor compression refrigeration cycles
  3.2.1 Ideal and actual vapor compression refrigeration cycles
  3.2.2 Representation of corresponding processes on P-h and T-s diagram
  3.2.3 Work done and coefficient of performance
3.3 Vapor absorption refrigeration system
  3.3.1 Basic vapor absorption refrigeration system, practical vapor absorption refrigeration system and Electrolux vapor absorption refrigeration system
  3.3.2 Comparison between vapor compression and vapor absorption type refrigeration systems
3.4 Refrigerants
  3.4.1 Introduction
  3.4.2 Classifications of refrigerants
  3.4.3 Desirable properties of an ideal refrigerant
  3.4.4 Properties and uses of commonly used refrigerants

4. Air-Conditioning (14 hours)

4.1 Definition and scope of air-conditioning
4.2 Psychometrics and properties of air
4.3 Psychometric chart
4.4 Various processes on psychometric chart and their analysis: sensible heating , sensible cooling, cooling with dehumidification, cooling with humidification, heating with dehumidification, heating with humidification, adiabatic mixing of two streams of moist air
4.5 Air-conditioning systems: DX system, all air system, all water system, air-water system, merits and demerits of each system
4.6 Components of air-conditioning systems: Ducts, Fans, Grills, Registers, Diffusers, Balancing dampers, Air filters, Air handling units, Fan coil units, Humidifiers and Dehumidifiers

Practical:

1. Performance of air compressor
2. Performance of vapor compression refrigeration system and electrolux type refrigerator
3. Air-conditioning processes: Cooling with dehumidification and cooling with humidification; Heating with dehumidification and heating with humidification
4. Air-conditioning process: Mixing of two streams of moist air
5. Performance of cooling Tower
6. Study of components of air-conditioning systems.

References:

1. Bernard D. Wood, "Applications of Thermodynamics", Waveland Press Inc., Illinois.
2. Carrier Air-conditioning Company, "Hand boor of Air-conditioning, System Design" , McGraw-Hill.
3. American Society of Heating Refrigerating and Air-conditioning Engineers (ASHRAE), "ASHRAE Hand books", ASHRAE.
4. S.C. Arora and S. domkudwar, " A course Refrigeration and Air-conditioning", Dhanpat rai and Sons, Delhi.
5. R.K. Rajput, "Thermal engineering" Laxmi Publications, New Delhi.

6. R.K. Rajput, “Refrigeration and air-conditioning”, S.K. Kataria & Sons.

Evaluation Scheme:

The questions will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below:

Unit	Chapter	Topics	Marks
1	1	1.1 to 1.4	**16**
2	1	1.5	**16**
	4	4.5 to 4.6	
3	2	all	**16**
4	3	all	**16**
5	4	4.1 to 4.4	**16**
Total			**80**

COMPUTER AIDED DRAWING
ME 505

Lecture : 1 **Year : II**
Tutorial : 0 **Part : I**
Practical : 3

Course Objective:

To give fundamental knowledge on Computer Aided Drafting (2D and 3D) using common drafting software program.

1. Introduction (4 hours)
- 1.1 Loading Software, Screen organization
- 1.2 Entering commands: menus, command line, function keys
- 1.3 Commands and System Variables
- 1.4 Coordinate System: entering distances and angles
- 1.5 Starting a new drawing: naming, and saving, ending session

2. Basic Drawing Commands (12 hours)
- 2.1 Creating point
- 2.2 Creating straight line and construction line
- 2.3 Creating circle, arc and ellipse
- 2.4 Creating polygons
- 2.5 Creating splines

3. Modifying Commands (8 hours)
- 3.1 Erasing the Object
- 3.2 Creating multiple Objects
- 3.3 Scaling the Object
- 3.4 Creating Chamfer and Fillet
- 3.5 Trimming and Extending of the Object
- 3.6 Breaking and Dividing
- 3.7 Modifying colors, styles, etc the Object

4. Drawing Aids and Tools (8 hours)
- 4.1 Setting up Units and Limits
- 4.2 Using Ortho, Grids and Snap
- 4.3 Help and Undo Commands
- 4.4 Display Commands
- 4.5 Creating Isometric Drawing

5. Fine Tuning Drawings and Grouping (4 hours)
- 5.1 Hatching Command
- 5.2 Working with Layers
- 5.3 Creating and Inserting Blocks

6. Working with Text and Dimensions (4 hours)
- 6.1 Inserting Tex on drawing
- 6.2 Dimension Styles, Dimensioning Commands, Tolerance, Limits, Dimension Setup, Dimension Variables, Dimension Scale

7. Working with Three Dimensional Drawing (12 hours)
- 7.1 Wireframe, Surface and Solid Modeling
- 7.2 Creating 3D Drawing using THICKNESS and ELEVATION Commands
- 7.3 Solid Modeling, Standard
- 7.4 Creating 3D Drawing using EXTRUDE Command
- 7.5 Standard Solid Editing Commands
- 7.6 3D Modifying Commands: move, rotate, mirror, array
- 7.7 Shading and Rendering and their Options, Motion Path Animations

8. Plotting Drawings (4 hours)
- 8.1 Layout Management
- 8.2 Plotting 2D and 3D Drawings
- 8.3 Creating multiple views for a 3D drawing

9. Other Facilities (4 hours)
- 9.1 Use of Script Files
- 9.2 Working with Standard Symbols
- 9.3 Import/Export

Practical:

1. Familiarization with Software Environment, Setting up Drawing
2. 2D Drawing Consisting Straight Lines, Circle and Arc
3. 2D Drawing Consisting Ellipse and Polygon
4. 2D Drawing Using Modifying Commands
5. Creating Isometric, Creating Hatch, Working with Layers and Blocks
6. Inserting Text and Dimensions of 2D Drawing
7. 3D Drawing: Wireframe , Surface and Solid Modeling
8. 3D Drawing: Solid Editing and 3D Operations
9. Plotting 2D and 3D Drawings. Using Script File, Design Center and Import/ Export Facilities
10. Project 1: Drawing of standard mechanical components: Spring, Nut Bolt, Gear, Cam Profile, etc.
11. Project 2: Detail Drawing
12. Project 3: Assembly Drawing

References:

1. "AutoCAD User's Guide", Autodesk, 2009.

Evaluation Scheme:
The questions will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below:

Unit	Chapter	Topics	Marks
1	1 & 3	all	**8**
2	2	all	**8**
3	4 & 5	all	**8**
4	6, 8 & 9	all	**8**
5	7	all	**8**
Total			**40**

PROBABILITY AND STATISTICS
SH 552

Lecture : 3 **Year : II**
Tutorial : 1 **Part : II**
Practical : 0

Course Objective:

To provide students practical knowledge of the principles and concept of probability and statistics and their application in engineering field.

1. Descriptive statistics and Basic probability (6 hours)
- 1.1. Introduction to statistics and its importance in engineering
- 1.2. Describing data with graphs (bar, pie, line diagram, box plot)
- 1.3. Describing data with numerical measure(Measuring center, Measuring variability)
- 1.4. Basic probability, additive Law, Multiplicative law, Baye's theorem.

2. Discrete Probability Distributions (6 hours)
- 2.1. Discrete random variable
- 2.2. Binomial Probability distribution
- 2.3. Negative Binomial distribution
- 2.4. Poison distribution
- 2.5. Hyper geometric distribution

3. Continuous Probability Distributions (6 hours)
- 3.1. Continuous random variable and probability densities
- 3.2. Normal distribution
- 3.3. Gama distribution
- 3.4. Chi square distribution

4. Sampling Distribution (5 hours)
- 4.1. Population and sample
- 4.2. Central limit theorem
- 4.3. Sampling distribution of sample mean
- 4.4. Sampling distribution of sampling proportion

5. Inference Concerning Mean (6 hours)
- 5.1. Point estimation and interval estimation
- 5.2. Test of Hypothesis
- 5.3. Hypothesis test concerning One mean
- 5.4. Hypothesis test concerning two mean
- 5.5. One way ANOVA

6. Inference concerning Proportion (6 hours)
- 6.1. Estimation of Proportions
- 6.2. Hypothesis concerning one proportion
- 6.3. Hypothesis concerning two proportion
- 6.4. Chi square test of Independence

7. Correlation and Regression (6 hours)
- 7.1. Correlation
- 7.2. Least square method
- 7.3. An analysis of variance of Linear Regression model
- 7.4. Inference concerning Least square method
- 7.5. Multiple correlation and regression

8. Application of computer on statistical data computing (4 hours)
- 8.1. Application of computer in computing statistical problem. eq scientific calculator, EXCEL, SPSS , Matlab etc

References:

1. Richard A. Johnson, "Probability and Statistics for Engineers", Miller and Freund's publication.
2. Jay L. Devore, "Probability and Statistics for Engineering and the Sciences" , Brooks/Cole publishing Company, Monterey, California.
3. Richard I. Levin, David S Rubin, " Statistics For Management", Prentice Hall publication.
4. Mendenhall Beaver Beaver, " Introduction Probability and statistics ", Thomson Brooks/Cole.

Evaluation scheme

The questions will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below:

Unit	Chapter	Topics	Marks
1	1	all	**16**
	2	2.1 to 2.2	
2	2	2.3 & 2.5	**16**
	3	all	
3	4 & 5	all	**16**
4	6	all	**16**
	7	7.1 and 7.5	
5	7	7.2 to 7.4	**16**
	8	all	
Total			**80**

ELECTRICAL MACHINES
EE 554

Lecture : 3 **Year : II**
Tutorial : 1 **Part : II**
Practical : 3/2

Course Objectives:
To impart knowledge on constructional details, operating principle and performance of Transformers, DC Machines, 1-phase and 3-phase Induction Machines, 3-phase Synchronous Machines and Fractional Kilowatt Motors

1. Magnetic Circuits and Induction (4hours)
- 1.1 Magnetic Circuits
- 1.2 Ohm's Law for Magnetic Circuits
- 1.3 Series and Parallel magnetic circuits
- 1.4 Core with air gap
- 1.5 B-H relationship (Magnetization Characteristics)
- 1.6 Hysteresis with DC and AC excitation
- 1.7 Hysteresis Loss and Eddy Current Loss
- 1.8 Faraday's Law of Electromagnetic Induction, Statically and Dynamically Induced EMF
- 1.9 Force on Current Carrying Conductor

2. Transformer (9 hours)
- 3.1 Constructional Details, recent trends
- 3.2 Working principle and EMF equation
- 3.3 Ideal Transformer
- 3.4 No load and load Operation
- 3.5 Operation of Transformer with load
- 3.6 Equivalent Circuits and Phasor Diagram
- 3.7 Tests: Polarity Test, Open Circuit test, Short Circuit test and Equivalent Circuit Parameters
- 3.8 Voltage Regulation
- 3.9 Losses in a transformer
- 3.10 Efficiency, condition for maximum efficiency and all day efficiency
- 3.11 Instrument Transformers: Potential Transformer (PT) and Current Transformer (CT)
- 3.12 Auto transformer: construction, working principle and Cu saving
- 3.13 Three phase Transformers

3. DC Generator (6 hours)
- 3.1 Constructional Details and Armature Winding
- 3.2 Working principle and Commutator Action
- 3.3 EMF equation
- 3.4 Method of excitation: separately and self excited, Types of DC Generator
- 3.5 Characteristics of series, shunt and compound generator
- 3.6 Losses in DC generators
- 3.7 Efficiency and Voltage Regulation

4. DC Motor (7 hours)
- 4.1 Working principle and Torque equation
- 4.2 Back EMF
- 4.3 Method of excitation, Types of DC motor
- 4.4 Performance Characteristics of D.C. motors
- 4.5 Starting of D.C. Motors: 3 point and 4 point starters
- 4,6 Speed control of D.C. motors: Field Control, Armature Control
- 4.7 Losses and Efficiency

5. Three Phase Induction Machines (6 hours)
- 5.1 Three Phase Induction Motor
  - 5.1.1 Constructional Details and Types
  - 5.1.2 Operating Principle, Rotating Magnetic Field, Synchronous Speed, Slip, Induced EMF, Rotor Current and its frequency, Torque Equation
  - 5.1.3 Torque-Slip characteristics
- 5.2 Three Phase Induction Generator
  - 5.2.1 Working Principle, voltage build up in an Induction Generator
  - 5.2.2 Power Stages

6. Three Phase Synchronous Machines (6 hours)
- 6.1 Three Phase Synchronous Generator
  - 6.1.1 Constructional Details, Armature Windings, Types of Rotor, Exciter
  - 6.1.2 Working Principle
  - 6.1.3 EMF equation, distribution factor, pitch factor
  - 6.1.4 Armature Reaction and its effects
  - 6.1.5 Alternator with load and its phasor diagram
- 6.2 Three Phase Synchronous Motor
  - 6.2.1 Principle of operation
  - 6.2.2 Starting methods
  - 6.2.3 No load and Load operation, Phasor Diagram
  - 6.2.4 Effect of Excitation and power factor control

7. Fractional Kilowatt Motors (7 hours)
- 3.14 Single phase Induction Motors: Construction and Characteristics
- 3.15 Double Field Revolving Theory
- 3.16 Split phase Induction Motor
  - 7.1.1 Capacitors start and run motor
  - 7.1.2 Reluctance start motor
- 3.17 Alternating Current Series motor and Universal motor
- 3.18 Special Purpose Machines: Stepper motor, Schrage motor and Servo motor

Practical:

1. **Magnetic Circuits**
   - To draw B-H curve for two different sample of Iron Core
   - Compare their relative permeability
2. **Two Winding Transformers**
   - To perform turn ratio test
   - To perform open circuit (OC) and short circuit (SC) test to determine equivalent circuit parameter of a transformer and hence to determine the regulation and efficiency at full load
3. **DC Generator**
   - To draw open circuit characteristic (OCC) of a DC shunt generator
   - To draw load characteristic of shunt generator
4. **DC Motor**
   - Speed control of DC Shunt motor by (a) armature control method (b) field control method
   - To observe the effect of increasing load on DC shunt motor's speed, armature current, and field current.
5. **3-phase Machines**
   - To draw torque-speed characteristics and to observe the effect of rotor resistance on torque-speed characteristics of a 3-phase Induction Motor
   - To study load characteristics of synchronous generator with (a) resistive load (b) inductive load and (c) capacitive load
6. **Fractional Kilowatt Motors**
   - To study the effect of a capacitor on the starting and running of a single-phase induction motor
   - Reversing the direction of rotation of a single phase capacitor induct

References:

1 I.J. Nagrath&D.P.Kothari,"Electrical Machines", Tata McGraw Hill
2 S. K. Bhattacharya, "Electrical Machines", Tata McGraw Hill
3 B. L. Theraja and A. K. Theraja, "Electrical Technology (Vol-II)", S. Chand
4 Husain Ashfaq ," Electrical Machines", DhanpatRai& Sons
5 A.E. Fitzgerald, C.KingsleyJr and Stephen D. Umans,"Electric Machinery", Tata McGraw Hill
6 B.R. Gupta &VandanaSinghal, "Fundamentals of Electrical Machines, New Age International
7 P. S. Bhimbra, "Electrical Machines"' Khanna Publishers
8 Irving L.Kosow, "Electric Machine and Tranformers", Prentice Hall of India.
9 M.G. Say, "The Performance and Design of AC machines", Pit man & Sons.
10 Bhag S. Guru and Huseyin R. Hizirogulu, "Electric Machinery and Transformers" Oxford University Press, 2001.

Evaluation Scheme

The questions will cover all the chapters of syllabus. The evaluation scheme will be as indicated in the table below:

Unit	Chapter	Topics	Marks
1	1 & 3	all	**16**
2	2	all	**16**
3	4	all	**16**
4	5 & 6	all	**16**
5	7	all	**16**
Total			**80**

MANUFACTURING AND PRODUCTION PROCESSES
ME 551

Lecture : 3 **Year : II**
Tutorial : 0 **Part : II**
Practical : 4

Course Objectives:

To impart knowledge and skills in the field of manufacturing and production processes. To make students familiar with different metal forming processes along with advanced manufacturing techniques used in modern industries.

1. Overview of Manufacturing (2 hours)
- 1.1. Introduction
- 1.2. Product Cycle
- 1.3. Material Flow and Processing
- 1.4. Information Flow
- 1.5. Evolution of Organization for Manufacture

2. Manufacturing Properties of Materials (3 hours)
- 2.1. Mechanical Properties of Solids
- 2.2. Deformation of Solids
- 2.3. Thermo Fluid Properties of Liquids
- 2.4. Tribology in Manufacturing

3. Properties of Manufactured Products (3 hours)
- 3.1. Geometrical Description and Tolerances
- 3.2. Dimensioning and Tolerances Control
- 3.3. Surface Configurations
- 3.4. Residual Stresses

4. Solidification Process and Powder Metallurgy (6 hours)
- 4.1. General Characteristics of Casting Process and Products
- 4.2. Solidification Phenomena and Associated problems
- 4.3. Sand Casting: Process Characteristics and Capabilities Pattern design
- 4.4. Investment Casting: Characteristics and Capabilities; Pattern Design and Manufacturing
- 4.5. Permanent Mould and Pressure Die Casting: Process characteristics and capabilities Part design
- 4.6. Continuous Casting Characteristics and Capabilities
- 4.7. Introduction to Powder Metallurgy

5. Bulk Deformation Process (6 hours)
- 5.1. General Characteristics of Bulk Deformation Process and Products
- 5.2. Force, Energy and Deformation: Sensitivity to frictions, geometry, temperature and deformation rate
- 5.3. Forging practice and Technology; Press and hammers, tooling design, manufacture wear
- 5.4. Design of Forgings; Characteristics and defects in forgings
- 5.5. Flat Rolling; Characteristics and defect in forgings
- 5.6. Shape Rolling: Process and Products
- 5.7. Extrusion
- 5.8. Wires, Bar and Tube Drawing

6. Sheet Metal Product Manufacturing Process (4 hours)
- 6.1. Shearing and Punching Operations
- 6.2. Sheet Metal and Tube Bending: Technology and Practices
- 6.3. Deep Drawing and Hydro forming
- 6.4. Spinning Operations and Capabilities
- 6.5. Formability Assessment

7. Material Removal Processes: " Chip-forming" (6 hours)
- 7.1. Modeling the cutting process
- 7.2. Force, Power and Productivity Relationship
- 7.3. Cutting tools Materials: Characteristics and Economics
- 7.4. General Purpose Machine Tool Types
  - 2.1.1 Operation of Lathes, Milling, Shapers and Drilling Machines
  - 2.1.2 Application of Shaping, Planning and Slotting Machines
- 7.5. Methods of mounting of jobs and cutting tools in machine tools
- 7.6. Uses of various attachments in machine tools
- 7.7. Control of Machine Tools and Product Properties
- 7.8. Cutting off Process: Saws, flame cutting, arc cutting

8. Material Removal Processes: "Abrasive and Non-Traditional" (3 hours)
- 8.1. Abrasive Based Tooling
- 8.2. Grinding Technology and Practice
- 8.3. Electrical discharge machining
- 8.4. Electrochemical machining

9. Numerical Control of Machine Tools (3 hours)
- 9.1. Need for Flexible Automation and Numerical controls
- 9.2. CNC Machine tool description; technology and practices
- 9.3. Introduction to CNC Machine Par Programming
- 9.4. Justification of CNC process
- 9.5. Industrial Robots

10. Jigs and Fixtures for Machine Shops (2 hours)
- 10.1. Purpose of jigs and fixtures
- 10.2. Design and application of typical jigs and fixtures

11. Screw Threads and Gear manufacturing Methods (3 hours)

11.1. Production of Screw Threads by Machining, Rolling and Grinding
11.2. Manufacturing of Gears

12. Material Joining Processes (4 hours)

12.1. Principle of Material Joining Process, Types
12.2. Mechanical vs. welded/brazed Connections
12.3. Introduction to the Metallurgy of welding
12.4. Characterization of Energy Sources
12.5. Arc-welding Processes
12.6. Combustion Torch Processes
12.7. Resistance welding processes
12.8. Design Considerations and Defects Analysis

Practical:

1. Workshop Practical should include the following processes:
2. Solidification and Bulk Deformation Processes
3. Sheet Metal Working
4. Engine Lathe Operations
5. Shaper Operations
6. Milling Machine Operations
7. Drilling Machine Operation
8. Grinding Machine Operation
9. Arc Welding
10. Gas Welding

References:

1. Serope Kalpakjian and Steven R. Schmid, "Manufacturing Engineering and Technology", Addison Wesley Longman (Singapore) P. Ltd.
2. Serope Kalpakjian and Steven R. Schmid, "Manufacturing Processes for Engineering Materials", Pearson Education, Fourth Edition.
3. J. A. Schey, "Introduction to Manufacturing Processes", McGraw Hill.
4. L. E. Doyleetal, "Manufacturing Processes and Materials for Engineers", Prentice Hall.
5. M. C. Shaw, "Metal Cutting Principles", Oxford University Press.
6. B.S. Nagendra Parashar and R. K. Mittal, "Elements of Manufacturing Processes", Prentice Hall of India Pvt Ltd, New Delhi.

Evaluation Scheme:

The questions will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below:

Unit	Chapter	Topics	Marks
1	1, 2 & 3	all	**16**
2	4 & 8	all	**16**
3	5 & 9	all	**16**
4	6, 10 &12	all	**16**
5	7 & 11	all	**16**
Total			**80**

STRENGTH OF MATERIALS
ME 552

Lecture : 3 **Year : II**
Tutorials : 1 **Part : II**
Practical : 3/2

Course Objective:

To analyze and solve problems related to different types of stress and strain and to design basic components of structure and machines on the basis of stiffness, strength and stability.

1. Introduction (2 hours)
- 1.1 Types of Stresses and strains
- 1.2 Normal stress, shear stress, bearing stress
- 1.3 Normal strain, shear strain
- 1.4 Ultimate stress, allowable stress, factor of safety

2. Stress and strain – axial loading (6 hours)
- 2.1 Stress – strain diagram
- 2.2 Hooke's law, modulus of elasticity
- 2.3 Deformation under axial load
- 2.4 Temperature effects
- 2.5 Poisson's Ratio
- 2.6 Multi-axial loading, Generalized Hooke's Law
- 2.7 Bulk Modulus
- 2.8 Shearing Strain
- 2.9 Relationship among modulus of elasticity, shear stress and Poisson's ratio
- 2.10 Stress Concentration and Plastic Deformation
- 2.11 Statically Indeterminate problems

3. Pure Bending (5 hours)
- 3.1 Introduction of pure or simple bending
- 3.2 Deformation of a symmetric member in pure bending in elastic range. (Relationship between transverse loads, bending moment and bending stresses, position of neutral axis and neutral layer)
- 3.3 Beams with composite section.
- 3.4 Stress concentration, plastic deformation
- 3.5 Eccentric axial loading
- 3.6 Unsymmetrical loading.

4. Torsion (5 hours)
- 4.1 Introduction Torque, Shaft, Torsion
- 4.2 Stress and deformation in a uniform shaft in elastic range
- 4.3 Torsion moment diagram.
- 4.4 Torsion formula for circular cross-section
- 4.5 Statically Indeterminate Shaft
- 4.6 Design of Transmission of shaft (by strength and stiffness)
- 4.7 Comparison between hollow and solid shaft.
- 4.8 Shafts in series and parallel
- 4.9 Composite shafts
- 4.10 Stress concentrations in circular shafts.

5. Transverse loading (3 hours)
- 5.1 Basic assumptions and distribution of normal stress.
- 5.2 Relationship between shear stress and shear force in a beam.
- 5.3 Distribution of Shear stress in common beam sections.

6. Transformation of stress and strain (6 hours)
- 6.1 Uniaxial stress system, biaxial stress system, pure shear stress system.
- 6.2 General plane stress system, principal stresses, maximum shearing stress, principal planes
- 6.3 Graphical method: Mohr's circle for plane stress
- 6.4 Application to three- dimensional state of stress
- 6.5 Yield criteria for ductile and brittle material.

7. Deflection of Beams by Integration Method (6 hours)
- 7.1 General deflection equation for beams.
- 7.2 Deflection equation for beams with different end conditions.
- 7.3 Method for superposition.
- 7.4 Deflection in statically indeterminate beams.
- 7.5 Direct determination of the elastic curve from the load-distribution.

8. Deflection of Beams by Moment- area Method (4 hours)
- 8.1 Moment- Area Theorems.
- 8.2 Application to symmetrical structure and symmetrical loading, unsymmetrical structure and symmetrical loading, symmetrical structure and unsymmetrical loading.
- 8.3 Maximum deflection in beams.

9. Design of Beams and shafts (5 hours)
- 9.1 Basic Consideration for the design of prismatic beams (for ductile, brittle material and for short and long beam)
- 9.2 Principal stresses in beams
- 9.3 Design of prismatic beams

10. Columns (3 hours)
(3 hours)
- 10.1 Introduction: Strut, column, buckling load
- 10.2 Euler's formula for different end conditions.
- 10.3 Design of columns under central and eccentric loading.

Practical:

1. Material Properties in simple bending and compression test.
2. Torsion test: Behavior of ductile and brittle materials in torsion, shear modulus
3. Stresses and strains in thin wall cylinders
4. Column behavior and buckling: effect of end conditions on buckling load of beams.
5. Beam reactions: Relationship between deflection and transverse load, end conditions, Young's modulus of elasticity, moment of inertia

References:

1. F.P. Beer and E. R. Johnson, " Mechanics of Materials", McGraw Hill,
2. R.K. Rajput, " Strength of Materials", S. Chand & Co. Ltd.,
3. E. P. Popov, "Engineering Mechanics of Solids", Prentice Hall Inc., Englewood Cliffs, N. J.

Evaluation Scheme:

The questions will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below:

Unit	Chapter	Topics	Marks
1	1 & 2	all	**16**
2	3 & 4	all	**16**
3	5 & 6	all	**16**
4	7 & 8	all	**16**
5	9 & 10	all	**16**
Total			**80**

INSTRUMENTATION AND MEASUREMENT
ME 553

Lecture : 3 **Year : II**
Tutorial : 1 **Part : II**
Practical : 1.5

Course Objective:

To make students familiar with mechanical measurement system. To model and analyze the response of different sensors and systems.

1. Fundamentals of Measurement (3 hours)
- 1.1 Fundamental Methods of Measurements
- 1.2 The Generalized Measurement System
- 1.3 Calibration Concepts
- 1.4 Measurement Errors

2. Time Dependent Properties of Signal (3 hours)
- 2.1 Types of Measurement Signals
- 2.2 Harmonic Signals
- 2.3 Periodic Signals and Fourier Series Representation
- 2.4 Determination of Fourier Coefficients: Analytical, Numerical and FFT Methods

3. Static Characteristics of Measurement System (4 hours)
- 3.1 Introduction
- 3.2 Accuracy and Precision, Tolerance, Range or Span, Linearity, Sensitivity of measurement, Threshold, Resolution, Sensitivity to disturbance, Hysteresis effects, Dead space

4. Dynamic Response of Measurement System (10 hours)
- 4.1 Introduction: Amplitude Response, Frequency and Phase Response, Rise Time and Delay
- 4.2 Mathematical Modeling of Measurement Systems: Zero order, First Order and Second Order System
- 4.3 Characteristics and Response of Zero Order System
- 4.4 Characteristics and Response of First Order System: Time Constant; Step, Ramp and Harmonic Response
- 4.5 Characteristics and Response of Second Order System: Natural Frequency and Damping Ratio; Step, Ramp and Harmonic Response
- 4.6 Physical Examples of Zero Order, First Order and Second Order Systems

5. Sensors (8 hours)
- 5.1 Classification of Transducers
- 5.2 Force Deflection Transducers
- 5.3 Variable Resistance and sliding Contact Devices
- 5.4 Resistance Gages
- 5.5 Thermistors and Thermocouples
- 5.6 Variable Inductance Transducers; Differential transformers
- 5.7 Variable Reluctance Transducers
- 5.8 Variable Capacitive Transducers
- 5.9 Piezoelectric Transducers
- 5.10 Photoelectric Transducers

6. Strain Gage (8 hours)
- 6.1 Introduction to Strain Measurement
- 6.2 Electrical Type Strain Gages: Unbonded and Bonded
- 6.3 Metallic Resistance Strain Gage: Characteristics, Selection and Installation
- 6.4 Strain Gage Ballast and Bridge Circuit
- 6.5 Constant Current and Constant Voltage Strain Gage Circuit
- 6.6 Semiconductor and Piezoresistive Gages
- 6.7 Orientation of Gages in a Bridge: Temperature Compensation and Sensitivity to Shear Stress

7. Common Mechanical Measurement System and Transducers (9 hours)
- 7.1 Force, Moment and Torque Measurement: Elastic transducers, Strain Gage Load Cells, Piezoelectric Load Cells, Hydraulic and Pneumatic Systems, Dynamometers, Combined Force and Moment Measurements
- 7.2 Pressure Measurement: Static and Dynamic Pressure Measurement Systems, Pressure Transducers Types, Measurement of Low Pressure, Measurement of High Pressure, Acoustical Measurement
- 7.3 Measurement of Fluid Flow: Obstruction Meters for Incompressible and Compressible Fluids, Variable Area Flow Meter, Measurement of Fluid velocities, Pressure Probes
- 7.4 Temperature Measurement: Use of Bimaterials, Pressure Thermometer, Thermoelectric Thermometry, Thermoresistive Elements, Thermocouples and Circuitry, Linear Quartz Thermometer, Pyrometry

Practical:

1. Fourier Analysis of Signals
2. Response of Zero Order, First Order and Second Order Systems
3. Variable Inductance and Variable Capacitive Transducers
4. Strain Gage
5. Experiment on Force, Torque, and Pressure Measurement
6. Experiment on Fluid Flow and Temperature Measurement

References:

1. E. O. Doeblien , " Measurement Systems: Application and Design", Mc Graw Hill.
2. T. G. Beck, N. L. Buck and R. D. Marangoni, "Mechanical Measurements", Addison Wesley.

3. A. S. Morris, “Measurement and Instrumentation Principles”, Butterworth-Heinemann

Evaluation Scheme:

The questions will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below:

Unit	Chapter	Topics	Marks
1	1, 2 & 3	all	**16**
2	4	all	**16**
3	5	all	**16**
4	6	all	**16**
5	7	all	**16**
Total			**80**

FLUID MECHANICS
ME 554

Lecture : 3 **Year : II**
Tutorial : 1 **Part : II**
Practical : 3/2

Course Objective:

To provide basic concept of fluid mechanics and its application for solving basic engineering problems.

1. Definition and Analysis method (2 hours)
- 1.1 Definition and Properties of a Fluid
- 1.2 Analysis Method
  - 1.2.1 System and Control Volume,
  - 1.2.2 Differential vs Integral Approach,
  - 1.2.3 Description – Lagrangian and Eulerian

2. Fluid Statics (3 hours)
- 2.1 Pressure Intensity at a Point
- 2.2 Pressure Variations in a Fluid
- 2.3 Unite of Pressure
- 2.4 Absolute and Gage Pressure
- 2.5 Manometers
- 2.6 Forces on Plane and Curve Surface
- 2.7 Buoyancy and Stability

3. Kinematics of Fluid Flow (5 hours)
- 3.1 Description of Fluid Flow: 1D, 2D and 3D Flow
- 3.2 Circulation and Vorticity
- 3.3 Rotational and Irrotational Flow
- 3.4 Equation of Stream Line
- 3.5 Velocity Potential
- 3.6 Stream Function
- 3.7 Acceleration of a Fluid Particle

4. Basic Equations for Fluid Flow (8 hours)
- 4.1 Continuity Equations
  - 4.1.1 Rectangular and Cylindrical Coordinate Systems
- 4.2 Momentum Equation and Applications
  - 4.2.1 Elbow reactions, jet propulsions
  - 4.2.2 Fixed and moving vanes, hydraulic jump
- 4.3 Navier-Stokes Equation: Newtonian Fluid
- 4.4 Bernoulli's Equation and Applications, Flow from a tank, Venturi Flow, Syphon Flow

5. Dimensional Analysis and Dynamic Similitude (3 hours)
- 5.1 Units and Dimensions
- 5.2 Nondimensionalizing basic Differential Equation and Dimensionless Numbers
- 5.3 Formation of Dimensionless Equations by Buckingham's Method
- 5.4 Dynamic Similitude Model Studies
- 5.5 Incomplete Similarities

6. Viscous Effects (10 hours)
- 6.1 One Dimensional Laminar Flow; Relationship between shear stress and velocity gradient
- 6.2 Laminar Flow Between Parallel Plates
- 6.3 Laminar Flow in Circular Tubes; Reynolds number, velocity profile
- 6.4 Laminar and Turbulent Boundary Layer Flow; Flow over flat plates, drag on immersed bodies
- 6.5 Frictional Resistance to Flow in Pipes; Darcey-Weisbach equation, friction factor Use of Moody diagram, head loss in pipe flow
- 6.6 Head Losses; In bends, joint expansions, valves Loss coefficients

7. Flow Measurement (6 hours)
- 7.1 Measurement of Static Pressure Intensity
- 7.2 Measurement of Velocity; Pitot tube, Pitot-static tube
- 7.3 Restriction Flow Meters: Orifice Plate, Flow nozzles, Venturi, Laminar Flow Elements
- 7.4 Linear Flow meters
- 7.5 Weir and Notches
- 7.6 Flow visualization

8. Flow Measurement (5 hours)
- 8.1 Hydraulic and Energy Grade Lines Systems including reservoirs, pumps and turbines
- 8.2 Pipe Flow Networks Series and parallel combinations

9. Introduction to Compressible Flow (3 hours)

Practical:

1 Properties of Fluid and Hydrostatics
- i) Measurement of Fluid viscosity and density
- ii) Buoyancy forces, Center of pressure, stability of floating objects

2 Demonstration of the Energy and Momentum Equations
- i) Pressure distribution for flow through a Venturi
- ii) Force developed by a steady impinging jet flow

3 Fluid flow in Piping
- i) Laminar and turbulent flow, friction losses in liquid flow
- ii) Velocity distribution in air duct

4 Calibration of Flow; Orifice, Venturi, Weir

5 Drag on immersed bodies, measurement of lift and drag force on objects of different shapes

6 The Hydraulic Jumps, relating measured jump parameters to Froude number, momentum, continuity and energy equations.

References:

1. Fox, R. W, McDonald, A. T., Pritchard, P. J., “Introduction to Fluid Mechanics”, John Wiley.
2. Douglas, J. F, Gasiorek, J. M., Swaffield, J. A., “Fluid Mechanics”, Pearson Education.
3. Frank M. White, “Fluid Mechanics”, McGraw-Hill
4. Kumar, D. S., “Fluid Mechanics”, S. K. Katarai and Sons

Evaluation Scheme:

The questions will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below:

Unit	Chapter	Topics	Marks
1	1, 2 & 3	all	**16**
2	4	all	**16**
3	5 & 8	all	**16**
4	6	all	**16**
5	7 & 9	all	**16**
Total			**80**

NUMERICAL METHODS
SH603

Lecture : 3 **Year : III**
Tutorial : 1 **Part : I**
Practical : 3

Course objective:
To introduce numerical methods used for the solution of engineering problems. The course emphasizes algorithm development and programming and application to realistic engineering problems.

1. Introduction, Approximation and errors of computation (4hours)
- 1.1. Introduction, Importance of Numerical Methods
- 1.2. Approximation and Errors in computation
- 1.3. Taylor's series
- 1.4. Newton's Finite differences (forward , Backward, central difference, divided difference)
- 1.5. Difference operators, shift operators, differential operators
- 1.6. Uses and Importance of Computer programming in Numerical Methods.

2. Solutions of Nonlinear Equations (5 hours)
- 2.1. Bisection Method
- 2.2. Newton Raphson method (two equation solution)
- 2.3. Regula-Falsi Method , Secant method
- 2.4. Fixed point iteration method
- 2.5. Rate of convergence and comparisons of these Methods

3. Solution of system of linear algebraic equations (8 hours)
- 3.1. Gauss elimination method with pivoting strategies
- 3.2. Gauss-Jordan method
- 3.3. LU Factorization
- 3.4. Iterative methods (Jacobi method, Gauss-Seidel method)
- 3.5. Eigen value and Eigen vector using Power method

4. Interpolation (8 hours)
- 4.1. Newton's Interpolation (forward, backward)
- 4.2. Central difference interpolation: Stirling's Formula, Bessel's Formula
- 4.3. Lagrange interpolation
- 4.4. Least square method of fitting linear and nonlinear curve for discrete data and continuous function
- 4.5. Spline Interpolation (Cubic Spline)

5. Numerical Differentiation and Integration (6 hours)
- 5.1. Numerical Differentiation formulae
- 5.2. Maxima and minima
- 5.3. Newton-Cote general quadrature formula
- 5.4. Trapezoidal, Simpson's 1/3, 3/8 rule
- 5.5. Romberg integration
- 5.6. Gaussian integration (Gaussian – Legendre Formula 2 point and 3 point)

6. Solution of ordinary differential equations (6 hours)
- 6.1. Euler's and modified Euler's method
- 6.2. Runge Kutta methods for 1st and 2nd order ordinary differential equations
- 6.3. Solution of boundary value problem by finite difference method and shooting method.

7. Numerical solution of Partial differential Equation (8 hours)
- 7.1. Classification of partial differential equation(Elliptic, parabolic, and Hyperbolic)
- 7.2. Solution of Laplace equation (standard five point formula with iterative method)
- 7.3. Solution of Poisson equation (finite difference approximation)
- 7.4. Solution of Elliptic equation by Relaxation Method
- 7.5. Solution of one dimensional Heat equation by Schmidt method

Practical:
Algorithm and program development in C programming language of following:
1. Generate difference table.
2. At least two from Bisection method, Newton Raphson method, Secant method
3. At least one from Gauss elimination method or Gauss Jordan method. Finding largest Eigen value and corresponding vector by Power method.
4. Lagrange interpolation. Curve fitting by Least square method.
5. Differentiation by Newton's finite difference method. Integration using Simpson's 3/8 rule
6. Solution of 1^{st} order differential equation using RK-4 method
7. Partial differential equation (Laplace equation)
8. Numerical solutions using Matlab.

References:

1. Dr. B.S.Grewal, "Numerical Methods in Engineering and Science ", Khanna Publication.
2. Robert J schilling, Sandra l harries , " Applied Numerical Methods for Engineers using MATLAB and C.", Thomson Brooks/cole.
3. Richard L. Burden, J.Douglas Faires, "Numerical Analysis", Thomson / Brooks/cole
4. John. H. Mathews, Kurtis Fink ,"Numerical Methods Using MATLAB" ,Prentice Hall publication
5. JAAN KIUSALAAS , "Numerical Methods in Engineering with MATLAB" , Cambridge Publication

Evaluation scheme:

The questions will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below

Unit	Chapter	Topics	Marks
1	1 & 2	all	**16**
2	3	all	**16**
3	4	all	**16**
4	5	all	**16**
	6	6.1, 6.2	
5	6	6.3	**16**
	7	all	
Total			**80**

CONTROL SYSTEM
EE602

Theory : 3 **Year : III**
Tutorial : 1 **Part : I**
Practical : 3/2

Course Objectives:
To present the basic concepts on analysis and design of control system and to apply these concepts to typical physical processes.

1. Control System Background (2 hours)
- 1.1 History of control system and its importance
- 1.2 Control system: Characteristics and Basic features
- 1.3 Types of control system and their comparison

2. Component Modeling (6 hours)
- 2.1 Differential equation and transfer function notations
- 2.2 Modeling of Mechanical Components: Mass, spring and damper
- 2.3 Modeling of Electrical components: Inductance, Capacitance, Resistance, DC and AC motor, Transducers and operational amplifiers
- 2.4 Electric circuit analogies (force-voltage analogy and force- current analogy)
- 2.5 Linearized approximations of non-linear characteristics

3. System Transfer Function and Responses (6 hours)
- 3.1 Combinations of components to physical systems
- 3.2 Block diagram algebra and system reduction
- 3.3 Signal flow graphs
- 3.4 Time response analysis:
  - 3.4.1 Types of test signals (Impulse, step, ramp, parabolic)
  - 3.4.2 Time response analysis of first order system
  - 3.4.3 Time response analysis of second order system
  - 3.4.4 Transient response characteristics
- 3.5 Effect of feedback on steady state gain, bandwidth, error magnitude and system dynamics

4. Stability (4 hours)
- 4.1 Introduction of stability and causes of instability
- 4.2 Characteristic equation, root location and stability
- 4.3 Setting loop gain using Routh-Hurwitz criterion
- 4.4 R-H stability criterion
- 4.5 Relative stability from complex plane axis shifting

5. Root Locus Technique (7 hours)
- 5.1 Introduction of root locus
- 5.2 Relationship between root loci and time response of systems
- 5.3 Rules for manual calculation and construction of root locus
- 5.4 Analysis and design using root locus concept
- 5.5 Stability analysis using R-H criteria

6. Frequency Response Techniques (6 hours)
- 6.1 Frequency domain characterization of the system
- 6.2 Relationship between real and complex frequency response
- 6.3 Bode Plots: Magnitude and phase
- 6.4 Effects of gain and time constant on Bode diagram
- 6.5 Stability from Bode diagram (gain margin and phase margin)
- 6.6 Polar Plot and Nyquist Plot
- 6.7 Stability analysis from Polar and Nyquist plot

7. Performance Specifications and Compensation Design (10 hours)
- 7.1 Time domain specification
  - 7.1.1 Rise time, Peak time, Delay time, settling time and maximum overshoot
  - 7.1.2 Static error co-efficient
- 7.2 Frequency domain specification
  - 7.2.1 Gain margin and phase margin
- 7.3 Application of Root locus and frequency response on control system design
- 7.4 Lead, Lag cascade compensation design by Root locus method.
- 7.5 Lead, Lag cascade compensation design by Bode plot method.
- 7.6 PID controllers

8. State Space Analysis (4 hours)
- 8.1 Definition of state -space
- 8.2 State space representation of electrical and mechanical system
- 8.3 Conversion from state space to a transfer function.
- 8.4 Conversion from transfer function to state space.
- 8.5 State-transition matrix.

Practical:

1. To study open loop and closed mode for d.c motor and familiarization with different components in D.C motor control module.
2. To determine gain and transfer function of different control system components.
3. To study effects of feedback on gain and time constant for closed loop speed control system and position control system.
4. To determine frequency response of first order and second order system and to get transfer function.
5. Simulation of closed loop speed control system and position control system and verification

References:

1. Ogata, K., "Modern Control Engineering", Prentice Hall, Latest Edition
2. Gopal. M., "Control Systems: Principles and Design", Tata McGraw-Hill, Latest Edition.
3. Kuo, B.C., "Automatic Control System", Prentice Hall, sixth edition.
4. Nagrath & Gopal, "Modern Control Engineering", New Ages International, Latest Edition

Evaluation scheme:

The question will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below:

Unit	Chapter	Topics	Marks
1	1, 2	all	**16**
2	3, 4	all	**16**
3	5	all	**16**
4	6, 8	all	**16**
5	7	all	**16**
Total			**80**

ORGANIZATION AND MANAGEMENT
ME601

Lecture : 3 **Year : III**
Tutorial : 2 **Part : I**
Practical : 0

Course Objective:
To give knowledge about organizational management and internal organization of companies required for managing an enterprise. Also to make familiar with personnel management, case study, management information system motivation and leadership for developing managerial skills.

1. Introduction

1.1 Organization (2 hours)
- 1.1.1 System approach applied to Organization
- 1.1.2 Necessity of Organization
- 1.1.3 Principles of Organization
- 1.1.4 Formal and Informal Organizations

1.2 Management (4 hours)
- 1.2.1 Functions of Management
- 1.2.2 Levels of Management
- 1.2.3 Managerial Skills
- 1.2.4 Importance of Management
- 1.2.5 Models of Management

1.3 Theory of Management (6 hours)
- 1.3.1 Scientific Management Approach
- 1.3.2 Administrative Management Approach
- 1.3.3 Behavioral Management Approach
- 1.3.4 Modern Management Theories

1.4 Forms of Ownership (2 hours)
- 1.4.1 Single Ownership – Advantages and limitations
- 1.4.2 Partnership – Types of Partners – Advantages and limitations
- 1.4.3 Joint Stock Company – Formation of Joint Stock Company – Advantages and limitations
- 1.4.4 Co – operative Societies – Types of Co – operatives – Advantages and limitations
- 1.4.5 Public Corporations – Advantages and limitations

1.5 Organizational Structure (2 hours)
- 1.5.1 Line Organization – Advantages and dis – advantages
- 1.5.2 Functional Organization – Advantages and dis – advantages
- 1.5.3 Line and Staff Organization – Advantages and disadvantages
- 1.5.4 Committee Organization – Advantages and disadvantages

1.6 Purchasing and Marketing Management (4 hours)
- 1.6.1 Purchasing – Introduction
- 1.6.2 Functions of Purchasing Department
- 1.6.3 Methods of Purchasing
- 1.6.4 Marketing – Introduction
- 1.6.5 Functions of Marketing
- 1.6.6 Advertising

2. Personnel Management (8 hours)
- 2.1 Introduction
- 2.2 Functions of Personnel Management
- 2.3 Development of Personnel Policy
- 2.4 Manpower Planning
- 2.5 Recruitment and Selection of manpower – Scientific selection
- 2.6 Training and Development of manpower
- 2.7 Job Analysis, Job Evaluation and Merit Rating
- 2.8 Wages and Incentives

3. Motivation, Leadership and Entrepreneurship (6 hours)

3.1 Motivation
- 3.1.1 Human needs
- 3.1.2 Motivation – Introduction
- 3.1.3 Types of Motivation
- 3.1.4 Attitude Motivation; Group Motivation; Executive Motivation
- 3.1.5 Techniques of Motivation
- 3.1.6 Motivation Theories
- 3.1.7 Maslow's Hierarchy of needs
  - 3.1.7.1 McGregor's Theory X - Y
  - 3.1.7.2 Fear and Punishment Theory
  - 3.1.7.3 Alderfer's ERG Theory
  - 3.1.7.4 MacClelland's Theory of learned needs
  - 3.1.7.5 Herzberg's Hygiene Maintenance Theory
  - 3.1.7.6 Vroom's Expectancy/ Valency Theory

3.2 Leadership - Introduction (2hours)
- 3.1.1 Qualities of a good Leader
- 3.1.2 Leadership Style
- 3.1.3 Blakes and Mouton's Managerial Grid
- 3.1.4 Leadership Approach
- 3.1.5 Leadership Theories

3.3 Entrepreneurship – Introduction (2 hours)
- 3.1.6 Entrepreneurship Development
- 3.1.7 Entrepreneurial Characteristics
- 3.1.8 Need for Promotion of Entrepreneurship
- 3.1.9 Steps for establishing small scale unit

4. Case Studies **(2 hours)**

4.1 Introduction
4.2 Objectives of case study
4.3 Phases of case study
4.4 Steps of case study
4.5 Types of case studies

5. Management Information System **(5 hours)**

5.1 Data and Information
5.2 Need, function and Importance of MIS
5.3 Evolution of MIS
5.4 Organizational Structure and MIS
5.5 Computers and MIS
5.6 Classification of Information Systems
5.7 Information Support for functional areas of management
5.8 Organizing Information Systems

Note: Students have to submit a case study report after visiting an industrial organization.

Reference:

1. H. B. Maynard, "Industrial Engineering Handbook" , Editor – in – Chief, McGraw Hill.
2. E. S. Buffa and R. K. Sarin "Modern Production / Operations Management", 8th Edition, Wiley.
3. H. J. Arnold and D. C. Feldman "Organizational Behavior" , McGraw – Hill.
4. J. A. Senn, "Information Systems in Management " , Wadsworth Inc.
5. P. Hershey and K. H. Blanchard, "Management of Organizational Behavior – Utilizing Human Resources ", Prentice – Hall Inc.
6. M. Mahajan, "Industrial Engineering and production Management" ,Dhanpat Rai and Co. (P) Ltd. , Delhi.
7. S. Sadagopan, "Management Information System", Prentice Hall of India Pvt Ltd.
8. C. B. Mamoria "Personnel Management", Himalaya Publishing House..
9. O. P. Khanna, "Industrial Engineering and Management", Dhanpat Rai Publications (P) Ltd.
10. S. K. Joshi, "Organization and Management", IOE, Pulchowk Campus.

Evaluation Scheme:

The questions will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below:

Unit	Chapter	Topics	Marks
1	1	1.2 & 1.3	**16**
2	1	1.1, 1.4 & 1.5	**16**
3	2	all	**16**
4	3	all	**16**
5	4 & 5	all	**16**
Total			**80**

MECHANICS OF SOLIDS
ME602

Lecture : 3 **Year : III**
Tutorial : 1 **Part : I**
Practical : 3/2

Course Objectives:
To provide fundamental knowledge and skills to solid mechanics. After completion of this course the students will be able to know in depth knowledge of general stress and strain.

Course outline:

1. Load on Structure and Response of Material (1 hour)
- 1.1. General Load on Structure and its Effects
- 1.2. Elastic and Non-elastic Response of Solids
- 1.3. Isotropy, Anisotropy, Continuity and Homogeneity
- 1.4. Effect of temperature on Elastic and Plastic range of Solids

2. Stress Tensor (6 hours)
- 2.1. Definition
- 2.2. Stress at a point
- 2.3. Stresses on Structure due to General Load
- 2.4. Stress Notation and Sign Convention
- 2.5. Stresses Acting on Arbitrary Planes
- 2.6. Transformation of Stress and Principal Stress
- 2.7. Stress on Deformable Body
  - 2.7.1. Differential Equation in Rectangular Co-ordinate System
  - 2.7.2. Differential Equation in Polar Co-ordinate System
  - 2.7.3. Application of Differential Equation and Its Solution
- 2.8. Relevant Problems

3. Deformable Body and Strain Tensor (4 hours)
- 3.1. Definition
- 3.2. Strain at a point
- 3.3. Strain on Structure due to General Load
- 3.4. Strain Notation and Sign Convention
- 3.5. Strain Acting on Arbitrary Planes
- 3.6. Transformation of Strain and Principal Strain
- 3.7. Small Displacement Theory
- 3.8. Volumetric Strain
- 3.9. Relevant Problems

4. General Hooke's Law (2 hours)
- 4.1. Definition
- 4.2. Internal Energy Density
  - 4.2.1. Strain Energy
  - 4.2.2. Complementary Strain Energy
- 4.3. Anisotropic and Isotropic Elasticity
- 4.4. Equations of Thermo-elasticity for Isotropic Materials

5. Deflections and Slope of Statically Determinate and Indeterminate Structures (6 hours)
- 5.1. Definition
- 5.2. Application in Engineering Field
- 5.3. Energy Method
- 5.4. Unit Force Method
- 5.5. Castigliano's Theorem
- 5.6. Relevant Problems

6. Curved Beams (4 hours)
- 6.1. Definition
- 6.2. Circumferential Stress in Curved Beams
- 6.3. Radial Stresses
- 6.4. Deflections
- 6.5. Statically Indeterminate Closed Ring
- 6.6. Relevant Problems

7. Non Symmetrical Bending of Straight Beams (4 hours)
- 7.1. Definition
- 7.2. Bending Stresses due to Non symmetrical Bending
- 7.3. Deflections due to Unsymmetrical Bending
- 7.4. Relevant Problems

8. Thick- Wall Cylinders (4 hours)
- 8.1. Basic Relations
- 8.2. Stresses for a cylinder with Open and Closed Ends
- 8.3. Linear and Volumetric Strain
- 8.4. Criteria of Failure
- 8.5. Composite Thick Cylinder
- 8.6. Stress Solution for Temperature Change Only
- 8.7. Relevant Problems

9. Torsion (6 hours)
- 9.1. Definition
- 9.2. Torsion of Non Circular Solid Section
  - 9.2.1. Saint- Venant's Semi- Inverse Method
  - 9.2.2. The Prandtl Elastic Membrane Analogy
  - 9.2.3. Torsion of a Narrow Rectangular Cross Section
- 9.3. Torsion of Hollow Thin Wall Section

9.4. Relevant Problems

10. Shear Centers for Thin- Wall Beam Cross Sections (4 hours)

10.1. Shear Flow in thin- Wall Beam Cross Sections
10.2. Shear Centre for a Channel Section
10.3. Composite Beams
10.4. Box Beams
10.5. Relevant Problems

11. Contact Stresses (2 hours)

11.1. Introduction; the Problem of Determining Contact Stresses
11.2. Point and Line Contact
11.3. Assumptions Involved in the Solution
11.4. Expressions for Principal Stresses

12. Introduction to Plastic Range Stress and Strain (2 hours)

12.1. Curve Beam
12.2. Structure Having Non Symmetrical Bending
12.3. Thick Wall Cylinder
12.4. Torsion member

Practical:

1. Nonlinear Behaviour of Materials in Tension
   1.1. Tensile Test on a Rubber Specimen
   1.2. Creep Test and relaxation Test on a Plastic Specimen
2. Deflections and Stresses in Indeterminate Shafts of Beams:
   2.1. Control of stresses and deflections using a central support
   2.2. Application of Maxwell's reciprocity law
3. Torsion of Non Circular tubes:
   3.1. Torsion test of circular, square and rectangular closed thin walled tubes
   3.2. Torsion of closed and open circular thin- walled tubes
4. Curved Beams and Thick- Walled Cylinders
   4.1. Deflections and Stresses in curved beams
   4.2. Stress and strain in thick walled cylinders
5. Shear stresses in beams and the shear centre:
   5.1. Shear stresses in beams and stiffness effects for layered beams
   5.2. Finding the shear centre for a beam with a channel cross section
6. Effects of Suddenly Applied Dynamic Loads:
   6.1. A tension member subjected to dynamic loads
   6.2. Sudden transverse loading of a beam

References

1. A.P. Boresi and O. M. Sidebottom, "Advanced Mechanics of Materials", Wiley.
2. Ugural and Fenster, "Advanced Strength and Applied Elasticity", Elsevier, S. I. Version
3. Popov, E.P., "Engineering Mechanics of Solids", Prentice Hall Inc.
4. Hibbler R.C., "Mechanics of Solids", Pearson Education Inc.

Evaluation scheme:

The questions will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below.

Unit	Chapter	Topics	Marks
1	1, 2 & 4	all	**16**
2	3 & 5	all	**16**
3	6 & 7	all	**16**
4	8 & 9	all	**16**
5	10, 11 & 12	all	**16**
Total			**80**

HEAT TRANSFER
ME 604

Lecture : 3 **Year : III**
Tutorial : 1 **Part : I**
Practical : 3/2

Course Objective:

To introduce the concepts of heat transfer to enable the students to design components subjected to thermal loading.

Course Outlines:

1. Review on Basic Concepts of Heat Transfer [1 hour]

1.1. Mechanism of Heat Transfer
1.2. Factors Affecting Heat Transfer
1.3. Engineering Applications

2. Conduction Heat Transfer [12 hours]

2.1. General Differential equation of Conduction
2.2. Fourier Law of Conduction
2.3. Cartesian and Cylindrical Coordinates
2.4. One and Two Dimensional Steady State Heat Conduction
2.5. Conduction through Plane Wall, Cylinders and Spherical systems
2.6. Composite Systems
2.7. Conduction with Internal Heat Generation
2.8. Unsteady Heat Conduction
2.8.1 Lumped Analysis
2.8.2 Use of Heislers Chart

3. Convection Heat Transfer [12 hours]

3.1. Newton's law of cooling
3.2. Convective Heat Transfer Coefficients
3.3. Boundary Layer Concepts
3.4. Free Convection
3.4.1 Dimensional Analysis
3.4.2 Flow over Plates, Cylinders and Spheres
3.5. Forced Convection
3.5.1 Dimensional Analysis
3.5.2 Flow over Plates, Cylinders and Spheres
3.5.3 Laminar and Turbulent Flow
3.5.4 Combined Laminar and Turbulent
Flow over Bank of tubes

4. Radiation Heat Transfer [8 hours]

4.1. Laws of Radiation
4.1.1 Stefan Boltzman Law, Kirchoff Law
4.1.2 Relationship between Temperature, Frequency and Wavelength
4.1.3 Reflectivity, Absorbtivity and Transmissivity
4.2. Black and Grey body radiation
4.3. Shape Factor Algebra
4.4. Electrical Analogy
4.5. Radiation Shields
4.6. Introduction to Gas Radiation

5. Phase Change Heat Transfer [2 hours]

5.1. Nusselts Theory of Condensation
5.2. Pool Boiling and Flow Boiling
5.3. Correlations in Boiling and Condensation

6. Applications of Heat Transfer [6 hours]

6.1. Fins
6.1.1 Types of Fins
6.1.2 Heat Dissipation from Fins
6.1.3 Fin Performance
6.2. 6.2 Heat exchanger
6.2.1 Types of Heat Exchangers
6.2.2 LMTD Method of Heat Exchanger Analysis
6.2.3 Effectiveness
6.2.4 NTU Method of Heat Exchanger Analysis
6.2.5 Overall Heat Transfer Coefficient
6.2.6 Fouling Factors

7. Introduction to Mass Transfer [4 hours]

7.1. Basic Concepts
7.2. Diffusion Mass Transfer
7.3. Fick's Law of Diffusion
7.4. Steady State Molecular Diffusion
7.5. Convective Mass Transfer
7.6. Momentum, Heat and Mass Transfer Analogy
7.7. Convective Mass Transfer Correlations

Practical:

Lab 1 Conduction Heat Transfer
Verification of Conduction Laws
Drawing of Temperature Profile
Comparison between Thermal Conductivities of Different Types of Materials

Lab 2 Convection Heat Transfer
Free Convection from Different Types of Plates
Force Convection from Different Types of Plates

Lab 3 Radiation Heat Transfer
Relationship between Temperature, Frequency and Wavelength
Reflectivity, Absorptivity and Transmissivity

Lab 4 Boiling Heat Transfer
Mass and Energy Balances
Efficiency
Effects of Mixture on Boiling Heat Transfer

Lab 5 Heat Exchanger
Energy Balance of Different Types of Heat Exchangers
Drawing of Temperature Profiles of Different Types of Heat Exchangers
Effectiveness of Different Types of Heat Exchangers

Lab 6 Fins
Drawing of Temperature Profiles of Different Types of Fins
Heat Dissipation from Different Types of Fins

References:

1. Holman J.P "Heat Transfer" Tata McGraw-Hill.
2. Ozisik M.N, "Heat Transfer", McGraw-Hill Book Co.
3. Incropera, DeWitt, Bergman, Lavine, "Fundamentals of Heat and Mass Transfer", Wiley India.
4. Yadav R "Heat and Mass Transfer" Central Publishing House.
5. Sachdeva R C, "Fundamentals of Engineering Heat and Mass Transfer" New Age International.
6. Nag P.K, "Heat Transfer", Tata McGraw-Hill, New Delhi.

Evaluation Scheme:
There will be questions covering all the chapters of the syllabus. The evaluation scheme for the questions will be as indicated in the table below:

Unit	Chapter	Topics	Marks
1	2	2.1 to 2.6	**16**
2	2	2.7 & 2.8	**16**
	3	3.1 to 3.4	
3	3	3.5	**16**
	5	all	
4	1 & 4	all	**16**
5	6 & 7	all	**16**
Total			**80**

FLUID MACHINES
ME605

Lecture : 3 **Year : III**
Tutorial : 1 **Part : I**
Practical : 3/2

Course Objective:
This course is designed to give ideas about fluid-force and power. It covers general introductory part of hydropower plant. Most of the parts deal with water-turbine, water-pumps, steam-turbine and hydraulic machine.

1. Introduction of Turbomachine and Dynamic Action of Fluid (10 hours)
- 1.1. Turbomachines
- 1.2. Hydraulic Machines
- 1.3. History of Development of Water Wheels and Water Turbine
- 1.4. Dynamic Force and Power
- 1.5. Linear Momentum and Impulse Equations
- 1.6. Application of Linear Momentum Principle
- 1.7. Dynamic Force Exerted by Fluid Jet;
- 1.8. Stationary and moving plates, flat and curved surfaces
- 1.9. Jet Propulsion Principle; Boat and ship propulsion

2. Hydroelectric Plant (4 hours)
- 2.1. Essential Components and Features
- 2.2. Classification of Hydroelectric plants
- 2.3. Existing Hydroelectric plants

3. Water Turbine (14 hours)
- 3.1. Types of turbines: Pelton, Francis, Kaplan, Cross Flow
- 3.2. Working Principles
- 3.3. Components and Their Functions, Specific speed, Design, Efficiency
- 3.4. Characteristics and application
- 3.5. Governor Principle, Types, Qualities, Control
- 3.6. Oil pressure governor:: Components, Working Principle

4. Pump (8 hours)
- 4.1. Centrifugal and Reciprocating Types
- 4.2. Theory of the Centrifugal Pump, Specific Speed, Pump Head
- 4.3. Pump Characteristics, Energy loss, Cavitation, Efficiency, Effect of Viscosity, Series and parallel combination
- 4.4. Selection of Pumps

5. Steam turbine and Hydraulic machine (9 hours)
- 5.1. Steam Nozzles and Types
- 5.2. Flow of Steam Through Nozzles;
- 5.3. Steady flow energy equation, Momentum equation
- 5.4. Principle of Operation of Steam Turbines
- 5.5. Types of Steam Turbine and Applications
- 5.6. Impulse and Reaction Turbine: Components and Their Functions, Working Principles, Efficiency
- 5.7. Hydraulic machine Types, Working Principle: Hydraulic Ram, Hydraulic lift, Hydraulic torque converter

Practical:
1. Performance Characteristics of Different Types of Pumps
2. Performance Characteristics of the Series and parallel combination of pumps
3. Performance Characteristics of the Pelton Turbine
4. Performance Characteristics of the Francis Turbine
5. Performance Characteristics of the Propeller Turbine
6. Performance Characteristics of the Cross-flow Turbine

References:

1. Robert L. Daugherty, Joseph B. Franzini and E. John Finnemore, "Fluid Mechanics with Engineering Applications", McGraw Hill Book Company, SI Metric Edition
2. Dr. P.N. Modi and Dr. M. Sethi, "Hydraulics and Fluid Mechanics", Standard Book house
3. Dr. J. Tritton, "Physical Fluid Dynamics", Second Edition, Claredon Press, Oxford Press
4. Dr. Jagadish Lal, "Hydraulics Machines", Metropoliton Co.
5. R.K Rajput, "A text book of Hydraulic Machine", S. Chandand Company Ltd. India

Evaluation Scheme:
There will be questions covering all the chapters of the syllabus. The evaluation scheme for the questions will be as indicated in the table below:

Unit	Chapter	Topics	Marks
1	1	all	**16**
2	2	all	**16**
	3	3.1 & 3.2	
3	3	3.3 to 3.6	**16**
4	4	all	**16**
5	5	all	**16**
Total			**80**

COMMUNICATION ENGLISH
SH651

Lecture : 3 **Year: III**
Tutorial : 1 **Part:II**
Practical : 2

Course Introduction

This course is designed for the students of engineering with the objective of developing all four skills of communication applicable in professional field.

Course Objectives:
To make students able to:

a. comprehend reading materials both technical and semi-technical in nature
b. develop grammatical competence
c. write notice, agenda, minutes
d. write proposals
e. write reports
f. write research articles
g. listen and follow instruction, description and conversation in native speakers' accent
h. do discussion in group, deliver talk and present brief oral reports

Unit I: Reading **(15 hours)**

1. **Intensive Reading** (8 hours)
   1.1. Comprehension
   1.2. Note-taking
   1.3. Summary writing
   1.4. Contextual questions based on facts and imagination
   1.5. Interpreting text
2. **Extensive Reading** (5 hours)
   2.1. Title/Topic Speculation
   2.2. Finding theme
   2.3. Sketching character
3. **Contextual Grammar** (2 hours)
   3.1. Sequence of tense
   3.2. Voice
   3.3. Subject-Verb agreement
   3.4. Conditional Sentences
   3.5. Preposition

Unit II: Introduction to technical writing process and meeting **(4 hours)**

1. Editing, MLA/APA (2 hours)
   1.1. Composing and editing strategies
   1.2. MLA and APA comparison
2. Writing notices with agenda and minutes (2 hours)
   2.1. Introduction
   2.2. Purpose
   2.3. Process

Unit III: Writing Proposal **(6 hours)**

1. Introduction
1.1 Parts of the proposal
   1.1.1. Title page
   1.1.2. Abstract/Summary
   1.1.3 Statement of Problem
   1.1.4. Rationale
   1.1.5. Objectives
   1.1.6. Procedure/Methodology
   1.1.7. Cost estimate or Budget
   1.1.8. Time management/Schedule
   1.1.9. Summary
   1.1.10. Conclusion
   1.1.11. Evaluation or follow-up
   1.1.12. Works cited

Unit IV: Reports **(18hours)**

1.1. Informal Reports (6 hours)
   1.1.1. Memo Report
      1.1.1.1. Introduction
      1.1.1.2. Parts
   1.1.2. Letter Report
      1.1.2.1. Introduction
      1.1.2.2. Parts
1.2. Project/Field Report (3 hours)
   1.2.1. Introduction
   1.2.2. Parts
1.3. Formal report (9 hours)
   1.3.1. Introduction
   1.3.2. Types of Formal Reports
      1.3.2.1. Progress Report

1.3.2.2. Feasibility Report
1.3.2.3. Empirical/ Research Report
1.3.2.4. Technical Report

1.3.3. Parts and Components of Formal Report

1.3.3.1. Preliminary section

1.3.3.1.1. Cover page
1.3.3.1.2. Letter of transmittal/Preface
1.3.3.1.3. Title page
1.3.3.1.4. Acknowledgements
1.3.3.1.5. Table of Contents
1.3.3.1.6. List of figures and tables
1.3.3.1.7. Abstract/Executive summary

1.3.3.2. Main Section

1.3.3.2.1. Introduction
1.3.3.2.2. Discussion/Body
1.3.3.2.3. Summary/Conclusion
1.3.3.2.4. Recommendations

1.3.3.3. Documentation

1.3.3.3.1. Notes (Contextual/foot notes)
1.3.3.3.2. Bibliography
1.3.3.3.3. Appendix

Unit V: Writing Research Articles **(2 hours)**

1.4. Introduction
1.5. Procedures

Language lab		30 hours
Unit I: Listening		12 hours
Activity I	General instruction on effective listening, factors influencing listening, and note-taking to ensure ttention. (Equipment Required: Laptop, multimedia, laser pointer, overhead projector, power point, DVD, video set, screen)	2 hours
Activity II	Listening to recorded authentic instruction followed by exercises. (Equipment Required: Cassette player or laptop)	2 hours
Activity III	Listening to recorded authentic description followed by exercises. (Equipment Required: Cassette player or laptop)	4 hours
Activity IV	Listening to recorded authentic conversation followed by exercises (Equipment Required: Cassette player or laptop)	4 hours
Unit II: Speaking		18 hours
Activity I	General instruction on effective speaking ensuring audience's attention, comprehension and efficient use of Audio-visual aids. (Equipment Required: Laptop, multimedia, laser pointer, DVD, video, overhead projector, power point, screen)	2 hours
Activity II	Making students express their individual views on the assigned topics (Equipment Required: Microphone, movie camera)	2 hours
Activity III	Getting students to participate in group discussion on the assigned topics	4 hours
Activity IV	Making students deliver talk either individually or in group on the assigned topics (Equipment Required: Overhead projector, microphone, power point, laser pointer multimedia, video camera, screen)	8 hours
Activity V	Getting students to present their brief oral reports individually on the topics of their choice. (Equipment Required: Overhead projector, microphone, power point, laser pointer multimedia, video camera, screen)	2 hours

Evaluation Scheme

Units	Testing Items	No. of Questions	Type of Questions	Marks Distribution	Total Marks	Remarks
I	Reading	3	For grammar = objective and for the rest = short	2 Short questions 5+5 Interpretation of text 5 Note + Summary 5+5 Grammar 5	30	For short questions 2 to be done out of 3 from the seen passages, for interpretation an unseen paragraph of about 75 words to be given, for note + summary an unseen text of about 200to 250 to be given, for grammar 5 questions of fill up the gaps or transformation type to be given
II	Introduction to technical writing process and meeting	3	MLA/APA = objective, Editing and Meeting = short	MLA/APA = 4 Editing = 5 Meeting = 5	14	For APA/MLA 4 questions to be given to transform one from another or 4 questions asking to show citation according to APA/MLA technique, For meeting minute alone or notice with agendas to be given
III	Proposal Writing	1	Long	10	10	A question asking to write a very brief proposal on any technical topic to be given
IV	Report writing	2	Informal report = short, Formal report = long	Informal report = 6 Formal report = 10	16	A question asking to write very brief informal report on technical topic to be given, for formal report a question asking to write in detail on any three elements of a formal report on technical topic to be given
V	Research article	1	Long	10	10	A question asking to write a brief research article on technical topic to be given

Evaluation Scheme for Lab

Units	Testing items	No. of Questions	Type of questions	Marks Distribution	Remarks
I	Listening • instruction • description • conversation	2	objective	5+5	listening tape to be played on any two out of instruction, description and conversation followed by 10multiple choice type or fill in the gaps type questions
II	Speaking • group/round table discussion • presenting brief oral report • delivering talk	2	subjective	Round table discussion 5, talk or brief oral report =10	Different topics to be assigned in groups consisting of 8 members for group discussion and to be judged individually, individual presentation to be judged through either by talk on assigned topics or by brief oral reports based on their previous project, study and field visit.

Prescribed books

1. Adhikari, Usha, Yadav, Rajkumar, Yadav, Bijaya, ; " A Course book of Communicative English", Trinity Publication, 2012.
2. Adhikari, Usha, Yadav, Rajkumar, Shrestha, Rup Narayan ; “Technical Communication in English", Trinity Publication, 2012.

(Note: 50 marks excluding reading to be covered on the basis of first book and reading part (i.e. 30 marks) to be covered on the basis of second book)

3. Khanal, Ramnath, “Need-based Language Teaching (Analysis in Relation to Teaching of English for Profession Oriented Learners)”, Kathmandu: D, Khanal.
4. Konar, Nira, “Communication Skills for Professional”, PHI Learning Private Limited, New Delhi.
5. Kumar, Ranjit, “Research Methodology”, Pearson Education.
6. Laxminarayan, K.R, “English for Technical Communication”, Chennai; Scitech publications (India) Pvt. Ltd.
7. Mishra, Sunita et. al. , “Communication Skills for Engineers”, Pearson Education First Indian print.
8. Prasad, P. et. al , “The functional Aspects of Communication Skills”, S.K. Kataria & sons.
9. Rutherfoord, Andrea J. Ph.D, “Basic Communication Skills for Technology”, Pearson Education Asia.
10. Rizvi, M. Ashraf), “Effective Technical Communication”, Tata Mc Graw Hill.
11. Reinking A James et. al, “Strategies for Successful Writing: A rhetoric, research guide, reader and handbook”, Prentice Hall Upper Saddle River, New Jersey.
12. Sharma R.C. et al., “Business Correspondence and Report Writing: A Practical Approach to Business and Technical communication”, Tata Mc Graw Hill.
13. Sharma, Sangeeta et. al, “Communication skills for Engineers and Scientists”, PHI Learning Private Limited, New Delhi.
14. Taylor, Shirley et. al., “Model Business letters, E-mails & other Business documents”, Pearson Education.

MACHINE DESIGN I
ME651

Lecture : 3 **Year : III**
Tutorial : 0 **Part : II**
Practical : 3

Course objective
To provide fundamental knowledge and skills to the students that are needed to design the most commonly used machine elements. To make students able to design different kinds of machine elements and components.

Course Outlines:

1. Design Process (3 hour)
- 1.1. Introduction
- 1.2. Basic Steps in the Design and Synthesis Process
  - 1.2.1 Recognition of need
  - 1.2.2 Definition of the problem
  - 1.2.3 Gathering relevant information, functional requirements
  - 1.2.4 Conceptualization
  - 1.2.5 Evaluating alternatives
  - 1.2.6 Communication
  - 1.2.7 Feedback from manufacturer and user
- 1.3. Communicating the design
  - 1.3.1. Drawings and CAD
  - 1.3.2. Charts and graphs

2. Materials Selection (2 hour)
- 2.1. Information on Materials Properties
- 2.2. Economics of Materials
- 2.3. Evaluation Methods for Materials Selection
- 2.4. Cost versus Performance Relations
- 2.5. Cost and Value Analysis

3. New Product Design (2 hours)
- 3.1. Feasibility Studies
- 3.2. Preliminary design
- 3.3. Detailed design and analysis
- 3.4. Planning for manufacture
- 3.5. Planning for distribution and use
- 1.4. Planning for Retirement

4. Problem Solving and Decision Making (4 hours)
- 4.1. The Problem Solving Process
- 4.2. Creative Problem Solving
- 4.3. Invention
- 4.4. Brainstorming
- 4.5. Problem Statement; Needs, goals, constraints, compromises, conditions, criteria for evaluation
- 4.6. Problem Solving; Preparation, incubation, inspiration and verification
- 4.7. Decision Matrix
- 4.8. Decision Tree
- 4.9. Relevant Problems

5. Design of shafts (8 hours)
- 5.1. Design for static load
- 5.2. Reversed bending and steady torsion
- 5.3. The solderberg approach
- 5.4. Design for alternating bending and torsional stress
- 5.5. The kimmelmann load approach
- 5.6. Basic graphical approach
- 5.7. A general approach
- 5.8. The sine approach

6. Rolling contact bearing (4 hours)
- 6.1. Types of roller bearing
- 6.2. Bearing life
- 6.3. Bearing load
- 6.4. Selection of ball and straight roller bearing
- 6.5. Selection of tapered bearing

7. Lubrication and journal bearings (6 hours)
- 7.1. Types of lubrication, viscosity and charts
- 7.2. Petroff law, stable lubrication, thick film lupr
- 7.3. Hydrodynamic theory
- 7.4. Design consideration for journal bearing
- 7.5. Minimum film thickness
- 7.6. Coefficient of friction, lubricant flow, film pressure and temperature rise, temp and viscosity consideration
- 7.7. Optimization techniques
- 7.8. Pressure fed bearing, heat balance
- 7.9. Bearing design and bearing alloys
- 7.10. Thrust bearing, boundary lubricated bearing
- 7.11. Bearing material

8. Design of belts (4 hours)
- 8.1. Flat belt design open cross belt
- 8.2. V-belt design
- 8.3. Choice of chain and sprocket drive

9. Gear design (12 hours)
- 9.1. Spur gear
  - 9.1.1. Gear train

9.1.2. Force analysis and tooth stresses
9.1.3. Stress concentration and geometry factor
9.1.4. Dynamics effects
9.1.5. Estimating gear size
9.1.6. Fatigue strength design
9.1.7. Factor of safety and surface durability
9.1.8. Surface fatigue strength
9.1.9. Gear blank design

9.2. Helical bevel and worm gear
9.2.1. Helical gears tooth proportion and force analysis
9.2.2. Strength analysis and design
9.2.3. Worm gearing – kinematics and force analysis
9.2.4. Power rating of worm gears
9.2.5. Bevel gears- kinematics and force analysis
9.2.6. Bevel gearing design – bending stress and strength surface durability
9.2.7. Spiral bevel gears

Practical:

1. Assigned Problems;

Chosen to relate to course material; the design process, decision making and new product design

2. Assignment on: Design of shafts
3. Assignment on: Rolling contact bearing
4. Assignment on: journal bearings
5. Assignment on: Belt design
6. Assignment on: Gear design

References:

1. G.E. Dieter, "Engineering Design- a Materials Processing Approach", McGraw Hill, First Metric Edition.
2. M. F. Spotts,"Design of Machine Elements" , Prentice Hall.
3. J.E. Shigley, "Machine Design", McGraw Hill.

Evaluation Schemes:

The questions will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below.

Unit	Chapter	Topics	Marks
1	1, 2 & 3	all	**16**
	9	9.2	
2	4 & 6	all	**16**
3	5	all	**16**
4	7 & 8	all	**16**
5	9	9.1	**16**
Total			**80**

INDUSTRIAL ENGINEERING AND MANAGEMENT
ME652

Lecture : 3 **Year : III**
Tutorial : 1 **Part : II**
Practical : 0

Course Objective:
To provide fundamental knowledge of industrial engineering. To describe production systems; loading and scheduling techniques; forecasting techniques, inventory control and material requirement planning. To apply knowledge and skills for plant maintenance, quality control and management.

1. Introduction to Industrial Engineering and Management (1hour)
- 1.1. Historical Development
- 1.2. System Concept

2. Design of Production Systems (18 hours)
- 2.1 Plant Location
  - 2.1.1 Importance of Plant Location
  - 2.1.2 Factors Affecting Plant Location
- 2.2 Factory Building and Plant Layout
  - 2.2.1 Types of Factory Building
  - 2.2.2 Types of Plant Layout
  - 2.2.3 Flow Patterns
- 2.3 Material Handling
  - 2.3.1 Engineering factors and Economic factors
  - 2.3.2 Classification of Material Handling Equipments
- 2.4 Production, Planning and Control
  - 2.4.1 Types of Production System
  - 2.4.2 Routing, Scheduling and Loading
- 2.5 Product Research, Development and Design
  - 2.5.1 Tools for Product Development
  - 2.5.2 Standardization
  - 2.5.3 Simplification and Specialization
- 2.6 Process Planning

3. Loading and Scheduling Techniques (4 hours)
- 3.1. Gantt Chart
- 3.2. Critical Path Method (CPM)
- 3.3. Program Evaluation and Review Technique (PERT)

4. Inventory Control hours)
- 4.1. Economic Order Quantity
- 4.2. Safety Stock; Reorder Quantity; Lead Time
- 4.3. ABC Analysis

5. Material Requirement Planning (MRP I and MRP II) (6 hours)
- 5.1. Introduction
- 5.2. MRP Concept
- 5.3. Benefits and Application
- 5.4. MRP II (Manufacturing Resource Planning)
- 5.5. The Japanese approach to MRP
- 5.6. Comparing MRP and Just in time (JIT) Concept

6. Forecasting (4 hours)
- 6.1. Forecasting Techniques
  - 6.1.1. Qualitative Techniques
  - 6.1.2. Quantitative Techniques
  - 6.1.3. Causal Quantitative Techniques
- 6.2. Forecast Errors

7. Plant Maintenance (4 hours)
- 7.1. Introduction
- 7.2. Preventive Maintenance
- 7.3. Scheduled Maintenance
- 7.4. Break – down Maintenance
- 7.5. Total Productive Maintenance (TPM)
- 7.6. Total Planned Quality Maintenance (TPQM)

8. Quality Management (4 hours)
- 8.1. Evolution of Quality Management
- 8.2. Quality – Definitions
- 8.3. Total Quality Management

References:

1. H. B. Maynard, "Industrial Engineering Handbook" , Editor – in – Chief, McGraw Hill.
2. E. S. Buffa and R. K. Sarin "Modern Production / Operations Management", 8th Edition, Wiley.
3. E. L. Grant and R. S. Leavenworth, "Statistical Quality Control" , Mc Graw Hill.
4. M. Mahajan, "Industrial Engineering and Production Management", Dhanpat Rai and Co. Delhi, India.

5. O. P. Khanna, "Industrial Engineering and Management", Dhanpat Rai and Sons, Delhi.
6. S. Dalela and Mansoor Ali, "Industrial Engineering and Management Systems", Standard Publishers Distributors, Delhi.
7. S. N. Chary "Production and Operations Management", Tata McGraw- Hill Publishing Company Limited, New Delhi.
8. Azaya Bikram Sthapit, Rashindra Prasad Yadav, Govind Tamang, Sushil Dhital and Prakash Ahdhikari, "Production and Operations Management", Asmita Books Publishers and Distributors, Putalisadak, Kathmandu, Nepal.
9. Prof. Dr. Pushkar Bajracharya, Dr. Subarna Lal Bajracharya, Budha Ratna Maharjan – " Production and Operations Management" , Quest Publicatopn, Kirtipur, Kathmandu, Nepal.
10. Amitava Mitra, " Fundamentals of Quality Control and Improvement" Second Edition, Pearson Education Asia.

Evaluation Scheme:

There will be questions covering all the chapters of the syllabus. The evaluation scheme for the questions will be as indicated in the table below:

Unit	Chapter	Topics	Marks
1	1	all	**16**
	2	2.1 & 2.2	
2	2	2.3 to 2.6	**16**
3	3 & 4	all	**16**
4	5 & 6	all	**16**
5	7 & 8	all	**16**
Total			**80**

THEORY OF MECHANISM AND MACHINE I
ME653

Lecture : 3 **Year : III**
Tutorial : 3/2 **Part : II**
Practical : 0

Course Objectives:
To make students understand about different mechanism used in devices or machines and make them able to do complete analysis of mechanism (including linkages, gears, gear trains, cams and followers).

1. Introduction (2 hours)
- 1.1. Introduction to the study of mechanisms
- 1.2. Basic definitions & descriptions
- 1.3. Mechanism configurations, links, chains, inversions
- 1.4. Transmission of motion
- 1.5. Mobility, Degree of freedom

2. Linkages and Mechanisms (4 hours)
- 2.1. Position Analysis of the four-bar mechanism
- 2.2. Four-bar linkage motion and Grashoff's law
- 2.3. Linkage position analysis; loop closure equations & iterative methods
- 2.4. Introduction to different mechanism : Slider crank, Scotch Yoke, Quick return, toggle, Oldham coupling & Hooke's Coupling, Straight line, Chamber wheel, constant velocity universal joint, intermittent motion, mechanical computing, etc. mechanisms.
- 2.5. Synthesis concepts

3. Cams and Followers (6 hours)
- 3.1. Classification of cams and nomenclature
- 3.2. Graphical cam layout;
- 3.3. Disk cam with flat-faced follower
- 3.4. Disk cam with Radial or Offset follower
- 3.5. Standardized Follower Displacement or Lift curves
- 3.6. Analytical Cam Design; Disk cam with flat-faced follower: Disk cam with Radial or Offset follower: Disc cam with Oscillating Roller follower
- 3.7. Other cam layouts
- 3.8. Cam production methods

4. Spur Gears (6 hours)
- 4.1. Introduction to Involute spur gears
- 4.2. Geometry of Involutes
- 4.3. Characteristics of Involute Tooth Action
- 4.4. Standardization of Gears; Metric system
- 4.5. Interference of Involute Gears
- 4.6. Numbers of teeth to avoid interference
- 4.7. Determining backlash in Involute gears
- 4.8. Non-standard Spur gears; extended center distance system
- 4.9. Methods of gear production

5. Bevel, Helical and Worm Gears (5 hours)
- 5.1. Theory of straight Bevel gears
- 5.2. Bevel Gear tooth proportions and geometrical details
- 5.3. Spiral and Hypoid gears
- 5.4. Theory of helical gears & tooth geometry
- 5.5. Parallel and crossed shafts for helical gears
- 5.6. Worm gearing

6. Simple and Planetary gear trains (5 hours)
- 6.1. Theory of Planetary Gear Trains
- 6.2. Speed Ratios; Formula and Tabular Methods
- 6.3. Applications
- 6.4. Assembly of Planetary gear trains

7. Kinematic Analysis of Mechanisms (9 hours)
- 7.1. General Plane Motion Representation
- 7.2. Relative Motion Velocity Analysis; Velocity Polygons; Graphical or Vector algebra solutions
- 7.3. Instantaneous centers of velocity
- 7.4. Kennedy's theorem
- 7.5. Velocities by Instantaneous centers
- 7.6. Relative motion acceleration analysis; Acceleration Polygons; Graphical or Vector algebra solutions; Corilis acceleration applications
- 7.7. Motion analysis by vector mathematics; Velocity analysis, Acceleration Analysis, Coriolis Acceleration Application
- 7.8. Analysis by Complex Numbers; Loop Closure Equation for Geometrical Layout, Kinematic Analysis by Complex Numbers Application

8. Force Analysis of Mechanisms (8 hours)
- 8.1. Centrifugal Force, Inertia Force and Inertia Torque

8.2. Methods of Force Analysis – Introduction
8.3. Forces on Gear Teeth- spur/bevel & helical gears
8.4. Force analysis on cams & followers
8.5. Superposition Force Analysis Methods, Graphical or Analytical
8.6. Linkage Force by Matrix Methods
8.7. Linkage Force by Method of Virtual Work
8.8. Linkage Force by Complex Number Method
8.9. Applications and Examples

References:

1. H.H. Mabie and C. F. Reinholtz, "Mechanism and Dynamics of Machinery", Wiley.
2. J.S. Rao & R.V. Dukkipati Mechanisms and Machine Theory, New Age International (P) Limited..
3. J.E. Shigley and J.J. Uicker, Jr., " Theory of Machines and Mechanisms", McGraw Hill.
4. B. Paul, "Kinematics and Dynamics of Planar Machinery", Prentice Hall.
5. C. E. Wilson, J.P. Sadler and W.J. Michels, "Kinematics and Dynamics of Machinery", Harper Row.

Evaluation Scheme:

There will be questions covering all the chapters of the syllabus. The evaluation scheme for the questions will be as indicated in the table below:

Unit	Chapter	Topics	Marks
1	1 & 2	all	**16**
	3	3.1 & 3.10	
2	3	3.2 to 3.9	**16**
	4	all	
3	5 & 6	all	**16**
4	7	all	**16**
5	8	all	**16**
Total			**80**

INTERNAL COMBUSTION ENGINES
ME654

Lectures : 3 **Year : III**
Tutorial : 1 **Part : II**
Practical : 3/2

Course Objectives:
To make student able to understand construction and operation of IC engine, fuels and combustion of fuels in SI and CI engine performance test procedure and formation of exhaust emissions and their controlling measures.

1. Overview of Thermodynamics of Fuel-air Cycles and Real Cycles (5 hours)
- 1.1 Otto cycle, Diesel cycle, Atkinson cycle, Stirling cycle, Brayton cycle.
- 1.2 Assumptions in fuel air cycle analysis
- 1.3 Composition of cylinder gases

2. Engine Construction and operation (4 hours)
- 2.1 Construction and working principle of SI, CI engines and gas turbines
- 2.2 Major engine components
- 2.3 Four stroke and two stroke engines

3. Engine Fuels (6 hours)
- 3.1 Basic requirements of engine fuels:
- 3.2 Chemical structure of petroleum
- 3.3 Heat value of fuels.
- 3.4 Rating of SI Engine fuels,
- 3.5 Rating of CI engine fuels
- 3.6 Combustion equation for hydrocarbon fuels
- 3.7 Properties and ratings of petrol and diesel fuels
- 3.8 Fuel supply systems of SI and CI engines
- 3.9 Non-conventional fuels for IC engines; LPG, CNG, Methanol, Ethanol, Non-edible vegetable oils, Hydrogen.

4. Carburetor & Fuel Injection Systems (6 hours)
- 4.1 Construction and working of carburettor
- 4.2 Inlet and exhaust valve timings
- 4.3 Fuel feed and fuel injection pumps
- 4.4 Petrol injection
- 4.5 Electronic Fuel Injection systems (EFI)
- 4.6 Multi-point fuel injection system (MPFI)

5. Combustion in SI and CI Engines (6 hours)
- 5.1 Ignition systems
- 5.2 Stages of combustion in engines
- 5.3 Flame propagation and factors affecting it
- 5.4 Knocking a nd pre-ignition
- 5.5 Factors affecting knocking and Control of knocking
- 5.6 Combustion chamber requirements
- 5.7 Turbo charging and super charging
- 5.8 Engine emissions
- 5.9 Engine emissions and emission standards

6 Engine lubrication systems (4 hours)
- 6.1 Engine lubrication systems
- 6.2 Hydrodynamic theory of lubrication
- 6.3 Properties of lubricants
- 6.4 Types of lubricants and additives
- 6.5 Grading of lubricating oils

7 Engine cooling (6 hours)
- 7.1 Air and water cooling systems
- 7.2 Working principles of air and water cooling systems
- 7.3 Variation of gas temperatures
- 7.4 Components of water cooling system

8 Engine Performance and Testing of Engines (8 hours)
- 8.1 Performance parameters
- 8.2 Engine power, BHP, Fuel consumption, Air consumption
- 8.3 Engine heat balance sheet
- 8.4 Mechanical efficiency
- 8.5 Engine efficiencies
- 8.6 Testing of engines and related numerical problems

Practical:
1. Engine dismantling and engine assembly: SI and CI engines.
2. Identification of engine components and checking them for defects.
3. Performance testing of SI/CI engine
4. Tailpipe emission testing of given engine

References:

1. Heywood, J. B, “Internal Combustion Engine Fundamentals”, McGraw Hill Publishing Co., New York.
2. Sharma, S. P, Chandramohan, “Fuels and Combustion”, Tata McGraw Hill Publishing Co.
3. Mathur and Sharma, “A course on Internal combustion Engines”, Dhanpat Rai & Sons.
4. Pulkrabek, W. W., “Engineering Fundamentals of the Internal Combustion Engine”, Prentice-Hall of India Private Limited.
5. Prof. P.L. Ballaney, “Internal Combustion Engines”, Khanna Publications, Delhi, India.
6. R.K. Mohanty, “A Text Book of Internal Combustion Engines”, Standard Book House, Delhi, India.

Evaluation Scheme:

There will be questions covering all the chapters of the syllabus. The evaluation scheme for the questions will be as indicated in the table below:

Unit	Chapter	Topics	Marks
1	1 & 2	all	**16**
2	3	all	**16**
	4	4.1 to 4.4	
3	4	4.5 & 4.6	**16**
	5	all	
4	6 & 7	all	**16**
5	8	all	**16**
Total			**80**

ENERGY RESOURCES
ME655

Lecture : 3 **Year : III**
Tutorial : 1 **Part : II**
Practical : 3/2

Course Objectives:
To make student able to understand different types of conventional energy resources, different types of renewable energy resources and energy conversion technologies.

1. Fossil fuels and their characteristics (4 hours)
- 1.1. Classification of traditional fuels
- 1.2. Refining of crude oil
- 1.3. Properties of gasoline and diesel

2. Solar energy (6 hours)
- 2.1. Movement of earth and Solar radiation, solar radiation measuring devices.
- 2.2. Solar radiation fundamentals and solar angles
- 2.3. Flat plate collectors, solar water heaters, Solar Concentrators
- 2.4. Photovoltaic materials; Materials in bulk and thin film forms
- 2.5. Role of microstructure (single crystal, multicrystalline, polycrystalline, amorphous and nanocrystalline) in electrical and optical properties of the materials
- 2.6. Applications of Photovoltaic for power generation

3. Bio energy (3 hours)
- 3.1. Biogas generation and factors affecting bio digestion or generation of gas
- 3.2. Biomass and biochemical conversion to fuels
- 3.3. Biogas plants

4. Wind energy (4 hours)
- 4.1. Principles of wind energy conversion
- 4.2. Types and characteristics of Horizontal & vertical axis wind turbines
- 4.3. Wind farming

5. Micro and small hydro power systems (6 hours)
- 5.1. Micro/Mini hydropower systems, principles and related technologies
- 5.2. Site investigation
- 5.3. Determination of flow
- 5.4. Construction and operation of the different types of water turbines within the range of micro and small hydro power systems
- 5.5. Characteristics of turbines used for micro and small hydro power plants

6. Non conventional forms of energy and batteries (6 hours)
- 6.1. Introduction to fuel cells and Hydrogen fuel system
- 6.2. Hydrogen production processes
- 6.3. General introduction to infrastructure requirement for hydrogen production, storage, and utilization
- 6.4. Battery fundamentals
- 6.5. Different types of batteries

7. **Nuclear energy (6 hours)**
- 7.1. Introduction
- 7.2. Nuclear fusion and reactions
- 7.3. Requirements for nuclear fusion
- 7.4. Health hazards
- 7.5. Radiation protection & shielding

8. Responsible development practices (4 hours)
- 8.1. World energy resources
- 8.2. Energy consumption pattern of different countries
- 8.3. Environment, Development and Society-comparative approaches to natural resource management:
- 8.4. Indigenous system of natural resource management-land, water, forest, air etc:
- 8.5. Environmental ethics.
- 8.6. Urbanization and Sustainability,
- 8.7. Environmentally responsible consumption.

9. Energy audit (6 hours)
- 9.1. Energy audit concepts
- 9.2. Basic elements and measurements
- 9.3. Preparation and presentation of energy audit reports
- 9.4. Case study and potential energy savings

Practical:
1. Measurement of Solar Radiation with Pyranometer
2. Determine the performance of liquid heating solar collector from open -loop through flow test setup
3. Determination of the performance of Study of Solar Water Heater

4. Study the construction and operation of wind turbine
5. Study of Bio gas plant and its principle of operation
6. Study of Micro/Small hydro power systems

References:

1. H.P. Garg & J. Prakash, “Solar Energy Fundamentals and Applications”, Tata McGraw Hill Education Private Limited, new Delhi, India.
2. S.N. Bhadra, D. Kastha, S. Banerjee, “Wind Electrical Systems”, Oxford University Press, New Delhi, India.
3. G. D. Rai, “Non-Conventional Sources of Energy”, Khanna Publishers, India
4. J.A.Duffie, W.A. Beckman, “Solar Engineering of Thermal Processes”, John Wiley & sons.

Evaluation Scheme:

There will be questions covering all the chapters of the syllabus. The evaluation scheme for the questions will be as indicated in the table below:

Unit	Chapter	Topics	Marks
1	1 & 2	all	**16**
2	3 & 4	all	**16**
3	5	all	**16**
	6	6.1 to 6.3	
4	6	6.4 & 6.5	**16**
	7	all	
5	8 & 9	all	**16**
Total			**80**

MACHINE DESIGN II
ME701

Lectures : 3 **Year : IV**
Tutorial : 0 **Part : I**
Practical : 3

Course Objective:
To provide fundamental knowledge and skills to the students that are needed to design the most commonly used machine elements.

1. Modeling and Simulation (4 hours)
- 1.1. The role of Models in Engineering Design
- 1.2. Mathematical Modeling
- 1.3. Similitude and Scale Models
- 1.4. Computer Simulation and Parameter Variation
- 1.5. Computer Generated Geometric Models
- 1.6. Finite Element Modeling and Analysis

2. Optimization Techniques (4 hour)
- 2.1. Optimization by Differential Calculus
- 2.2. Search Methods
- 2.3. Multivariable Search Methods
- 2.4. Linear and Geometric Programming
- 2.5. Multifactor Objective Functions

3. Interaction of Materials, Processing and Design (2 hour)
- 3.1. Role of Processing in Design
- 3.2. Overviews of Manufacturing Processes and Relation to Design: Casting, forging, sheet metal forming, machining, powder metallurgy, welding, heat treatment, assembly
- 3.3. Other factors Affecting the Design Process Material properties, type of loading, stress concentrations, corrosion resistance, wear and abrasion resistance

4. Risk and Reliability of Design (4 hours)
- 4.1. Risk and Society; Regulations, standards, risk assessment
- 4.2. Probabilistic Approach to Design
- 4.3. Reliability Theory;
  - 4.3.1. Failure Rates
  - 4.3.2. System Reliability
  - 4.3.3. Maintenance and repair
- 4.4. Design for reliability
- 4.5. Hazard Analysis
- 4.6. Fault Tree Analysis

5. System Design (10 hours)
Power Transmission System Design such as Machine Tools, Automobile, Air craft etc.

6. Spring design (8 hours)
- 6.1. Stresses in helical spring
- 6.2. Deflection of helical spring
- 6.3. Extension and compression springs
- 6.4. Spring materials: estimation of tensile and torsion yield strength
- 6.5. Design of helical spring: critical frequency
- 6.6. Fatigue loading
- 6.7. Belleville spring
- 6.8. Helical torsion spring
- 6.9. Leaf spring
- 6.10. Energy store capacity of spring

7. Clutches and brakes (8 hours)
- 7.1. Internal expanding rim clutches and brakes
- 7.2. External expanding rim clutches and brakes
- 7.3. Band type clutches and brakes
- 7.4. Frictional contact axial clutches
- 7.5. Cone clutches and brakes
- 7.6. Energy consideration and temperature rise
- 7.7. Frictional material

8. Power screw (5 hours)
- 8.1. Screw thread for power transmission, types and standard
- 8.2. Relationship between applied torque and axial force
- 8.3. Friction effects; self locking thread
- 8.4. Stress concentration in threads
- 8.5. Effects of material

Practical:
1. **Machine Drawing Practice;**
   One or two drawing assignments that utilize the student's experience in previous drawing courses, but requires more depth of exposure to the production of working drawings including limit dimensioning, surface finish, welds, threads, fasteners, bearings, couplings and other hardware.
2. **Design Project I;**
   Introductory design project which may be the same for all students. It should be selected to combine the ideas of the design process with any analysis required, as well as the drawing process for communication of results. Students should be asked to outline and justify the logic behind the process of decision- making involved in the development of the design.
3. **Design Project II;**

More advanced project requiring a team approach say 4 students per group. The work of the project must be planned by the students as a group, the work divided and deadlines set for completion. Progress should be monitored and evaluated by the instructor at intervals to ensure success of the design effort. Again, detailed drawings are required and, if appropriate, oral presentations may be required for communication and justification of the project.

References:

4. G.E. Dieter, "Engineering Design- a Materials Processing Approach", McGraw Hill, First Metric Edition.
5. M. F. Spotts,"Design of Machine Elements" , Prentice Hall.
6. J.E. Shigley, "Machine Design", McGraw Hill.

Evaluation Schemes:

The questions will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below:

Unit	Chapter	Topics	Marks
1	1, 2 & 3	all	**16**
2	4 & 8	all	**16**
3	5	all	**16**
4	6	all	**16**
5	7	all	**16**
Total			**80**

THEORY OF MECHANISM AND MACHINE II
ME702

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : I**
Practical : 3/2

Course Objective:

To provide basic concept for the dynamics response analysis of common machines and machine components. To model a given system for a vibratory response. To develop computer simulation and program for the dynamic response

1. Engine Force Analysis (2hours)
- 1.1. Analytical Method for Velocity and Acceleration of the Piston and the Connecting Rod
- 1.2. Equivalent Dynamical System
- 1.3. Analytical Method for Inertia Torque
- 1.4. Graphical Method for Velocity and Acceleration of the Piston and the Connecting Rod

2. Turning Moment Diagram and Flywheel (2hours)
- 2.1. Turning Moment Diagram
- 2.2. Fluctuation of Energy and Coefficient of Fluctuation of Energy
- 2.3. Flywheel
- 2.4. Coefficient of Fluctuation of Speed
- 2.5. Energy Stored in a Flywheel and Flywheel Sizing

3. Gyroscopic Couple (3 hours)
- 3.1. Precessional Angular Motion
- 3.2. Gyroscopic Couple
- 3.3. Effect of Gyroscopic Couple on Aeroplane
- 3.4. Stability of a Four Wheel and Two Wheel Vehicles
- 3.5. Effect of Gyroscopic Couple on a Disc Fixed Rigidly at a Certain Angle to a Rotating Shaft

4. Governors (4 hours)
- 4.1. Function of a Governer
- 4.2. Terms Used in Governer
- 4.3. Types of Governers
- 4.4. Sensitiveness and Stability of Governors

5. Balance of Machinery (6 hours)
- 5.1. Balancing of a Single Rotating Mass by a Single Mass Rotating in the Same Plane
- 5.2. Balancing of a Single Rotating Mass by Two Masses Rotating in Different Planes
- 5.3. Balancing of Several Masses Rotating in the Same Plane
- 5.4. Balancing of Several Masses Rotating in the Different Planes
- 5.5. Types of Balancing Machines
- 5.6. Balancing of Reciprocating Masses
- 5.7. Balancing of Multicylinder Engines, In-line, V-type, Opposed and Radial Configurations
- 5.8. Balance of Four Bar Linkages

6. Vibration of Single Degree of Freedom Systems[(10 hours)
- 6.1. Definition and Effects of Vibration, Terms Used in Vibration
- 6.2. Elements of a Vibrating System
- 6.3. Undamped Vibration of Single Degree of Freedom System
- 6.4. Damped Vibration of Single Degree of Freedom System
- 6.5. Forced Harmonic Response of Single Degree of Freedom System with Viscous Damping
- 6.6. Systems with Coulomb Damping
- 6.7. Rotating Unbalance
- 6.8. Whirling of Rotor-Shaft Systems
- 6.9. Vibration Isolation and Force Transmissibility
- 6.10. Response of Harmonic Excitation of Support
- 6.11. Vibration Measuring Instruments
- 6.12. Energy Dissipated by Damping
- 6.13. Convolution Integral and General Force Excitation

7. Vibration of Two Degree of Freedom Systems (4hours)
- 7.1. Undamped Vibration of Two Degrees of Freedom System, Natural Frequencies and Mode Shapes
- 7.2. Damped Vibration of Two Degrees of Freedom System
- 7.3. Forced Harmonic Vibration of Two Degrees of Freedom System
- 7.4. Vibration Absorber

8. Vibration of Multi Degree of Freedom Systems (6hours)
- 8.1. Equations of Motion in Matrix Form
- 8.2. Flexibility and Stiffness Matrices, Reciprocity Theorem
- 8.3. Eigenvalues and Eigenvectors, Orthogonal Properties of Eigenvectors
- 8.4. Modal Analysis
- 8.5. General Forced Response

9. Approximate Numerical Methods (4hours)
- 9.1. Rayleigh Method
- 9.2. Rayleigh-Ritz Method
- 9.3. Dunkerley Method
- 9.4. Matrix Iteration Methods
- 9.5. Finite Difference Method

10. Vibration of Continuous Systems (4 hours)
- 10.1. Lateral Vibration of a String

10.2. Longitudinal Vibration in Rods
10.3. Torsional Oscillation in Circular Shafts
10.4. Lateral Vibration in Beams

Practical:

1. Response of Governors
2. Experiment on Gyroscope
3. Balancing of Rotating Masses
4. Response of a Spring Mass System
5. Whirling of a Rotating Shaft

References:

2. H. Mabie and C.F. Reinholtz, "Mechanisms and Dynamics of Machinery", H, Wiely.
3. W. T. Thomson, "Theory of Vibration with Applications", Prentice Hall.
4. S.S. Rao, "Mechanical Vibrations", Addison Wesley.
5. S. G. Kelly, "Fundamentals of Mechanical Vibrations", Mc Graw Hill.
6. A. Gilat, "MATLAB An Introduction with Applications", Wiley India.

Evaluation Scheme:

There will be questions covering all the chapters of the syllabus. The evaluation scheme will be indicated in the table below:

Unit	Chapter	Topics	Marks
1	1, 2 & 3	all	**16**
2	4 & 5	all	**16**
3	6	all	**16**
4	7 & 8	all	**16**
5	9 & 10	all	**16**
Total			**80**

ENGINEERING ECONOMICS
ME703

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : I**
Practical : 0

Course Objectives:

To provide sound and comprehensive coverage of engineering economics especially. To explain how the business operates, how engineering project decisions are made within the business, and how engineering decisions can affect the bottom line (profit) of the firm. To build a thorough understanding of the theoretical and conceptual basis upon which the practice of financial project analysis is built. To satisfy the very practical needs of the engineer toward making informed financial decisions when acting as a team member or project manager for an engineering project. To incorporate all critical decision-making tools – including the most contemporary, computer –oriented ones such as simulation techniques in risk analysis so that engineers can make informed decision making under uncertainty.

1. Introduction to Engineering Economics (1 hour)
- 1.1. Engineering economics
- 1.2. Engineering economic decisions

2. Cost Concepts and Behavior (5 hours)
- 2.1. Direct material costs
- 2.2. Direct Labor costs
- 2.3. Manufacturing overheads
- 2.4. Non-manufacturing overheads
- 2.5. Cost-volume analysis

3. Understanding Financial Statements (6 hours)
- 3.1. Balance Sheet
- 3.2. Income Statement
- 3.3. Cash-flow Statements
- 3.4. Financial Ratio Analysis of Companies

4. Time value of Money (6 hours)
- 4.1. Compound interest
- 4.2. Types of cash flows
- 4.3. Single cash-flow
- 4.4. Uniform cash-flows, annuity
- 4.5. Linear gradient series
- 4.6. Geometric Gradient series
- 4.7. Irregular cash-flows

5. Project Evaluation Techniques (12 hours)
- 5.1. Project cash flows
- 5.2. Payback period Method
- 5.3. Net present Value Method (NPV)
- 5.4. Future Value Method
- 5.5. Annual Equivalent Method
- 5.6. Internal Rate of Return Method (IRR)

6. Depreciation (3 hours)
- 6.1. Straight-line method
- 6.2. Declining Balance Method
- 6.3. Sum of the digits Method

7. Income Tax & Discounted Cash-flow models (3 hours)
- 7.1. Effect of income tax on cash-flows
- 7.2. Development of discounted cash-flows models on EXCEL

8. Project Risk Analysis (3 hours)
- 8.1. Sensitivity analysis
- 8.2. Breakeven analysis
- 8.3. Probability concepts and
- 8.4. Probability distributions on Excel

9. Economic Analysis in Public Sector (6 hours)
- 9.1. Social costs & social Benefits
- 9.2. Benefit-cost analysis

References:

1. Chan S. Park, "Contemporary Engineering Economics", Prentice Hall of India Pvt. Ltd., New Delhi.

Evaluation Scheme:

There will be questions covering all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below:

Unit	Chapter	Topics	Marks
1	1 & 2	all	**16**
	5	5.1 & 5.2	
2	3 & 6	all	**16**
3	4 & 7	all	**16**

4	5	5.3 to 5.6	**16**
5	8 & 9	all	**16**
Total			**80**

TURBO MACHINES
ME704

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : I**
Practical : 3/2

Course Objective:

To provide fundamental knowledge of turbo machines and their application. Also make them able to describe the working principles and applications of gas turbines and their components.

1. Introduction **(8 hours)**
- 1.1. Definition of a Turbo machine
- 1.2. Parts of a Turbo machine
- 1.3. General Classification of Turbines
- 1.4. Application of First and Second Laws of Thermodynamics
- 1.5. Efficiencies
- 1.6. Dimensionless Parameters and Their Physical Significance
- 1.7. Effect of Reynolds Number and Specific Speed

2. Velocity Vector Diagram **(8 hours)**
- 2.1. Typical Turbine Blade Profile
- 2.2. Analysis of Work Done
- 2.3. Stage Efficiency in
  - 2.3.1. Impulse Turbine
  - 2.3.2. Reaction Turbine
- 2.4. Related problems

3. Gas Turbine **(7 hours)**
- 3.1. Gas Turbine Engine: Schematic
- 3.2. The Theoretical Cycle: The Brayton Cycle
- 3.3. Compressor Inlet and Compressor Performance
- 3.4. Combustion Chamber
- 3.5. Turbine Performance

4. Gas Turbine Nozzles **(8 hours)**
- 4.1. Principle of Operation
- 4.2. Types of Nozzles
- 4.3. Nozzle Performance
- 4.4. Total Temperature and Pressure
- 4.5. Nozzle Energy Equation
- 4.6. The Nozzle Efficiency

5. Theoretical Jet Engine **(8 hours)**
- 5.1. Types of Jet Engines
  - 5.1.1. Turbine powered
  - 5.1.2. Ram Powered
  - 5.1.3. Non-continuous Combustion
- 5.2. Rocket Engine
- 5.3. Hybrid Engines

6. Gas Turbine Cycles of Aircraft Propulsion **(6 hours)**
- 6.1. Turbojet Engines
- 6.2. Turbofan Engines
- 6.3. Turboprop Engines
- 6.4. Overall Performance and Comparison
- 6.5. The Propulsion Efficiency
- 6.6. Variation of the Basic Gas Turbine Engine Cycle

Practicals:
1. Familiarization with Different Types of Turbo Machines
   a. Demonstration of Turbine Parts and Components
   b. Demonstration of Gas Turbine Engine System
2. Familiarization with Different Equipments and Components used in Turbo Machines
3. Gas Turbine Engine Study using Software (Computer Lab)
4. Demonstration of Aircraft Engine and Familiarization with Engine Parameters and Control
5. Familiarization with Tools used in Maintenance Operation of Gas Turbines

References:

1. Csanady , G.T., “Theory of Turbo machines”, McGraw Hill Book Co., New York.
2. Sorensen, H.A., “Gas Turbines”, The Ronald Press co., New York.
3. William W Perg, “Fundamentals of Turbomachinery”, John Wiley & Sons, Inc.

Evaluation Schemes:
The questions will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below.

Unit	Chapter	Topics	Marks
1	1	all	**16**
2	2	all	**16**
3	3 & 6	all	**16**
4	4	all	**16**
5	5	all	**16**
Total			**80**

ENVIRONMENT AND POLLUTION CONTROL
ME705

Lectures : 3 **Year : IV**
Tutorial : 1 **Part : I**
Practical : 3/2

Course Objectives
To make student able to understand sources, nature, and health effects of air pollutants and basic control strategies and equipment; fundamentals of water pollution; nature of sound and quantification, noise control strategies and solid waste, and basic strategies for proper handling of solid waste.

1. Air pollution (8 hours)
- 1.1. Introduction to the different aspects of air pollution
- 1.2. Sources and effects of particulate and gaseous air pollutants
- 1.3. Photochemical reactions
- 1.4. Air pollution sampling and measurement
- 1.5. Measurement of Total suspended particulate, PM_{10} and $PM_{2.5}$
- 1.6. Industrial dust control methods and equipment
- 1.7. Selection of particulate control device
- 1.8. Air quality standards of Nepal

2. Metrological aspects of air pollution dispersion (6 hours)
- 2.1. Temperature lapse rates, atmospheric stability and inversions
- 2.2. Dispersion of air pollutants
- 2.3. The Gaussian plume model

3. Indoor Air Quality (6 hours)
- 3.1. Indoor Air Pollutants
- 3.2. Sources of Indoor Pollutants
- 3.3. Control strategies
- 3.4. Ventilation standards
- 3.5. Household smoke pollution and its effects to the residents

4. Water pollution (6 hours)
- 4.1. Introduction to various aspects of water pollution and water quality standards
- 4.2. BOD, COD, Oxygen sag curve
- 4.3. Water quality standards of Nepal
- 4.4. Municipal waste water treatment systems

5. Solid waste (6 hours)
- 5.1. Characteristics of solid waste
- 5.2. Overview of solid waste generation and management techniques
- 5.3. Hazardous wastes; definition and classification
- 5.4. Hazardous waste management techniques

6. Noise pollution (6 hours)
- 6.1. Nature of sound
- 6.2. Human ear
- 6.3. Quantification of sound in terms of SPL and PWL
- 6.4. Typical noise levels at different places and effects of noise
- 6.5. Noise control methods

7. Global issues and responsible development practices (7 hours)
- 7.1. Brief history of human civilization and development
- 7.2. Ozone depletion
- 7.3. Montreal protocol and controlling of CFC's and HCFCs
- 7.4. Control of ozone depleting substances in Nepal
- 7.5. Causes and effects of greenhouse gases
- 7.6. Indigenous system of natural resource management-land, water, forest, air etc
- 7.7. Sustainability of eco systems and the need for responsible development practices.
- 7.8. Environmentally responsible construction
- 7.9. Education in Human Values (EHV)
- 7.10. Introduction to Clean Development Mechanism (CDM) and carbon trading

Practical:
1. Measurement of TSP by High Volume Sampler
2. Measurement of PM_{10}
3. Measurement of particulate level in different rooms by low volume air sampler
4. Measurement of Noise levels at different surroundings
5. Study visits to municipal solid waste management stations

References:

1. Mackenzie L. Davis & David A. Cornwell, "Introduction to Environmental Engineering", McGraw Hill.
2. Gilbert M. Masters, Standford University, "Introduction to Environmental Engineering and Science", Printice Hall.
3. Stephan Konz, Kansas State University, "Work design", Grid Publishing Inc., Colombus, Ohio
3. C. S. Rao, "Environmental Pollution Control Engineering", New age International (P) Limited, Publishers, India.

Evaluation Scheme
There will be questions covering all the chapters of the syllabus. The evaluation scheme will be indicated in the table below:

Unit	Chapter	Topics	Marks
1	1	all	**16**
2	2 & 3	all	**16**

3	4	all	**16**
4	5 & 6	all	**16**
5	7	all	**16**
Total			**80**

INDUSTRIAL ATTACHMENT
ME 706

Attachment: One month **Year : IV**
Part : I

Course Objective:
To visit and work in different kinds of industries in the country. To study the existing management system and technology of that industry.

General Procedures:
Students in groups will be placed in different industries for the duration of two weeks during vacation. They will be assigned to perform available work in the industry supervised by the assigned engineer/technician from the industry.

After the completion of their attachment each group has to submit the report in writing and give presentation to the committee formed by the department.

The report should include technical as well as managerial part of the industry.

Evaluation Scheme:
The evaluation scheme will be indicated in the table below:

	Marks
Evaluation by supervisor from industry	**50**
Evaluation of written report	**20**
Presentation	**30**
Total	**100**

ELECTIVE-I

AUTOMOBILE TECHNOLOGY
ME72501

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : I**
Practical: 3/2

Course Objectives:
To familiarize the main components of automobile and its classification and to understand the functions of various components. To find possible faults and take necessary action for repair and to carry out the regular maintenance of the motor vehicle.

1. Introduction To Automobiles (1 hour)
- 1.1 History of development
- 1.2 Classification of motor vehicles
- 1.3 Components of an automobile
- 1.4 Chassis layout and types

2. Drive Train (8 hours)
- 2.1 Clutch
  - 2.1.1 Purpose and function
  - 2.1.2 Types, main parts
  - 2.1.3 Common troubles and its diagnosis
- 2.2 Gearbox: manual, automatic
  - 2.2.1 Introduction
  - 2.2.2 Purpose and function
  - 2.2.3 Types: sliding mesh, constant mesh, synchromesh and epicyclic gearboxes; gear shifting
  - 2.2.4 Automatic gearbox
  - 2.2.5 Overdrive
  - 2.2.6 Common trouble and its diagnosis
- 2.3 Universal joints and propeller shafts
  - 2.3.1 Introduction, types of universal joints
  - 2.3.2 Common trouble and its diagnosis
- 2.4 Final drive
  - 2.4.1 Function and types
  - 2.4.2 Main parts
  - 2.4.3 Differential
  - 2.4.4 Four wheel drive
  - 2.4.5 Common trouble and its diagnosis

3. Wheel And Tyres (4 hours)
- 3.1 Types of wheels, wheel dimensions
- 3.2 Types of tyre, properties
- 3.3 Tyre designations, factors affecting tyre life, tyre pressure and its effect
- 3.4 Changing of tyre, tyre rotation

4. Suspension System (2 hours)
- 4.1 Introduction and objective
- 4.2 Types, main parts
- 4.3 Trouble shooting

5. Brakes (4 hours)
- 5.1 Introduction and objective
- 5.2 Importance of stopping distance, braking distance
- 5.3 Main parts
- 5.4 Types: mechanical, hydraulic, power-assisted brakes
- 5.5 Brake adjusting
- 5.6 Brake shoe and lining materials
- 5.7 Antilock braking system

6. Steering System (4 hours)
- 6.1 Need for the system and parts
- 6.2 Types of steering linkage and boxes
- 6.3 Power steering
- 6.4 Common trouble
- 6.5 Wheel alignment

7. Electrical System (6 hours)
- 7.1 Lighting and wiring system
- 7.2 Battery, starter motor, generator
- 7.3 Electrical and electronics instrument
- 7.4 Accessories
- 7.5 Common trouble and its diagnosis

8. Alternative Fuel Vehicles (8 hours)
- 8.1 Working of alternative fuel vehicles: alcohol, compressed natural gas, propane or LPG, hydrogen, electricity
- 8.2 Working of hybrid vehicles
- 8.3 Historical development of these vehicles
- 8.4 Construction of hybrid and alternative fuel vehicles
- 8.5 Benefits to environment
- 8.6 Operation and maintenance of these vehicles

9. Vehicular Rules And Acts (2 hours)
- 9.1 Introduction
- 9.2 Motor vehicle act, registration of motor vehicle, driving license, control of traffic, insurance against risk, claims for compensation

10. Workshop Layout And Vehicle Maintenance (6 hours)

10.1 Garage and workshop layout
10.2 Calculation of workshop post, no. of workers and area of sections of the workshop
10.3 Measuring instruments, tool and workshop equipment
10.4 Vehicle maintenance and repair: types and purposes

Practical:

1. **Clutch And Gearbox**
   Types, main parts, dismantling, identification and assembling of components of clutch and gearbox; checking the conditions of clutch plate, pressure plate, release bearing, gears.
2. **Propeller Shaft, Final Drive And Differential**
   Main parts, dismantling, identification and assembling of main parts of differential; checking the conditions of propeller shaft, universal joints, final drive and differential.
3. **Brakes**
   Types, main parts, dismantling, identification and assembling of brake components; checking the conditions of master cylinder, brake drum/discs, brake linings, pipe lines, brake oil reservoir
4. **Suspension And Axles**
   Types, main parts; checking their conditions
5. **Wheel, Tyres And Steering**
   Types, main parts; checking the conditions of tyres and tubes, wheel and steering gearbox, steering wheels
6. **Battery, Starting Motor, Charging System, Lighting And Wiring**
   Battery: main parts, proper handling of electrolyte, use of battery charging and testing equipment, charging of new/used battery, servicing of battery.
   Starting motor: main parts, dismantling, Identification of parts and assembling of starting motor, testing of starting motor on test bench and on car.
   Charging system: types of generator and working principle, dismantling, identification of parts and assembling of generators, working principle of regulator and cut-outs.
   Wiring layouts, identification of components, fault finding, replacing the damaged components.

References:

1. Crouse, H. W. and Anglin, D. L., " Automotive Mechanics", TATA McGraw hill Publishing Company Ltd., New Delhi
2. Bosch, " Automotive Handbook", Robert Bosch GmbH, Germany.
3. Moeed, K.M., "Automobile Engineering", S.K. Kataria & Sons, New Delhi, India.
4. "Skill testing standards on motor vehicle" – Nepal skill testing authority, CTEVT

Evaluation Scheme:

There will be questions covering all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below:

Unit	Chapters	Topics	Marks
1	1 & 2	all	**16**
2	3, 4 & 5	all	**16**
3	6 & 7	all	**16**
4	8	all	**16**
5	9 & 10	all	**16**
Total			**80**

HEATING VENTILATING AND AIR CONDITIONING
ME72502

Lectures : 3 **Year : IV**
Tutorial : 1 **Part : I**
Practical : 3/2

Course Objectives:

To understand the properties of air and the psychometric processes that takes place in various Heating, Ventilating and Air Conditioning Systems and to become familiar with Vapor compression, Vapor absorption and Air refrigeration and Air Conditioning systems. Also to understand the basic issues involved with Human comfort with respect to thermal surroundings and to understand the basic structure, and operation of major components used in HVAC systems. To develop understanding of HVAC system design principles .

1. Basic Refrigeration systems review: (5 hours)
- 1.1. Vapor compression cycle fundamentals
- 1.2. Vapor absorption system.
- 1.3. Air refrigeration system

2. Revision of Psychrometrics, and Psychrometric Processes (6 hours)
- 2.1. Properties of Air
- 2.2. Psychrometric relationships
- 2.3. Adiabatic Saturation Processes
- 2.4. Psychrometer, Anemometer
- 2.5. Psychrometric Chart
- 2.6. Sensible Heating and Cooling.
- 2.7. Cooling and Dehumidification
- 2.8. Adiabatic humidification
- 2.9. Adiabatic Chemical Dehumidification
- 2.10. Humidification by Steam Injection
- 2.11. Heating and Dehumidification
- 2.12. Mixing of Air Streams
- 2.13. Numerical examples on Psychrometric processes involving different processes and/or their combinations

3. Human comfort and Air Conditioning requirements (2 hours)
- 3.1. Thermodynamics of Human body
- 3.2. Effective Temperature
- 3.3. Factors governing Effective Temperature
- 3.4. Acceptable Indoor Air quality

4. Vapor Compression Air Conditioning Systems (6 hours)
- 4.1. Construction uses and operations of the following Components
  - 4.1.1. Different types of Compressors
  - 4.1.2. Evaporators
  - 4.1.3. Condensers
  - 4.1.4. Expansion devices
  - 4.1.5. Pressure cutouts
  - 4.1.6. Thermostats
  - 4.1.7. Humidistat
  - 4.1.8. Cooling towers
  - 4.1.9. Flow control valves
- 4.2. Air cooled air conditioning machines including automobile air conditioning system
- 4.3. Water cooled air conditioning systems
- 4.4. Central air conditioning system with air cooled chiller, AHUs and FCUs
- 4.5. Water balancing
- 4.6. Direct expansion (DX) systems
- 4.7. Principles of VRV system
- 4.8. Variable Refrigerant Volume type of Air Conditioning system
  - 4.8.1. Construction and operation of VRV system
  - 4.8.2. Different types of Indoor units and their application

5. Solar Heating system fundamentals (6 hours)
- 5.1. Passive solar systems
- 5.2. Solar Floor Heating Systems
- 5.3. Characteristics of solar Floor Heating Systems

6. Air Conveying Systems & Ventilation (6 hours)
- 6.1. Fans, and types of Fans; Centrifugal, Axial, Inline
- 6.2. Fan laws and velocity triangles for moving blades of centrifugal fans
- 6.3. Fan and System characteristics
- 6.4. Related Numerical examples
- 6.5. Ducts and related standards
- 6.6. Diffusers, Grills
- 6.7. Air Filters

7. Measuring instruments (4 hours)
- 7.1. Air flow measurement instruments
- 7.2. Temperature measuring instruments
- 7.3. Pressure measurement instruments
- 7.4. Relative humidity measurement instruments

8. Introduction to Air Conditioning System Design (10 hours)
- 8.1. Cooling load determination & CLTD method
- 8.2. Heating load determination
- 8.3. Plotting of Air Conditioning processes in Psychometric chart and related numerical examples

Practical:

1. Use of different types of temperature measuring equipment, Use of Sling Psychrometer, Use of Anemometer and Measurement of air flow and friction loss in ducts of different shapes
2. Study of Comfort Air Conditioning system with the help of the simulator and determination of the coefficient of Performance
3. Study automobile air conditioning system
4. Site visits where HVAC systems are preferably in the process of installation or installed
5. Case Study

References:

1. C. K. Rajput, "A Text Book of Refrigeration and Air Conditioning", S. K Kataria & Sons publication, New Delhi, India.
2. S. C. Arora & S. Domkundwar, "A Course in Refrigeration and Air Conditioning", Dhanpar Rai & Sons Publication, New Delhi, India.
3. Andrew D. Althouse, Carl H. Thrnouist, and Alfred F. Bracciano, "Modern Refrigeration and Air Conditioning", Galgotia Publication, New Delhi, India.
4. Carrier Air Conditioning Company, "Handbook of Air Conditioning System Design".
5. C. P. Arora, "Refrigeration and Air Conditioning", Tata McGraw Hill, India.,
6. "ASHRAE Handbooks on Fundamentals and HVAC Applications", Americal Society of Heating Refrigerating and Air Conditioning Engineers, Tullie Circle, Atlanta, USA

Evaluation Scheme:

The questions will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below:

Unit	Chapters	Topics	Marks
1	1 & 4	all	**16**
2	1 & 5	all	**16**
3	2 & 3	all	**16**
4	6 & 7	all	**16**
5	8	all	**16**
Total			**80**

GASEOUS BIO-FUEL
ME72503

Lectures : 3 **Year : IV**
Tutorial : 1 **Part : I**
Practical : 3/2

To know different types of gaseous biofuels resources, production technologies, and applications and system design of major gaseous biofuel plants. To know operation and maintenance of major gaseous biofuel plants and scope and application of gaseous biofuel in Nepal.

1. **Introduction of gaseous biofuel (9 hours)**
   - 1.1. Overview of different types of gaseous bio-energy (Pyrolytic gas, CH_4, H_2, C_2H_6, Producer gas, Land fill gas etc.)
   - 1.2. Resources of gaseous biofuel in Nepal
   - 1.3. Scope and application of gaseous biofuel in Nepal
   - 1.4. Gaseous biofuel development agencies and their activities in Nepal
   - 1.5. Review of relevant gaseous biofuel policy of Nepal and its limitations

2. **Biogas (9 hours)**
   - 2.1. Composition and characteristics of biogas
   - 2.2. Metabolic pathway of biogas
   - 2.3. Biochemical and physical continents of substrate , biogas and effluent
   - 2.4. Loading rate, retention time, dilution and consistency of input, pH value, temperature, C/N ratio, toxicity for biogas production
   - 2.5. Necessary condition for anaerobic digestion
   - 2.6. Scope of biogas
   - 2.7. Limitations of GGC 2047 model
   - 2.8. Government subsidy policy and its limitations
   - 2.9. Advantages and limitations of biogas

3. **Design and construction of biogas plant (9 hours)**
   - 3.1. Configuration of biogas plant
   - 3.2. Types of digester
   - 3.3. Different parts of biogas plant
   - 3.4. Site selection and construction detail
   - 3.5. Different size and model of biogas plant
   - 3.6. Quality control during construction
   - 3.7. Design of plant for urban area in small scale with kitchen waste as well as toilet attached
   - 3.8. Design of commercial bio-gas plant
   - 3.9. Low temperature biogas plant

4. **Management and socio economic aspect (9 hours)**
   - 4.1. Operation and maintenance of biogas plant
     - 4.1.1. Potential problems during operation of biogas plant
     - 4.1.2. Maintenance of biogas plant
     - 4.1.3. Users Training and After sales Services
     - 4.1.4. Biogas production methods at winter season
   - 4.2. Economic, social and environmental aspect of biogas
     - 4.2.1. Biogas installation cost and financial viability (Discounted payback and IRR)
     - 4.2.2. Loan arrangement and repayment condition
     - 4.2.3. Slurry utilization
     - 4.2.4. Biogas in relation to health and sanitation
     - 4.2.5. Biogas in relation to local environment
     - 4.2.6. Carbon trade

5. **Biohydrogen (4 hours)**
   - 5.1. Basics of biohydrogen production
     - 5.1.1. Dark and photo fermentation
     - 5.1.2. Metabolic process
   - 5.2. Biohydrogen reactor
   - 5.3. Effect of process parameters including pH, temperature, hydraulic retention time, organic loading rate, volatile fatty acids
   - 5.4. Optimization of biohydrogen production

6. **Thermo chemical gasification of biomass (5 hours)**
   - 6.1. Chemistry of biomass gasification
   - 6.2. Type of gassifier and their working principle
   - 6.3. Thermal and power applications of producer gas

Practical:
1. Determination of efficiency of biogas stove and comparison with gas stove
2. Complete design, financial and economic analysis of small biogas plant
3. Site visit to observe large biogas plant in different stage of construction and operation and prepare detail feasibility study report

Reference:

1. Biomass Forum: A journal published by BORDA, Germany
2. FAO/CMS, “Biogas Technology: A Training Manual for Extension. Prepared for FAO by consolidated Management Services”, Nepal (p) Ltd.
3. Godfrey, B, “Renewable Energy Power for a Sustainable Future”, Oxford University press.
4. Howes, M. and Endagama, P, “Farmers, Forests and Fuel”, Intermediate Technology Publications.

5. Hurst, C and Barnrtt, A, " The Energy Dimension – A Practical Guide to Energy in Rural Development Programmes", Intermediate Technology Publications.
6. IUCN, "EIA of the Bara Forest Management Plan", Kathmandu, Nepal.
7. J. Twidell and T. Weir, "Renewable Energy Resources", Taylor and Francis.
8. Karki A.B. and Dixit, K, "Biogas Fieldbook", Sahayogi Prakashan , Tripureshwar , Kathmandu, Nepal.
9. Martian, A, "Introduction to Soil Microbiology", John Wiley & Sons. New York.
10. Sathianathan, M. A, "Biogas: Achievement and challenges", AVARD, New Delhi.
11. "Updated Guidebook on Biogas Development Series (1984) No. 27", United Nations, New York, USA.
12. Werner U, Stohr U and Hees N, "Biogas Plants in Animal Husbandry", GATE / GTZ, Germany.

Evaluation Scheme:

There will be questions covering all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below:

Unit	Chapter	Topics	Marks
1	1	all	**16**
2	2	all	**16**
3	3	all	**16**
4	4	all	**16**
5	5 & 6	all	**16**
Total			**80**

OPERATIONS RESEARCH/MANAGEMENT SCIENCE
ME72504

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : I**
Practical : 3/2

Course Objectives:

To make capable of managing data, analyzing data such as sorting, pivoting tables, and applying statistical analysis in a spreadsheet environment. To familiarize with forecasting methods, linear programming, inventory models. To make familiar with simulation in decision-making under risk and uncertainty with the use of risk analysis software such as CRYSTAL BALL. To make capable in applying the knowledge gained during the course for solving real problems in decision-making.

1. Introduction to Modeling for Decisions & Data Management and Analysis (7 hours)
- 1.1. application and benefits of Operations Research
- 1.2. developing Models
- 1.3. analyzing and solving models; interpretation and Use of Model Results
- 1.4. applications of Data Management and Analysis
- 1.5. data Storage and Retrieval & data Visualization

2. Regression Analysis & Time series analysis (10 hours)
- 2.1. Regression Analysis
  - 2.1.1. Simple linear regression
  - 2.1.2. Multiple linear regression
- 2.2. Forecasting models with
  - 2.2.1. trend components
  - 2.2.2. seasonal components
  - 2.2.3. trend and seasonal components
  - 2.2.4. Selecting the best forecasting methods
  - 2.2.5. Forecasting with CB predictor

3. Introduction to optimization (10 hours)
- 3.1. Modeling optimization problem in EXCEL
- 3.2. Building Linear Programming Models
- 3.3. Solving Linear Programming Models
- 3.4. Network modeling
- 3.5. Interpreting Solver Results and Sensitivity Analysis
- 3.6. solving Multi-objective Models
- 3.7. using Premium Solver for Linear Programming
- 3.8. Goal programming & multi-objective programming
- 3.9. genetic algorithms

4. Decision Analysis (4 hours)
- 4.1. Application of Decision analysis
- 4.2. Structuring Decision Problems
- 4.3. Demand limiter
- 4.4. Expected Value decision-making
- 4.5. Optimal Expected Value Decision Strategies

5. Risk Analysis (10 hours)
- 5.1. Monte Carlo Simulation
- 5.2. Applications of Monte Carlo Simulation
- 5.3. Building Monte Carlo Simulation Models
- 5.4. Different Probability Distributions
- 5.5. Building Simulation Models with CRYSTAL BALL & analysis

6. Optimization and Simulation (4 hours)
- 6.1. Optimization under uncertainty
- 6.2. Optimization and Monte carlo simulation
- 6.3. Use of OPTQUEST and CRYSTAL BALL

Practical:
Course project on real and practical problems such as forecasting, queuing, inventory and optimization problems has to be done. The report has to be submitted on the acceptable format at the end of the course. Group presentation should be carried out at the end of the course period.

References:

1. Ragsdale, Cliff T., "Spreadsheet Modeling and Decision Analysis, A Practical Introduction to Management Science", South Western, Cengage Learning.
2. Wayne Winston, and S. Christian Albright, "Practical Management Science: Spreadsheet modeling and applications", Thompson Learning.
3. Camm, Jeffrey D. and James R. Evans, "Management Science & Decision Technology", South – Western College Publishing, A Division of Thompson Learning, USA.
4. Hillier, Frederick S., Mark S. Hillier, and Gerald J. Lieberman, "Introduction to Management Science: A Modeling and Case Studies Approach with Spreadsheets", McGraw-Hill International Editions.

5. Evans, James R. and David L. Olson, “Introduction to Simulation and Risk Analysis”, Prentice Hall, Upper Saddle River, New Jersey.
6. Winston, Wayne L., “Operations Research: Applications and Algorithms”, International Thompson Publishing.

Evaluation Scheme:
The questions will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below:

Units	Chapters	Topics	Marks
1	1	all	**16**
2	2	all	**16**
3	3	all	**16**
4	4 & 6	all	**16**
5	5	all	**16**
Total			**80**

BASICS OF MICRO HYDROPOWER PLANT
ME72505

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : I**
Practical : 3/2

Course Objectives

To develops an idea of effectively generating electrical energy from hydraulic energy using micro hydropower system. To become familiar with technical aspects of MHP plant which includes civil components, mechanical components, electrical components and transmission system. To become familiar with management and various application of MHP plant, failure as well as sustainability of MHP plant. To give concepts for the evaluation of MHP plant, basic concepts of financial analysis. To acquire some knowledge on future prospects of MHP project in Nepal.

1. Introduction to micro-hydropower technology (7 hours)
- 1.1. Power from water
- 1.2. Classification of hydropower and end uses
- 1.3. System components of Mini and Micro Hydropower
- 1.4. Introduction of Hydropower plant in Nepal
- 1.5. Micro Hydropower plant in Nepal
- 1.6. Policy of Nepal Government and concerned authorities
- 1.7. Potential Hydropower plant projects identified in Nepal
- 1.8. Water management

2. Hydrology and site survey (4 hours)
- 2.1. Preparation for site survey
  - 2.1.1. Map study of site
  - 2.1.2. Meteorological data analysis
- 2.2. Site survey
  - 2.2.1. Head measurement
  - 2.2.2. Flow measurement

3. Technical aspects of MHP plant (12 hours)
- 3.1. Main component of MHP plant
  - 3.1.1. Intake
  - 3.1.2. Canal
  - 3.1.3. De-sanding basin
  - 3.1.4. Spillway

3.1.5. Fore-bay
3.1.6. Penstock
3.1.7. Powerhouse
3.1.8. Tailrace
3.2. Suitable condition for MHP
3.3. Potential power from MHP
3.4. Turbine
3.4.1. Introduction
3.4.2. Types of turbine
3.4.3. Uses of turbine
3.5. Types of generator
3.5.1. Synchronous generator
3.5.2. Induction generator
3.6. Controllers for MHP generator
3.6.1. Control panel
3.6.2. Load control governor
3.7. Transmission and distribution lines and service connection
3.8. Plant efficiency
3.9. Load factor
3.10. Operation and maintenance of MHP plant
3.10.1. Structured system for operation and maintenance
3.10.2. Maintenance of different parts of MHP
3.10.3. Operation of different parts of MHP plant

4. Energy management (3 hours)
4.1. Introduction of energy management
4.2. Payment by metering
4.3. Demand limiter
4.4. Pre-payment metering
4.5. Time diversity for high load uses

5. Application of MHP plant (3 hours)
5.1. Application of MHP
5.2. Agro processing
5.3. Battery charging
5.4. Lighting houses
5.5. Small scale industries

6. Failure of MHP plant (3 hours)
6.1. Overview of failure of MHP plant
6.2. Insufficient site studies
6.3. Effects of floods and land slides
6.4. Uneconomical canal length
6.5. Insufficient structures for service and repair
6.6. Inability to pay tariffs by targeted population

7. Sustainability of MHP plant (3 hours)
7.1. Overview of sustainability of MHP plant
7.2. Technically feasible
7.3. Social acceptance
7.4. Community management
7.5. Financially viable

8. Project evaluation and report preparation (10 hours)
8.1. Overview of project evaluation and report preparation
8.1.1. Plant factors
8.1.2. Unit energy cost
8.1.3. Cost benefit decisions
8.2. Financial analysis
8.3. Pre-feasibility and feasibility study
8.3.1. Pre-feasibility
8.3.2. Feasibility study
8.4. Problems, recommendations and areas of future prospective of MHP plant in Nepal

Practical:
Practical means project work and report have to be submitted at the end of the course. The report should be around 20-30 pages plus appendix.

References:

1. Adam Harvey, "Micro Hydro design Manual", Intermediate Technology Publication.
2. Win Hulsher and Peter Frankel, "The Power Guide, Intermediate Technology Publication.
3. "Manuals on MHP for Installation and Commissioning, Maintenance and Repair, Operation and Management", ICIMOD.
4. Dr. Rajendra Shrestha, "Basics of micro hydropower (AE 123)", Course Manual for Department of Alternative Energy Tumba College of Technology Rwanda, 2009
5. Dr. Rajendra Shrestha, "Reference Book on Beginner's Micro Hydropower Plant", Graphic International Nepal.

Evaluation Scheme:
The questions will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below:

Unit	Chapters	Topics	Marks
1	1	all	**16**
2	2, 4 & 5	all	**16**
3	3	all	**16**
4	6 & 7	all	**16**
5	8	all	**16**
Total			**80**

BASIC AIRCRAFT & AIR FRAME
ME72506

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : I**
Practical : 3/2

Course Objective:

To develops basic idea about different types of aircraft. To become familiar with different types of aircraft structure, construction & materials and to develop basic idea about the airframe maintenance.

1. Introduction to Aircraft (2 hours)
- 1.1. History of aircraft
- 1.2. Development trends of aircraft on the aspect of design and scale
- 1.3. Classification of Aircraft on the basis of engine, Commercial application and manufacturer
- 1.4. Modern era of Aircraft
- 1.5. Introduction of Aircraft use in Nepal

2. Main component of Air Frame (18 hours)
- 2.1. Fuselage
  - 2.1.1. Construction and pressurisation sealing;
  - 2.1.2. Wing, stabiliser, pylon and undercarriage attachments
  - 2.1.3. Seat installation and cargo loading system
  - 2.1.4. Doors and emergency exits: construction, mechanisms
  - 2.1.5. Operation and safety devices
  - **2.1.6.** Windows and windscreen construction and mechanisms.
- 2.2. Wings
  - 2.2.1. Construction;
  - 2.2.2. Fuel storage;
  - 2.2.3. Landing gear, pylon, control surface and high lift/drag attachments
- 2.3. Landing Gear
  - 2.3.1. Construction, shock absorbing;
  - 2.3.2. Extension and retraction systems: normal and emergency;
  - 2.3.3. Indications and warning;
  - 2.3.4. Wheels, brakes, antiskid and auto braking;
  - 2.3.5. Tyres;
  - 2.3.6. Steering.
- 2.4. Empennage
  - 2.4.1. Construction;
  - 2.4.2. Control surface attachment.
  - 2.4.3. Tail functions and arrangement
  - 2.4.4. Horizontal Stabilizer
  - 2.4.5. Vertical Stabilizer
  - 2.4.6. Rudder and Elevator

3. Flight Control Surfaces (3 hours)
- 3.1. Primary controls: aileron, elevator, rudder, spoiler;
- 3.2. Trim control;
- 3.3. Active load control;
- 3.4. High lift devices;
- 3.5. Lift dump, speed brakes;
- 3.6. System operation: manual, hydraulic, pneumatic, electrical
- 3.7. Artificial feel, Yaw damper, Mach trim, rudder limiter, gust
- 3.8. Locks systems;
- 3.9. Balancing and rigging

4. Hydraulic & Pneumatic System (3 hours)
- 4.1. Hydraulic systems and its components
- 4.2. Pneumatic system and its components

5. Equipment and Furnishings (3 hours)
- 5.1. Emergency equipment requirements; Seats, harnesses and belts.
- 5.2. Cabin lay-out; Equipment lay-out;
- 5.3. Cabin Furnishing Installation;
- 5.4. Cabin entertainment equipment;
- 5.5. Galley installation;
- 5.6. Cargo handling and retention equipment;
- 5.7. Air stairs.

6. Fuel Systems (5 hours)
- 6.1. System Layout
- 6.2. Fuel Tanks
- 6.3. Supply system
- 6.4. Dumping, Venting & Draining
- 6.5. Cross feed & Transfer
- 6.6. Indication & warning
- 6.7. Refuelling & Defueling

7. Other equipments & Components (9 hours)
- 7.1. Fire Protection system
- 7.2. Lighting System
- 7.3. Waste and Water system
- 7.4. Oxygen supply
- 7.5. Ice & Rain Protection system
- 7.6. Air conditioning systems & distribution

7.7. Cabin Pressurisation
7.8. Safety & Warning Device

8. Maintenance of Airframe (2 hours)

8.1. Maintenance work of airframe
8.2. Maintenance equipments & tools
8.3. Spare parts management

Practical:

Practical means project work and report have to be submitted at the end of the course. The report should be around 20-30 pages plus appendix in the context of different types of piston and jet engines aircraft , corresponding airframe constructions, layout and their maintenance practice in Nepal.

1. Case study
2. Site visit

References:

1. Michael Chun-Yung Niu, "Airframe Structural Design", Hong Kong Conmilit Press Ltd.
2. "Airframe & Power plant Mechanics", U.S. Department of Transportation, Federal Aviation Administration (FAA), AC65-12A & 15A
3. Daniel P. Raymer, "Aircraft Design: A conceptual Approach", American Institute of Aeronautics & Astronautics (AIAA) Education.
4. Bandu N. Pamadi, "Performance, Stability, Dynamics, and Control of Airplanes", AIAA Education Series.
5. R.S.shevell, "Fundamentals of Flight", Pearson Education, Second Edition.
6. John J. Bertin , "Aerodynamics for Engineers", Pearson Education.
7. Aircraft Manual of different manufactures

Evaluation Scheme:

The questions will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below:

Unit	Chapter	Topics	Marks
1	1, 3 & 4	all	**16**
2	2	2.1 & 2.2	**16**
3	2	2.3 & 2.4	**16**
4	5, 6 & 8	all	**16**
5	7	all	**16**
Total			**80**

TOOL DESIGN FOR ECONOMIC PRODUCTION
ME72508

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : I**
Practical : 3/2

Course Objectives : After completion of the course students appreciate and realize the importance of the relation between tooling with design, cost and production. They can apply jigs and fixtures in production and design them as per demand.

1. **Cutting tools for productive machining** **(12 hours)**
   - **1.1** Mechanics of metal cutting
   - **1.2** Cutting tools materials
   - **1.3** Machinability
   - **1.4** Economics of machining
   - **1.5** Modern cutting tool techniques.
2. **Press tools** **(8 hours)**
   - **2.1** Types of presses
   - **2.2** Computation of capacities and tonnage requirements for blanking, piercing, bending, forming and drawing operations.
   - **2.3** Principles and design procedures for press tools
   - **2.4** Detailed design procedure for bending operation with examples.
3. **Forging dies** **(8 hours)**
   - **3.1** Types of forging equipment and operations
   - **3.2** Component and materials design for forging
   - **3.3** Die design for drop and press forging
   - **3.4** Die design for machine forging
   - **3.5** Tools for flash trimming and hole piercing
4. **Jigs and Fixtures – introduction** **(5 hours)**
   - **4.1** Definitions of jigs and fixtures
   - **4.2** Function of jigs and fixtures
   - **4.3** Analysis of locating, clamping and guiding methods
   - **4.4** Work holding principles of flat, round and irregular surfaces and methods of holding them.
5. **Design of drill jigs** **(5 hours)**
   - **5.1** Types of drill jigs
   - **5.2** Jig and machine relationship
   - **5.3** Jig body and jig feet
   - **5.4** Examples of typical drill jigs
     - **5.4.1** Plate jig, solid jig, turn over jig
     - **5.4.2** Pot and post jig, swing-latch jig
     - **5.4.3** bBox jig, indexing drill jig
6. **Design of fixtures** **(7 hours)**
   - **6.1** Types of milling fixtures
   - **6.2** Fixtures and machine relationship
   - **6.3** Examples of typical milling fixtures
     - **6.3.1** Plain milling fixtures, string milling fixtures
     - **6.3.2** Gang milling fixtures, indexing milling fixtures
   - **6.4** Design of turning, grinding and broaching fixtures.

Practical:
Minimum of **THREE assignments** on Design, manufacture and use of a complete set of tooling for a component.

References:

1. ASTME, "Fundamental of Tool Design"
2. Colo C.B, " Tool Design"
3. ASTME, "Die Design Hand Book".
4. Calvin and Hoise , "Jigs and Fixtures"
5. Jain and Gupta, " Production Technology**"**

Evaluation Schemes

The question will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table.

Unit	Chapter	Topics	Marks
1	1	all	**16**
2	2	2	**16**
3	3	all	**16**
4	4 & 5	all	**16**
5	6	all	**16**
Total			**80**

PROJECT ENGINEERING
CE 751

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : II**
Practical : 0

Course Objective:

- To introduce the basic knowledge on project and project environment
- To make the students able to prepare feasibility study report and project proposal.
- To provide the sound knowledge of project planning, implementation and controlling.
- To provide knowledge on risk associated with the project
- To provide the knowledge of project finance and
- To provide the concept of modern trends and techniques of project management.

1. Introduction of Project and Project Management (6 hours)

1.1. Definition of Project, its characteristics, and example of project.
1.2. Classification of Project
1.3. Project Objective and Goal
1.4. Project Life Cycle Phases
1.5. Project Environment
1.6. Introduction to Project Management

2. Project Appraisal and Project Formulation (8 hours)

2.1. Concept of Project Appraisal
2.2. Project Proposal (technical and financial)
2.3. Procedure for Developing Project Proposal
2.4. Techniques of Project Formulation
- Feasibility analysis
- Cost Benefit analysis
- Input analysis
- Environmental analysis

3. Project Planning and Scheduling (12 hours)

3.1. Concept of Project Planning and its Importance
3.2. Project Planning Process
3.3. Work Breakdown Structure (WBS)
3.4. Project Scheduling with Bar Chart, CPM & PERT
3.5. Project Scheduling with Limited Resources (Resource Leveling and Smoothing)
3.6. Introduction to Planning Software - MS Project

4. Project Implementation and Controlling. (7 hours)

4.1. Introduction to Monitoring, Evaluation and Controlling
4.2. Project Control
4.3. Project Control Cycle
4.4. Elements of Project Control (time, cost and quality)
4.5. Project Schedule Control
4.6. Project Cost Control: Methods and procedure (Earned value analysis)
4.7. Project Quality Control
4.8. Introduction to Project Management Information System (PMIS)

5. Project Risk Analysis and Management (7 hours)

5.1. Introduction to Project Risk
5.2. Types of Project Risk
5.3. Analysis of Major Sources of Risk
5.4. Effective Management of Project Risk
- Risk Management planning
- Risk Identification
- Qualitative and Quantitative Risk Analysis
- Risk Response Planning
- Risk Monitoring and Controlling

6. Introduction to Project Financing (5 hours)

6.1. Project finance
6.2. Capital Structure Planning
6.3. Capital Budgeting Decision

Tutorial:

1.	Writing project Proposal	(2 hours)
2.	Scheduling Using Bar chart & CPM	(4 hours)
3.	Scheduling Using Planning Software	(4 hours)
4.	Project Control Method (EVA)	(1 hour)
5.	Capital Structure Planning Exercise	(2 hours)
6.	Capital Budgeting Exercise	(2 hours)

References:

1 IshwarAdhikari and Santosh Kr. Shrestha, "A text book of Project Engineering", Chandeshwori Publication, First Editn.
2 DhurbaP.Rizal, "Project Management" , Ratnapustakbhandar.
3 E.R. Yescombe, "Principles of Project Finance" Yescombe-Consulting Limited.
4 K. Nagarajan, "Project Management", ISBN: 81-224-1340-4, New Age International (P) Limited, New Delhi, India.
5 Dr. Govinda Ram Agrawal, "Project Management in Nepal" Edition: 2006, M.K. Publishers and Distributors, Kathmandu, Nepal.

Evaluation Scheme:

The questions will cover all the chapters in the Syllabus. The evaluation scheme will be as indicated in the table below.

Unit	Chapters	Topics	Marks
1	1& 6	all	**16**
2	2	all	**16**
3	3	all	**16**
4	4	all	**16**
5	5	all	**16**
Total			**80**

FINITE ELEMENT METHOD

ME751

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : II**
Practical : 3/2

Course Objectives:

To understand the basic steps of finite element methods, its applications and advantages. To develop the finite element model for discrete structural and non structural problems and continuum problems specially heat transfer, plane elasticity. To develop computer program and use commercial software for above mentioned problems.

1. Overview (2 hours)
- 1.1. Introduction
- 1.2. Brief history
- 1.3. Mathematical modeling of the physical system
- 1.4. FEM Analysis Process
- 1.5. FEM Steps
- 1.6. Applications of the Finite Element Method
- 1.7. Advantages of the Finite Element Method

2. Mathematical Background (2 hours)
- 2.1. Vector analysis
- 2.2. Matrix theory
- 2.3. Differential Equations

3. Direct Stiffness Method: Discrete Finite Elements (8 hours)
- 3.1. Spring/Bar Element
- 3.2. Truss Element
- 3.3. Beam Element
- 3.4. Frame Element
- 3.5. Analogous problems in one dimension

4. Continuum Problems (8 hours)
- 4.1. Ritz Method
- 4.2. Method of Weighted residuals
- 4.3. Strong and Weak formulation

5. Interpolation Functions (10 hours)
- 5.1. Piecewise defined functions
- 5.2. One dimensional element
- 5.3. Two dimensional element
  - 5.3.1. Triangular element
  - 5.3.2. Rectangular element
- 5.4. Variation approach

6. Applications in Solid Mechanics (10 hours)
- 6.1. Plane stress
- 6.2. Plane strain
- 6.3. 3 dimensional element
- 6.4. Axisymmetric stress analysis
- 6.5. Thermal stress analysis

7. Higher order Elements (5 hours)
- 7.1. Lagrange elements
- 7.2. Serendipity elements
- 7.3. Parametric Mapping

Practical:

1. Development of Computer programs for discrete structural problems (Bar, Truss, Beam and Frame).
2. Development of Computer program for discrete non-structural problems (Heat Transfer, Fluid Flow).
3. Development of Computer program for one dimensional continuum problems.
4. Development of Computer program for two dimensional continuum problems with one dependent variable.
5. Development of Computer program for two dimensional continuum problems with two dependent variables.
6. Development FEM model using parametric mapping.
7. Use of commercial software for heat transfer and stress analysis.

References:

1. D. L. Logan, “A First Course in the Finite Element Method”, Thomson India Edition.
2. D. V. Hutton, “Fundamentals of Finite Element Analysis”, Tata McGraw Hill Publishing Company Limited.
3. J. N. Reddy, “An Introduction to the Finite Element Method”, Tata McGraw Hill Publishing Company Limited.
4. A. Gilat, “MATLAB An Introduction with Applications”, Wiley India.

Evaluation Scheme:

There will be questions covering all the chapters in the syllabus. The evaluation scheme for the questions will be indicated in the table below:

Unit	Chapter	Topics	Marks
1	1, 2 & 7	all	**16**
2	3	all	**16**
3	4	all	**16**
4	5	all	**16**
5	6	all	**16**
Total			**80**

ENGINEERING PROFESSIONAL PRACTICE
CE 752

Lecture : 2 **Year : IV**
Tutorial : 0 **Part : II**
Practical : 0

Course Objective:
To familiarize the students with their roles in the society, ethical and legal environment in which engineering is practiced, contract administration, regulatory environment and contemporary issues in Engineering.

1. **History of Engineering Practices** (3 **hours)**
   - 1.1. Man and Society
   - 1.2. Technology and Society
   - 1.3. History of Engineering Practice in Eastern Society
   - 1.4. History of Engineering Practice in Western society
   - 1.5. Engineering Practices in Nepal

2. **Profession and Ethics** **(6 hours)**
   - 2.1. Profession: Definition and Characteristics
   - 2.2. Professional Institutions
   - 2.3. Relation of an Engineer with Client, Contractor and Fellow Engineers
   - 2.4. Ethics, Code of Ethics and Engineering Ethics
   - 2.5. Moral Dilemma and Ethical Decision Making
   - 2.6. Detailed Duties of an Engineer and Architect
   - 2.7. Liability and Negligence

3. **Professional Practices in Nepal** **(3 hours)**
   - 3.1. Public Sector Practices
   - 3.2. Private Sector Practices
   - 3.3. General Job Descriptions of Fresh Graduates in both Public and Private Sector

4. **Contract Management** **(6 hours)**
   - 4.1. Methods of Work Execution/Contracting
   - 4.2. Types of Contracts
   - 4.3. Tendering Procedure
   - 4.4. Contract Agreement

5. **Regulatory Environment** **(5 hours)**
   - 5.1. Nepal Engineering Council Act
   - 5.2. Labor Law
   - 5.3. Intellectual Property Right
   - 5.4. Building Codes and Bylaws
   - 5.5. Company Registration

6. **Contemporary Issues in Engineering** **(3 hours)**
   - 6.1. Globalization and Cross Cultural Issues
   - 6.2. Public Private Partnership
   - 6.3. Safety, Risk and Benefit Analysis
   - 6.4. Development and Environment
   - 6.5. Conflict and Dispute Management

7. **Case Studies Based on Engineering Practices** **(4 hours)**

References:

1. Carson Morrison and Philip Hughes "Professional engineering Practice – Ethical Aspects", McGraw-Hill Ryerson Ltd.' Toronto 1982
2. DrRajendraAdhikari, "Engineering Professional Practice – Nepalese and international Perspectives" Pashupati Publishing House, Kathmandu Nepal 2010
3. M. Govindarajan; S Natarajan and V.S. Senthikumar., " Engineering Ethics" – PHI Learning Pvt. Ltd. New Delhi 2009
4. Nepal Engineering Council Act
5. Contract Act
6. Labor Act
7. Company Act
8. Copyright Act
9. Public Procurement Act
10. Building By-Laws

Evaluation Scheme:
The questions will cover all the chapters in the Syllabus. The evaluation scheme will be as indicated in the table below.

Unit	Chapter	Topics	Marks
1	1 & 3	all	8
2	2	all	8
3	4	all	8
4	5 & 6	all	8
5	7	all	8
Total			**40**

PROJECT I & II
ME

Consultation: 3/6 **Year: IV**
Part : I/ II

Course Objective:
To plan and complete an individual mechanical engineering design project under the supervision of a faculty member in the Department of Mechanical Engineering. To prepare written report and give oral examination.

General Procedures:
The project course will involve working on a design project under the supervision of a faculty member in the Department of Mechanical Engineering. The subject of the project should be as relevant as possible to the local industrial environment and may be selected in consultation with an industrial firm or government departments. The students are advised to select the project topic at the beginning of the term (Part **I** of the fourth year). The consultation hour of Supervisor will be three hours in the part **I** and Six hours in the Part II of the fourth year.

Course Requirements:

1. A detailed project proposal is to be submitted to the HOD within two weeks of the start of the term. The HOD and supervisor will decide whether the project is accepted or not. An oral presentation (10 minutes plus 10 minutes for question) will take place at a convenient time of supervisor and evaluation committee. The written proposal and oral reports will account for 5 marks.
2. A written mid-term progress report is to be submitted 2-3 weeks before the end of the term (Part A of the fourth year). An oral presentation (15 minutes plus 15 minutes for question) will take place at a convenient time of supervisor and evaluation committee. The mid-term written and oral reports will account for 25 marks.
3. A final written report (in the provided format by department) will be submitted before the end of 12' week of the term (4" year, Part II). This report will be evaluated by the supervisor, members of examination committee and external examiner. This will account for 50 marks.
4. An oral examination of the final report will be conducted during the 15 week of the term (4^{th} year, Part II) at a time convenient to the examination committee, supervisor and the student. The final oral examination will account for 50 marks

ELECTIVE II

ECONOMICS OF AUTOMOBILE
ME76501

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : II**
Practical: 3/2

Course Objective:

To provide a global view of automobile related industry. To provide down-to-earth knowledge of economics involving automobile as the key component.

1. Economic Management of Road Transport (11 hours)

1.1 Introduction. Importance of Road Transport. Scope. Economic Function. Government involvement. Future development in Transport Classification of hydropower and end uses
1.2 Demand on Road Transport: Factors affecting demand: Land use pattern, Quality of service, Price, Time value, Demand Analysis Introduction of Hydropower plant in Nepal
1.3 Costing of Road Transport: Concept of Fixed and Variable costs, Direct and Indirect Costs, Joint and Common Costs. Excapability and opportunity costs. Policy of Nepal Government
1.4 Pricing of Road Transport: Cost-Plus Pricing, Pricing policy in imperfect market condition, Marginal Cost Pricing, Subsidy in Transport
1.5 Investment Appraisal: Introduction. Conventional investment appraisal, Average rate of return, Payback Period, Discounted Cash Flow, Net Present Valve, Benefit-Cost Ratio, Internal Rate of Return
1.6 Cost Benefit Analysis: Social cost benefit analysis, hidden Cost, Benefit in transport
1.7 Valuation of Cost and Benefits: Shadow Pricing of Market items, Valuation of Time, accidents, environmental costs

2. Road Passenger Transport (7 hours)

2.1 Introduction. Characteristics of Road Passenger Transport, Capacity, Productivity, Flexibility and economic range of services
2.2 Physical Components of Road Passenger Transport
  2.2.1 The Way: Differentiation, Taxation
  2.2.2 Vehicles: Ranges of Buses, Express Service, Local service. Taxi service. Private Cars.
2.3 Legal Requirements for Safe Operation: Licensing, Vehicle Testing, Road Accidents and Implications
2.4 Sources of Funds and Investment: Private Sector, Public Sector.
2.5 Operational Practices: Scheduling, Revenue Collection and Types of fares. Cartelling

3. Road Freight Transport (5 hours)

3.1 Introduction. Characteristics of road freight transport. Capacity. Flexibility. Traffic diversity. Economic Range of Service
3.2 Physical Components of road freight transport. The Way: Differentiation, Taxation. The Way: Differentiation, Taxation. Vehicles: Designs and Types. Motive Power
3.3 Size and Scale of Industry. Historical development. Current size of industry, tonnage and distance. Trend in future development.
3.4 Structure and Control of Industry. Private and Public sector. Government agencies. Government involvement and its effects.
3.5 Legal Requirements for Operation. Process of Setting up a Road Freight Transport. Licensing of Sectors and permits. Association with Trade Groups. Requirements in Vehicular conditions
3.6 Fund for Investment in Industry. Sources. Government subsidy. Depreciation. Costs. Insurance
3.7 Operational Practices. Vehicular scheduling and routing. Pricing and marketing. Cost Plus. Average Cost. Marginal Costs

4. Road Traffic Laws (4 hours)

4.1 Introduction
4.2 Evolution of traffic laws
4.3 Traffic law in Nepal. Nepal Traffic Rules
4.4 International Traffic Rules
4.5 Nepal and Internal Driving Licenses

5. Insurance of Motor Vehicles (5 hours)

5.1 Introduction
5.2 Importance
5.3 Type
5.4 Scope
5.5 Players in Insurance Industry

6. Trade and Commerce in Motor Vehicles (8 hours)

6.1 Introduction
6.2 Scope and Size. Sectors
6.3 Financial Laws. Banking Regulations
6.4 Procedure and regulation for import
6.5 Government duties and taxations
6.6 Harmonic Codes

7. Stock Management (5 hours)

7.1 Introduction
7.2 Principles, policy and problems
7.3 Economic Lots

7.4 Demand and supply analysis
7.5 Lead time and buffer stock
7.6 Concept of zero inventory
7.7 Demand forecasting
7.8 Systems of stock control
7.9 Problems of variety
7.10 Stock management of spare parts
7.11 Space management

Total	**80**

Practical:

Practical means project work and report have to be submitted at the end of the course. The report should be around 20-30 pages plus appendix. Each student shall write report on one each of government and non-government agencies and two commercial enterprises from amongst the topics below.

1. Ministry of Transport
2. Traffic Management Department
3. A bus transport company
4. A road transport company
5. An insurance company
6. An automobile trading company
7. FNCCI
8. Automobile Dealers Association

References:

1. Bell, G., Blackledge, D.A. and Bowen, P., "The economics and Planning of Transport", Heinemann.
2. Bell, G., Bowen, P., and Fawcett, P., "The Business of Transport", Macdonald and Evans Ltd.
3. Benson, D., "Elements of Transport Management", Croners.
4. Fawcett, P., "The road to Transport Management", Fleetbooks.
5. Lowe, D.," Road Freight Transport", Gower.
6. Government and other Publications

Evaluation Scheme:

The questions will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below:

Unit	Chapters	Topics	Marks
1	1	all	**16**
2	2	all	**16**
3	3 & 4	all	**16**
4	6	all	**16**
5	5 & 7	all	**16**

REFRIGERATION
ME76502

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : II**
Practical : 3/2

Course Objective:
To understand the concept of simple and advanced refrigeration systems and the working principle of various type of refrigeration systems, Cryogenics, various system of cryogenics. To analyze the merits and demerits of various type of refrigeration systems. To design cold storage.

1. Fundamentals of Refrigeration (2 hours)
- 1.1. Introduction to Refrigeration
- 1.2. Application of Refrigeration
- 1.3. Refrigeration Systems
- 1.4. Coefficient of performance of Refrigerator

2. Methods of refrigeration (5 hours)
- 2.1. Ice Refrigeration
- 2.2. Evaporative Refrigeration
- 2.3. Refrigeration by Expansion of Air
- 2.4. Refrigeration by Throttling of Gas
- 2.5. Steam Jet Refrigeration System
- 2.6. Dry Ice Refrigeration

3. Vapor Compression Refrigeration Systems with Multiple Evaporators and Compressors (6 hours)
- 3.1. Introduction
- 3.2. Multi Stage Compression Systems
- 3.3. Multi Evaporator Systems
- 3.4. Multi Evaporator and Multi Compression Systems

4. Chapter 4 Air Refrigeration Systems (6 hours)
- 4.1. Introduction
- 4.2. Air Refrigeration working on Reversed Carnot Cycle
- 4.3. Air Refrigeration working on Bell-Coleman Cycle
- 4.4. Aircraft Refrigeration System
- 4.5. Advantages and disadvantages of Air Refrigeration System

5. Steam Jet Refrigeration (3 hours)
- 5.1. Introduction
- 5.2. Advantages and disadvantages of Steam Jet Refrigeration
- 5.3. Working of Steam Jet Refrigeration
- 5.4. Analysis of Steam Jet Refrigeration

6. Low Temperature Refrigeration (Cryogenics) (5 hours)
- 6.1. Introduction
- 6.2. Limitations of Vapor Compressions Refrigeration systems for Production of Low Temperature
- 6.3. Cascade Refrigeration System
- 6.4. Production of Dry Ice
- 6.5. Linde system and Claude system for Liquefaction of Air
- 6.6. Liquefaction of Hydrogen and Helium
- 6.7. Application of Low Temperature

7. Non Conventional Refrigeration System (4 hours)
- 7.1. Thermoelectric Refrigeration System
- 7.2. Vertex Tube Refrigeration System
- 7.3. Pulse Tube Refrigeration System

8. Cooling by Adiabatic Demagnetization Application s of Refrigeration (8 hours)
- 8.1. Food Preservation
  - 8.1.1. Introduction
  - 8.1.2. Factors contributing to food spoilage
  - 8.1.3. Methods of food preservation
  - 8.1.4. Methods of food freezing
  - 8.1.5. Food Processing/Preservation by Refrigeration
- 8.2. Ice Manufacturing
- 8.3. Air-conditioning
- 8.4. Domestic Refrigerators
- 8.5. Display cases
- 8.6. Water Coolers

9. Cooling Load Calculations for cold stores (6 hours)
- 9.1. Introduction
- 9.2. Wall gain Loads
- 9.3. Product Load
- 9.4. Occupant load
- 9.5. Equipment Load
- 9.6. Process load
- 9.7. Infiltration load

Practical:
1. Analysis of Simple vapor compression refrigeration system
2. Analysis of modified vapor compression refrigeration system
3. Study on effect of various conditions on COP
4. Study on effect of performance of various components on COP

5. Field study of cold rooms for vegetables and meat products
6. Field study of dairy industry

References:

1. Dossat, “Principles of Refrigeration”, John Wiley and Sons.
2. W.F. Stoecker, “Refrigeration & Air-conditioning”, McGraw Hill Publishing Co. Ltd.
3. “ASHRAE Hand Book of Refrigeration”, ASHRAE
4. Arora & Domkundwar, “A Course in Refrigeration & Air-conditioning”, Dhanpat Ria & Co.
5. R.K. Rajput, “Refrigeration & Air-conditioning”, Katson Books.
6. Michael Boast, “Newness Refrigeration Pocket Book”, CBS publishers.
7. S.B. Mathur & S. Domkundwar, “Elements of Mechanical Engineering”, Danpat Rai & Co.

Evaluation Scheme:

The questions will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below:

Unit	Chapter	Topics	Marks
1	1 & 3	all	**16**
2	2 & 9	all	**16**
3	4 & 5	all	**16**
4	6 & 7	5.1 to 5.3	**16**
5	8	all	**16**
Total			**80**

LIQUID BIO-FUEL
ME76503

Lectures : 3 **Year : IV**
Tutorial : 1 **Part : II**
Practical : 3/2

Course Objectives:
To know different types of liquid biofuels, resources and production technologies. To know characteristics and scope of different biofuels. To know the scope and application of liquid biofuel in Nepal.

1. Introduction (6 hours)
- 1.1. Overview of various liquid biofuels
- 1.2. Current status of use of liquid biofuel in Brazil, USA, India and world
- 1.3. Scope and application of liquid biofuels in Nepal
- 1.4. Necessity of liquid biofuel development and its importance in Nepal
- 1.5. Liquid biofuel development agencies and their activities in Nepal
- 1.6. Municipal sewage- and biogas production for treatment and energy recovery
- 1.7. Legal and social issues

2. Bioethanol (12 hours)
- 2.1. Resources of bioethanol
- 2.2. Production of bioethanol
- 2.3. Purification of bioethanol
- 2.4. Techno economic aspect of bioethanol production
- 2.5. Physico chemical characteristics
- 2.6. Calorific value
- 2.7. Octane number
- 2.8. Blending of bioethanol with fossil fuel
- 2.9. Engine testing of bioethanol
- 2.10. Analyses of exhaust gasses

3. Biodiesel (12 hours)
- 3.1. Resources of biodiesel
- 3.2. Extraction of straight vegetable oils and use in diesel engines
- 3.3. Transesterification process and production of biodiesel
- 3.4. Techno-economic aspect of biodiesel production
- 3.5. Use byproduct
- 3.6. Physico chemical characteristics
- 3.7. Calorific value
- 3.8. Cetane number
- 3.9. Properties of biodiesel in comparison to diesel
- 3.10. Use of biodiesel-diesel blends in diesel engines
- 3.11. Analyses of exhaust gasses

4. Biobutanol (6 hours)
- 4.1. Comparison of bioethanol and biobutanol
- 4.2. Production of butanol in batch, Fed-batch and continuous fermentation
- 4.3. Process development
- 4.4. Metabolic pathways
- 4.5. Stoichiometry of butanol producing clostridia
- 4.6. ABE fermentation

5. Biohydrocarbon oil (4 hours)
- 5.1. Potential plant for biohydrocarbon oil
- 5.2. Biohydrocarbon oil production technology
- 5.3. Physico chemical characteristics
- 5.4. Use of biohydrocarbon oil and its byproduct

6. Algae biofuel (3 hours)
- 6.1. Algae biofuel products and main processes
- 6.2. Algae types
- 6.3. Algae biomass
- 6.4. Techo-economics of algae biofuels

7. Microbial fuel cells (2 hours)
- 7.1. Introduction
- 7.2. Electrical generation process
- 7.3. Types of microbial fuel cells
- 7.4. Applications

Practical:
1. Field visit on extraction of jatropha oil and transesterification
2. Demonstration on preparation of ethanol
3. Demonstration on use of biofuel technology
4. Case study: SWOT analysis of different liquid biofuel

References:

1. AlFinch , E.O, “Energy Research by Broglis”, Agricultural Research System
2. J. Twidell and T. Weir, “Renewable Energy Resources”, Taylor and Francis.
3. Luty A., “Vegetable Oil as Fuel, a Environmentally and Socially Compatible Concept”
4. Wilsons. D, “Evaluating Alternatives: Aspect of an Integrated Approach using Ethanol”,

Evaluation Scheme:
There will be questions covering all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below:

Unit	Chapter	Topics	Marks
1	1	all	**16**
	2	2.1 to 2.3	
2	2	2.4 to 2.10	**16**
3	3	3.1 to 3.8	**16**
4	3	3.9 to 3.10	**16**
	4	all	
5	5, 6 & 7	all	**16**
Total			**80**

QUALITY MANAGEMENT
ME76504

Lectures : 3 **Year : IV**
Tutorial : 1 **Part : II**
Practical : 3/2

Course objective
To specialize engineering students with management principles and practices required for modern engineering trades.

1. Quality Management In Modern Business Organization (1 hour)
- 1.1 Definition, importance and Improvement of quality
- 1.2 History, qualitative transformation and quality development in manufacturing
- 1.3 Learning organizations, their relationship with quality philosophy, Nepal standards.

2. Total Quality Management (TQM) (2 hours)
- 2.1 Definition of TQM and its philosophy
- 2.2 Legal aspects of quality
- 2.3 Top management awareness
- 2.4 TQM implementation

3. Core concept of TQM (6 hours)
- 3.1 Quality for profit, right fist time, quality cost
- 3.2 Benchmarking, every one involvement and synergy
- 3.3 Ownership and self-management
- 3.4 Managers as role models, recognition and rewards
- 3.5 The quality delivery process
- 3.6 TQM and productivity, TQM and advanced manufacturing technology- a link
- 3.7 Costume supplier chai continuous improvement

4. Organizing for Quality and ISO certification (3 hours)
- 4.1 Determining the requirements for success, presentation to office board
- 4.2 Quality steering committee meeting guidelines
- 4.3 Education and training, human dimensions of quality in the work place
- 4.4 The ISD awareness
- 4.5 Registration and accreditation in quality systems
- 4.6 ISD standards and certification
- 4.7 Requirements of quality standards
- 4.8 ISD certification

5. Total preventive maintenance for TQM (4 hours)
- 5.1 Introduction
- 5.2 Failure patterns
- 5.3 Costs and benefits of TPM
- 5.4 some examples of TPM implementation
- 5.5 Toward zero defect zero break.....
- 5.6 Guidelines for implementing TPM

6. Total safety system for TQM (5 hours)
- 6.1 Definition
- 6.2 The cost of poor safety, economic value of safety standards
- 6.3 The implementation of TSS
- 6.4 Tools, techniques for zero risk
- 6.5 Effective safety practices industrial law, Nepal standard and ILO standards, implementation of TSS

7. Quality of Machine Parts and Improvement (6 hours)
- 7.1 Pan accuracy machine performance
- 7.2 Factors effecting machine performance
- 7.3 Deviations of quality characteristics from the required values
- 7.4 Setting up errors
- 7.5 Deviations in the quality of the material
- 7.6 Machine tool vibration, wear of tools and control
- 7.7 Operators skill and quality of product

8. Inspection and quality control (8 hours)
- 8.1 Definition, need and planning for inspection
- 8.2 Organization of inspection department, methods, functions of inspection
- 8.3 Factors effecting quality, cost of quality, economics and causes of quality failure
- 8.4 Inspection, quality control and quality assurance
- 8.5 On line of off line quality control, machine capability studies

9. Statistical quality control / statistical process control (SQC/SPC) with problem solving tools (10 hours)
- 9.1 Introduction, evolution and relevance of SPC
- 9.2 Statistical process control tools and practices
- 9.3 Control charts for individual readings/practices
- 9.4 Process variation, causes, attribute charts, target
- 9.5 Conformance to specifications v. Meeting the target
- 9.6 Universal concept of quality, taguchis loss function

Practical:
- Two case studies will be Discussed, tutorials Project work will be organized regularly in addition to lecture classes
- Quality circles within participant students will be formed.
- Departmental laboratory studies (DLS) will be organized
- One industrial visit will be organized for quality exposure
- Project work will be focused on statistical process control/quality control and quality management tools

References:

1. Arearo Jerome S, “Quality in Education and ,ollementation hand books”. Venity books international New Delhi.
2. Bagchi, Tapan, “ISO 9600 Concepts, Methods and Implementation”, A.E. Wheeler & Co. Ltd. New Delhi.
3. Balaksum, B.C. , “Fundamentals of Manufacturing Engineering”, Mosocw.
4. Dalema, s. Ali Mansoo , “Industrial Engineering and Management systems”, Standard Publishers Distributors, Delhi.
5. John Bank , “The Essence of Total Quality Management”, Prentice-Hall of India Private Limitted, New Delhi.
6. Montogamery, Douglas C , “Introduction of Statistical Quality Control”, John Wiley and Sons Ltd.
7. Mohamad Zairi , ‘Total quality Management for Engineers”, Aditya Booooks Pvt. Ltd. Delhi.
8. Schey, John A, “Introduction to Manufacturing Processes”, McGraw Hill International Ecitions, Industrial Engineering Series,.
9. Sundas, S.M. Raju, “Total Quality Management”, Tata Mc.Graw-Hill Delhi.
10. Terry Shresman , “Small Business Success Through TQM”, Tata McGraw-Hill Company Limited, New Delhi.
11. Thomas Pyzdek, Roge W. Gerger , “Quality Engineering Handbook”, Tata McGraw-Hill Publishing company Limited, New Delhi.
12. Verma, A.P. ” Industrial Engineering “, S.K. Kataria and Sons, Delhi.

Evaluation Scheme:

The questions will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below:

Unit	Chapters	Topics	Marks
1	1, 2 & 3	all	**16**
2	4 & 5	all	**16**
3	6 & 7	All	**16**
4	8	All	**16**
5	9	All	**16**
Total			**80**

DESIGN OF MICRO HYDROPOWER SYSTEM
ME76505

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : II**
Practical : 3/2

Course Objectives:

To develops an idea of designing and selecting of civil components, mechanical components, electrical components and transmission system.

1. Introduction to design of micro-hydropower system (2 hours)

1.1. Introduction to MHP system design
1.2. Planning concepts
1.3. Evaluation of MHP requirements

2. Layout design of civil components of MHP system (12 hours)

2.1. Overview of civil components of MHP system
2.2. Intake and weir
2.2.1. Overview of diversion weir
2.2.2. Overview of intake
2.2.2.1. Side intake
2.2.2.2. Bottom intake
2.2.3. Trashrack
2.2.3.1. Overview of trashrack
2.3. Headrace canal
2.3.1. Overview of headrace canal
2.3.2. Design criteria of the headrace canal
2.3.3. Design for headrace canal
2.4. Spillway
2.4.1. Overview of spillway
2.4.2. Design of spillway
2.5. Settling basins
2.5.1. Overview of settling basins
2.5.2. Components of settling basin
2.5.3. Design of settling basin
2.6. Fore-bay
2.6.1. Overview of fore-bay
2.6.2. Design of fore-bay
2.7. Penstock
2.7.1. Overview of penstock
2.7.2. Design of the penstock pipe
2.8. Anchor blocks
2.8.1. Overview of anchor blocks
2.8.2. Design criteria of anchor blocks
2.9. Support piers
2.9.1. Overview of support piers
2.9.2. Design of support piers
2.10. Expansion joints
2.10.1. Overview of expansion joints
2.10.2. Sizing of expansion joints
2.11. Powerhouse
2.11.1. Overview of power house
2.11.2. Design and requirement of power house
2.11.3. Overview of tailrace

3. Design and Selection of mechanical components of MHP system

(9 hours)

3.1. Selection of turbines and its components
3.1.1. Introduction of turbines
3.1.2. Types of turbines
3.1.3. Selection Criteria
3.1.4. Main component of turbine (housing, rotor, guide van etc)
3.2. Selection of turbine based on load demand
3.2.1. Selection chart
3.2.2. Calculation of specific number
3.3. Valves
3.3.1. Introduction of valves
3.3.2. Sealing system
3.3.3. Valve specification
3.4. Plant efficiency
3.4.1. Hydraulic components
3.4.2. Efficiency of turbine
3.4.3. Efficiency of transmission system belt
3.4.4. Efficiency of generator
3.5. Power output calculation

3.6. Turbine sizing

4. Selection of electro-mechanical equipment (9 hours)

4.1. Introduction of different belts :Vee belt, tooth belt, flat belt ,Selection of belt
4.2. Pulley: Introduction of pulleys
4.3. Coupling :Introduction of different couplings, Selection of couplings
4.4. Gear box
4.5. Safety measures of MHP equipment
  4.5.1. De-silting basin
  4.5.2. Fore-bay structure
  4.5.3. Water convey pipe line
  4.5.4. Valves
  4.5.5. Turbines
  4.5.6. Belt and coupling

5. Selection of electrical components of MHP scheme (5 hours)

5.1. Generator –type and size
  5.1.1. Synchronous generator
  5.1.2. Induction generator
5.2. Selection of generator type
5.3. Determination of size of generator
5.4. Speed governing system
  5.4.1. Conventional oil pressure mechanical governor
  5.4.2. Electronic governor

6. Selection of Transformer (4 hours)

6.1. Introduction of transformer
6.2. Constructional details of transformer
6.3. Selection of transformer rating and specification
6.4. Operation and maintenance of transformer
6.5. Safety measures

7. Selection of Transmission and distribution lines (4 hours)

7.1. Selection of transmission voltage
7.2. Selection of underground or overhead lines
7.3. Sizing of overhead transmission line conductor
7.4. Installation of transmission and distribution lines
  7.4.1. Steps before installing transmission line
  7.4.2. Installation procedure
  7.4.3. Installation of distribution and service line
  7.4.4. Earthing
  7.4.5. Lightning arrester
7.5. Grid connection of MHP plant
  7.5.1. Synchronizing MHP plant with SG to the grid
  7.5.2. Synchronizing MHP plant with IG to the grid

Practical:

Practical means project work and report have to be submitted at the end of the course. The report should be around 20-30 pages plus appendix.

1. Case study
2. Design of different components

References:

1. Adam Harvey, "Micro Hydro design Manual", Intermediate Technology Publication.
2. Win Hulsher and Peter Frankel, "The Power Guide, Intermediate Technology Publication.
3. "Manuals on MHP for Installation and Commissioning, Maintenance and Repair, Operation and Management", ICIMOD.
4. Dr. Rajendra Shrestha, "Basics of micro hydropower (AE 123)", Course Manual for Department of Alternative Energy Tumba College of Technology Rwanda, 2009
5. Dr. Rajendra Shrestha, "Reference Book on Beginner's Micro Hydropower Plant", Graphic International Nepal.

Evaluation Scheme:

The questions will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below:

Unit	Chapter	Topics	Marks
1	1 & 5	All	**16**
2	2	All	**16**
3	3	All	**16**
4	4	All	**16**
5	6 & 7	All	**16**
Total			**80**

Aircraft Dynamics

EG 76508ME

Lecture : 3
Year : IV
Tutorial : 1
Part : II

Practical: 1.5

COURSE OBJECTIVES:

- To introduce students with basic aircraft design and manufacturing techniques.
- To provide insights on how the design and analysis of aircrafts are carried out in phases and iteratively.
- To provide students with the basic knowledge about flight dynamics, aircraft performance measures and analysis methods.

PREREQUISITES

All students taking this course must have taken previous course on Aircraft and Airframe.

COURSE OUTLINE:

1. **Basic Aerodynamic Principles (6 hrs)**
   - 1.1. Fluid Flow over Wings and Bodies
   - 1.2. Aerodynamic Forces and Aerodynamic Coefficients
   - 1.3. Lift and Drag of Bodies
   - 1.4. Aerodynamic Characteristics of Wing Sections
   - 1.5. Aerodynamic Characteristics of Finite Wings
   - 1.6. Flow of Compressible Fluids
   - 1.7. Application of CFD
2. **Aircraft Performance (8 hrs)**
   - 2.1. Equations of Motion for Flight in Vertical Plane
   - 2.2. Gliding Flight
   - 2.3. Level Flight
   - 2.4. Climbing Flight
   - 2.5. Range and Endurance
   - 2.6. Turning Flight
   - 2.7. Take-off and Landing
   - 2.8. Hazards during Take-off and Landing: Wind Shear and Microbrust
3. **Static Stability and Control (16 hrs)**
   - 3.1. Concept of Equilibrium and Stability
   - 3.2. Static Longitudinal Stability
   - 3.3. Stability in Maneuvering Flights
   - 3.4. Static Directional Stability
   - 3.5. Lateral Stability
   - 3.6. Stick-Free Stability
   - 3.7. Dynamic Stability
   - 3.8. Inertia Coupling
   - 3.9. Handling Qualities
4. **Introduction to Aircraft Design Principles (3 hrs)**
   - 1.1. Aircraft Configuration and Functional Studies
   - 1.2. Overview of Design Process
   - 1.3. Conceptual Design Parameters
   - 1.4. Introduction to Modern Design Tools and Techniques
5. **Design of Unique Aircraft Concepts (6 hrs)**
   - 4.1. Flying wing, Lifting Fuselage, BWB
   - 4.2. Delta and Double-Delta Wing
   - 4.3. Forward-Swept Wing
   - 4.4. Canard-Pusher
   - 4.5. Multi-Fuselage
   - 4.6. Unmanned High-Altitude Vehicles
6. **Aircraft Manufacturing Techniques (6 hrs)**
   - 5.1. Modern Manufacturing Industries
   - 5.2. Composite Materials in Aerospace Applications
   - 5.3. Mock-Up and Prototyping

PRACTICALS:

1. Design Exercises

2. Practice work on XFLR5 Open Source Software

An assigned project work and an accompanying report will be needed to be submitted by students by end of the course. The report should be written in a LaTeX platform.

REFERENCES:

1. Raymer, Daniel P., "Aircraft Design: A Conceptual Approach", Fourth Edition, AIAA Education Series, 2006.
2. Luling An (compiled by),"An Introduction to Aircraft Manufacturing Technology", College of Mechanical and Electrical Engineering, Nanjing University of Aeronautics and Astronautics, 2010.
3. Bandu N. Pamadi, "Performance, Stability and Dynamics, and Control of Airplanes", AIAA Education Series, 1998.

EVALUATION SCHEME:

The questions will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below:

Chapters	Hours	Marks Distribution*
1 & 2	14	16
3	8	16
3 & 4	11	16
5	6	16
6	6	16
Total	45	80

*** There may be minor deviation in marks distribution.**

AUTOMOBILE ENGINEERING ENTERPRISES
ME76509

Lecture : 3 **Year : IV**

Tutorial : 1 **Part : II**
Practical : 3/2

Course Objectives:

To prepare students for the automobile engineering enterprises in the country and abroad.

1. Fundamentals of Automobile Overhaul (15 hours)

1.1 Introduction. Scope and importance
1.2 Overhauling of engines. Machines and equipment for overhauling. Lifting and handling equipment, measuring and quality control equipment, their operation. Overhauling by over sizing and under sizing of components. Overhauling by rebuilding of components. Overhauling by replacement of components.
1.3 Diesel pump overhauling
1.4 Quality control. Post-overhaul running and testing of engines
1.5 Overhauling of electrical components. Motors and generators. Overhauling by replacement of parts.

2. Service Stations and Maintenance /Repair Shops (10 hours)

2.1 Introduction. Differentiation. Scope. Types
2.2 Service station. Functions. Equipment
2.3 Maintenance/Repair Shop
  2.3.1 Function. Equipment and Process.
  2.3.2 Lifting and transportation equipment
  2.3.3 Cleaning and lubricating equipment
  2.3.4 Measuring and calibrating equipment
  2.3.5 Diagnostic equipment
2.4 Types and scopes of maintenances
2.5 Specialized maintenance shops
  2.5.1 Electricals
  2.5.2 Aircons
  2.5.3 Battery
  2.5.4 Chassis and body
  2.5.5 Engine
  2.5.6 Tyres
2.6 Dynamometric testing
  2.6.1 Engine
  2.6.2 Brake
2.7 Planning and designing of Service stations and maintenance shops

3. Gas station, Petrol Pump and Charging Stations (4 hours)

3.1 Introduction. Role. Queueing theory
3.2 Fuel dispensing station. Equipment. Safety.
  3.2.1 Economics of enterprise

3.2.2 Planning and designing
3.3 Gas dispensing station. Equipment. Safety
3.3.1 Economics of enterprise
3.3.2 Planning and designing
3.4 Motive Battery charging station. Equipment. Safety
3.4.1 Economics of enterprise
3.4.2 Planning and designing

4. Tyre manufacturing and tyre repair shop (4 hours)

4.1 Introduction . Economics of tyre. Market size
4.2 Introduction to tyre, tube manufacturing technology
4.2.1 Raw materials
4.3 Volcanizing and chemical process of tyre manufacturing
4.4 Tyre resoling technology.
4.4.1 Technological of hot resoling
4.4.2 Technology of cold resoling. Franchises
4.4.3 Defects in resoling and their remedies

5. Repainting and denting of automobiles (5 hours)

5.1 Introduction. Scope. Process
5.2 Denting. Process. Tools and equipment
5.3 Painting. Process. Tools and equipment. Introduction to chemistry of paints.

6. Fundamentals of Automobile body building (7 hours)

6.1 Introduction and Scope
6.2 Basics of body design. Forces and stress on body.
6.3 Materials and components for body building
6.4 Designing of bus and passenger car body.
6.5 Equipment and process

Practical:

1. Practical means project work and report have to be submitted at the end of the course. The report should be around 20-30 pages plus appendix.
2. Case study of any one existing enterprises
3. Detailed study of some overhauling equipment
4. Designing of one commercial enterprise including technical and financial analysis.

References:

1. Selar D, “Auto Repair for Dummies”, Wiley.
2. Livesey A., A. Robinson, “The Repair of Vehicle Bodies”, Taylor and Francis.
3. Dorries E H. Thomson, “TechOne: Automotive Engine Repair”, Delmar Learnings.
4. Gilles T, “Automotive Engines Diagnosis, Repair, Rebuilding”,. Cengage Learning.
5. Anderson P, “Start your own Auto Repair Shop”, Wiley.
6. “Business Plan for your Auto Repair Shop”, ed. Matters J, Wiley.
7. Beckwith H., “Selling the invisible; a field Guide to Modern Marketing”, Kindle Edition, New York.

Evaluation Scheme:

The questions will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below:

Unit	Chapter	Topics	Marks
1	1	1.1 to 1.3	**16**
2	1	1.4 & 1.5	**16**
	5	all	
3	2	all	**16**
4	3 & 4	all	**16**
5	6	all	**16**
Total			**80**

SYSTEM DESIGN AND SIMULATION
ME765010

Lectures : 3 **Year : IV**
Tutorials : 1 **Part : II**
Practical : 3/2

Course objective

To integrate the knowledge of Statics, Dynamics, Strength of Materials, Mechanics of Solids, Engineering Materials and Machine Component Design into the system design of Machine, Mechanism and Structure. To be familiar the fundamentals of the system design and simulation process, and the design of some common machine and structure will be the focus.

Course Outlines:

1. Review of Matrix Algebra and Finite Element Method (1 hour)

1.1 Basic operations, solution methods, eigenvalues and eigenvectors
1.2 Nodes & elements, modelling fundamentals, computational steps and Formulation of Finite Element Equations

2. General Design Consideration (1 hours)

2.1 Human engineering consideration
2.2 Design for X methodologies

3. Introduction to Simulation Software (2 hours)

3.1 Definition
3.2 Basics of Software
3.3 Workbench Environment
3.4 Graphics and Picking
3.5 The Database and Files
3.6 Saving Files
3.7 File Types

4. General Analysis Procedure (1 hour)

4.1 Overview
4.2 Preliminary Decisions
4.3 Preprocessing
4.4 Solution
4.5 Post processing

5. Introduction to Modeling (6 hours)

5.1 Direct Generation
5.2 Creating nodes and elements
5.3 Filling between nodes
5.4 Setting Element Attributes
5.5 Solid Modeling
  5.5.1 Using key points
  5.5.2 Using lines, splines & arcs
  5.5.3 Using areas and volumes (arbitrary)
  5.5.4 Creating rectangle, circle, polygon, block, cylinder, prism, sphere, cone and torus
5.6 Concepts of hard points, line fillets and area fillets
5.7 Modeling with Boolean operations
  5.7.1 Intersect
  5.7.2 Add
  5.7.3 Subtract
  5.7.4 Overlap
  5.7.5 Glue
  5.7.6 Divide

6. Meshing (1 hours)

6.1 Introduction to different type of elements
6.2 Introduction to Meshing
6.3 Mapped and free meshing
6.4 Numbering Controls

7. Structural Analysis (6 hours)

7.1 Linear Static Analysis
7.2 Non-Linear static Analysis
7.3 Model and analysis of 2 D and 3 D structural elements under condition of shock, impact, initial forces, residual stress, corrosion, environment, wear, elevated temperature and low temperature

8. Fatigue and Fracture Failure (6 hours)

8.1 Introduction to fatigue, fatigue-life methods, stress-life and strain-life methods
8.2 Endurance limit and fatigue strength
8.3 Fluctuating stresses and fatigue failure criteria for fluctuating stresses
8.4 Crack propagation and energy balance
8.5 Model and analysis of machine element subjected to fluctuating load
8.6 Model and analysis of machine element subjected to fracture failure

9. Thermal Analysis (4 hours)

9.1 Heat flow equations, thermal stiffness matrix, thermal loads
9.2 Model and analysis of Steady State and Transient Thermal Analysis

10. IC Engine System Design (4 hours)

10.1 General design considerations, Design of Cylinder and cylinder head, Design of piston, piston ring and gudgeon pin, Design of connecting rod and crankshaft
10.2 Model and analysis of IC Engine System

11. Fluid Flow Problem Analysis (6 hours)

11.1 Fluid flow equations, fluid loads
11.2 Model and analysis of fluid flow problems
11.3 Model and analysis of turbo machine
11.4 Model and analysis of pressure vessel

12. Power Transmission System Analysis **(6 hours)**

Model and analysis of machine tools power transmission system

13. Design Optimization **(1 hour)**

Optimization of design problems using Simulation Software

Practical:

1. Homework Problems

Traditional homework problems will be assigned periodically from the textbook. These problems may include derivations and analytical problems requiring hand computations.

2. Assignments

5 projects will be assigned throughout the semester requiring the use of Simulation Software. These projects are to be done individually. A brief report describing the objectives of the analysis, modelling techniques used, and results must be submitted for each project.

3. Group Design Project/Research Project

A group design project will also be required by the end of the semester. This project will be conceived by the group, must be of a "design" nature (no unique answer will exist), and will require the use of Simulation Software (with more than one iteration). Groups of 3-4 people will work on the project. A final report must be submitted detailing the objectives, modelling techniques and assumptions, and results of the project. In place of a design project, students are required to complete a research-oriented project that uses advanced capabilities of Simulation Software.

4. Case study

Industrial Engineering problems study and analysis

References:

1. M.Asghar Bhatti, "Fundamental Finite Element Analysis and Applications", Wiley,.
2. K.L. Lawrence, "ANSYS Tutorial, ANSYS Release 11, SDC Publications.
3. Joseph E. Shigely, "Mechanical Engineering Design", McGraw Hill Publications.
4. Alex Valance and VI Doughtie, "Design of Machine Members", McGraw Hill Co.
5. M.F. Spott, "Machine design", Prentice Hall India

Evaluation Schemes:

The questions will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below:

Unit	Chapter	Topics	Marks
1	1, 2 & 7	all	**16**
2	3, 4 & 5	all	**16**
3	6, 8 & 13	all	**16**
4	9 & 10	all	**16**
5	11 & 12	all	**16**
Total			**80**

ELECTIVE III

AN INTRODUCTION TO CONSTRUCTION EQUIPMENT
ME78502

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : II**
Practical : 3/2

Course Objective:
To be familiar with the types, repair and maintenance and management of construction equipment used in Nepal.

Course Outlines:

1. Introduction to construction equipment (4 hours)
- 1.1. Types: Graders, loaders, excavators, dozers, road roller, compressor, rock crusher, asphalt equipment
- 1.2. specifications (general)
- 1.3. Application of Construction equipment
- 1.4. Terminologies used in construction equipment

2. Chassis components (12 hours)
- 2.1. Hydraulic system
  - 2.1.1. Introduction to hydraulic units: pump, valve, cylinders and motors, accumulator and motors, accumulator and filters, reservoirs, hoses, pipe, tubes and couplers, seals and fluids.
  - 2.1.2. General maintenance of hydraulic system
- 2.2. Transmission
  - 2.2.1. Production to power trains: clutches, mechanical transmission, hydraulic assist transmissions, power shift transmission, hydrostatic drive, torque converters, differential, final drive, power take-offs, special drives
  - 2.2.2. General maintenance of power transmission
- 2.3. Undercarriage
  - 2.3.1. Introduction to undercarriage: track chain, idler, sprocket, track rollers, tyres
  - 2.3.2. General maintenance of power transmission
- 2.4. Implements and tools
  - 2.4.1. Introduction to implement and tools: blades rippers, bucket
  - 2.4.2. General maintenance of implement and tools

3. Electronic components and their functions (7 hours)
- 3.1. Components pressure sensor, pressure switch, proportional solenoid, pump and valve controller, engine controller and their related signs and symbols

4. Repair and maintenance of construction equipment (10 hours)
- 4.1. Maintenance objectives
- 4.2. Maintenance polity types, replacement, factors affecting maintenance policy
- 4.3. Lubricants, uses, storage and their specifications
- 4.4. Strategy for maintenance of construction equipment
  - 4.4.1. Maintenance cost (direct and indirect)
  - 4.4.2. Inventory control (stock control and spare parts policy)
  - 4.4.3. Safety inspections special care and precautions required for repair and maintenance of components of construction equipment

5. Management of construction equipment (12 hours)
- 5.1. Equipment policy
  - 5.1.1. Equipment acquisition: methods purchase, Lessing, hitting
  - 5.1.2. Comparison between leasing and purchasing
  - 5.1.3. Estimation of owning and operating cost and hitting cost
  - 5.1.4. Analysis of equipment utilization and price variance
- 5.2. Equipment procurement
  - 5.2.1. Marketing aspects of construction equipment (availability, dealers)
  - 5.2.2. Procurements methods and practices
  - 5.2.3. Commissioning of equipment

Practical:
1. Related practical classes will be conducted on hydraulic system and transmission
2. Students will be attached to constructing sites and repair and maintenance workshops
3. Perform repair and maintenance of construction equipment

Reference:

1. Technical book, "Construction Machinery Training", Instate, Imlambad
2. Harris, F. and McCaffer, "Management of Construction Equipment", Macmillan Education Ltd. London, UK.
3. Erich J. Schulz, "Diesel Equipment I and II", Mcgraw-Hill book co.
4. Frank Harries, Ronald McCaffer, "Construction of Plant Excavating and Material Handling", Granda Publishing.
5. SAE Handbook Volume 4
6. "Caterpillar performance Handbook", Edition 33, Caterpillar Inc, Peoria, Illinois, USA.

Evaluation Scheme:
The questions will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below:

Unit	Chapter	Topics	Marks
1	1	all	**16**

	2	2.1	
2	2	2.2 to 2.4	**16**
3	3	all	**16**
4	4	all	**16**
5	5	all	**16**
Total			**80**

SOLID BIO FUEL
ME78503

Lectures : 3 **Year : IV**
Tutorial : 1 **Part : II**
Practical : 3/2

Course Objectives:
To know different types of solid biofuels resources and technology applied for different end uses and sector. To know about wood and non woody biomass resources. To design of cook stove.To know scope and application of solid biofuel in Nepal.

Course Outlines:

1. Introduction of gaseous biofuels (12 hours)
- 1.1. Traditional and modern application of solid biofuels
- 1.2. Share of solid biomass fuels in the national, regional energy consumption and newly emerging trend
- 1.3. Contribution of biomass solid fuel to the local socio-economy through income and employment generation
- 1.4. Wood and non wood solid biomass fuel resources
  - 1.4.1. Direct fuelwood from forest
  - 1.4.2. Direct fuel from non forest land
  - 1.4.3. Indirect and recovered fuelwood
  - 1.4.4. Non wood solid fuel (Animal residue, agricultural residue)
- 1.5. Assessment of current state of cooking fuel
- 1.6. Characteristics and calorific value of different solid biofuls

2. Solid biofuel conversion and utilization technology (18 hours)
- 2.1. Cook stove
  - 2.1.1. Design and operation of different kinds of ICS
  - 2.1.2. Design and operation Institutional Cook Stove
  - 2.1.3. Commercial design of fuel wood stove
  - 2.1.4. Techno economic aspect of different ICS
  - 2.1.5. Subsidy policy of ICS
- 2.2. Pyrolysis and charcoal making
  - 2.2.1. Charcoal production
  - 2.2.2. Medium CV gas
  - 2.2.3. Bio-oil production
- 2.3. Briquetting and Pelltising
  - 2.3.1. Existing technology of bio-briquette
  - 2.3.2. Raw material for briquette
  - 2.3.3. Briquette production technology
  - 2.3.4. Techno-Economic analysis of production
  - 2.3.5. Prospects of commercial bio-briquette
- 2.4. Biomass gasification
- 2.5. Dendro thermal power generation
- 2.6. Biomass fuel based boiler, kilns and furnace

3. Organic Solid Waste Management Technology (9 hours)
- 3.1. Land fill
  - 3.1.1. Introduction
  - 3.1.2. Operations
  - 3.1.3. Impacts
- 3.2. Incineration
  - 3.2.1. Introduction
  - 3.2.2. Technology
  - 3.2.3. Consequences
- 3.3. Composting
  - 3.3.1. Introduction
  - 3.3.2. Comparison of aerobic and anaerobic processes
  - 3.3.3. Operating process
  - 3.3.4. Advantages and disadvantages
- 3.4. Anaerobic digestion
  - 3.4.1. Introduction
  - 3.4.2. Process
    - 3.4.2.1. Process stages
    - 3.4.2.2. Configuration
  - 3.4.3. Feedstocks
  - 3.4.4. Products
  - 3.4.5. Applications

4. Municipal Waste Management (3 hours)
- 4.1. Production of municipal solid wastes (Generation, Composition, Collection, Segregation, Transportation, Processing, Disposal)
- 4.2. Contents, quantities, disposal by landfill
- 4.3. Recovery of energy by biomethanation
- 4.4. Incineration and pelletisation

5. Industrial and agricultural solid waste management (3 hours)
- 5.1. Generation, Composition and Disposal
- 5.2. Recovery of energy by biomethanation
- 5.3. Techno-economics

Practical:
1. Determination of efficiency of different type of ICS
2. Briquette making process and determining efficiency
3. Gasification

References:

1. "A guide for woodfuel surveys. ES – FAO Patnership programme (2000 – 2002)", Sustainable Forest Management Programme, GCP/RAF/345/EC and GCP/ bRLA/133/EC, FAO Rome, 2002.
2. Abbasi, S.A. and Abbasi, N., 2001, "Renewable Energy Sources and their Environmental Impact", Orince hall of India, New Delhi.
3. CD – ROM of – RWEDP (November 2000)
4. "Energy and environment basis: RWEDP Report No. 29, 2nd edition". FAO Regional Wood Energy Development Programme in Asia, Bangkok, July 1997
5. "Energy statistics: Definitions, units of measure and conversion factors, studies in method, series F No/ 44", Department of international economics and social affairs, Statitical office, UNDP, New York 1987
6. J. Twidell and T. Weir, "Renewable Energy Resources", Taylor and Francis.
7. "Option for Dendro Power in Asia: Report on the expert Consultation", Manila, Philipines, RWEDP Field Document No. 57. FOA Regional Wood Energy Development programme in Asia, Bangkok, 2000.
8. Others national and international sources of information, including published documents, journals and newsletters
9. P.D. Grover and S.K. Mishra, "Biomass Briqueeting: Technology and Practice"
10. "Regional study on wood energy Today and Tomorrow in Asia. RWEDP field document No. 50", FAO Regional Wood Energy, Development programme in Asia,Baangkok, 1997.
11. RWEDP (2000), Wood Energy, Climate and health: International Expert Consultation, summary Report.Field Document NO.58 (paper of A. Koopmans, "Trends in Wood/Biomass and other renewable energies").
12. Unified Wood Energy (UWE) Terminology (Draft),FAO Forestry department ,Rome, November 2001.
13. Wood Energy Development: Planning, Policies and strategies. RWEDP Field Document No. 37 (a,b & c). FAO Regional Wood Energy Development Programme in Asia, Bangkok, 1993.
14. Wood enrgy, Climate and Health: An International Export Consultation. RWEDP Field Document No. 58 FAO Regional Wood Energy Development programme in Asia, Bangkok, 2000.

Evaluation Scheme:

There will be questions covering all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below:

Unit	Chapter	Topics	Marks
1	1	1.1 to 1.4	**16**
2	1	1.5 & 1.6	**16**
	2	2.1 & 2.2	
3	2	2.3 & 2.6	**16**
4	3	all	**16**
5	4 & 5	all	**16**
Total			**80**

CONSTRUCTION OF MICRO HYDROPOWER SYSTEM
ME78505

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : II**
Practical : 3/2

Course Objectives:

To give basic concept of planning and preparation MHP. To give knowledge for the installation of the plant, planning and preparation for installation and construction. To give concepts for commissioning and testing of MHP. To give ideas about maintenance, repair and preparation of bill of quantities. It also includes future prospect of MHP project in Nepal and a literature study of a potential MHP projects.

Course Outlines:

1. Planning and Preparation (5 hours)
- 1.1. Initial enquiry
- 1.2. Licensing and agreements
- 1.3. Terms and specification for specification, orders and contracts
- 1.4. Limits and responsibility
- 1.5. Tendering document

2. Construction of the Civil Structures (10 hours)
- **2.1.** Site inspection and Preparation
- **2.2.** The Construction Sequence
- **2.3.** Machine Foundation, Powerhouse, and Tailrace
  - 2.3.1. Construction of the Machine foundation
  - 2.3.2. Preparation of Concrete
  - 2.3.3. Construction of the Powerhouse
- 2.4. Civil Works lor the Penstock
  - 2.4.1. Penstock Pipe installation
  - 2.4.2. Cement Masonry Work
  - 2.4.3. Anchor Blocks
- 2.5. Construction of the Forebay
- 2.6. The Headrace Canal
  - 2.6.1. Setting out the Canal
  - 2.6.2. Preparation of the Bench
  - 2.6.3. Fixing the Excavation Lines
  - 2.6.4. Excavation of the Canal
  - 2.6.5. Construction of the Canal Lining
- 2.7. The Construction of the Settling Basins and Spillways
- 2.8. Intake Structures
- 2.9. Retaining Structures and Stabilization

3. Installing the Electro-Mechanical Equipment (10 hours)
- 3.1. Machine Foundations
- 3.2. Machinery Installation
- 3.3. Alignment
  - 3.3.1. Direct Drive
  - 3.3.2. Belt Drives
- 3.4. Installation procedure for penstock
  - 3.4.1. Joining and adjusting steel penstocks
  - 3.4.2. Joining HDPE penstocks
  - 3.4.3. Laying buried penstock
  - 3.4.4. Fixing penstock with support piers and anchor blocks
  - 3.4.5. Installing expansion joints
  - 3.4.6. Positioning pipe in expansion joint
  - 3.4.7. Installing the packing
  - 3.4.8.
- 3.5. Controls and instrumentation

4. Installation of Transmission Lines (4 hours)
- 4.1. Steps before installing Transmission Lines
- 4.2. Installation Procedure
- 4.3. Installation of distribution and service lines
- 4.4. Earthing
  - 4.4.1. Earthing electrodes
  - 4.4.2. Pipe electrodes
  - 4.4.3. Plate electrodes
- 4.5. Lightning arresters
  - 4.5.1. Installation Procedure of Lightning arresters

5. Commissioning and Testing (7 hours)
- 5.1. Commissioning Procedure
- 5.2. **C**leaning of penstock.
- 5.3. Checks before starting
  - 5.3.1. Intake
  - 5.3.2. Canal
  - 5.3.3. Desalting basin
  - 5.3.4. Gates and stoppages
  - 5.3.5. Penstock supports and anchor blocks
  - 5.3.6. Penstock
  - 5.3.7. Turbine
  - 5.3.8. Power transmission
  - 5.3.9. Alternators
  - 5.3.10. Control panels
  - 5.3.11. Transmission and distribution
- 5.4. Commissioning and performance tests

5.4.1. Operation sequence
5.4.2. Starting
5.4.3. Stopping
5.5. Rectifying faults
5.5.1. Fault diagnosis
5.5.2. Serious problems
5.5.3. Ordinary problems
5.6. Endurance test
5.7. Training Managers and operator
5.8. Handing over the Plant
5.8.1. Completion Certificate
5.8.2. Guarantees

6. Maintenance and Repair (7 hours)
6.1. Civil Works
6.2. The Penstock and Allied Structures
6.3. Electro-mechanical equipment
6.4. Transmission lines
6.5. Maintenance check list and schedule
6.6. Spear parts
6.7. List of tools

7. Preparation of bill of quantities (2 hours)
7.1. Civil part (Intake structure to tail race canal)
7.2. Mechanical part (Penstock pipe to armoured cable of first pole)
7.3. Electrical part (Electrical transmission and distribution first to last pole)
7.4. Other parts
Summary of cost A, B, C and D

Practical/ Project Works:
Practical means project work and report have to be submitted at the end of the course. The report should be around 20-30 pages plus appendix.
1. Case study of MHP plant under contraction
2. Preparation of bill of quantities

References:

1. Adam Harvey, "Micro Hydro design Manual", Intermediate Technology Publication.
2. Win Hulsher and Peter Frankel, "The Power Guide, Intermediate Technology Publication.
3. "Manuals on MHP for Installation and Commissioning, Maintenance and Repair, Operation and Management", ICIMOD.
4. Dr. Rajendra Shrestha, "Basics of micro hydropower (AE 123)", Course Manual for Department of Alternative Energy Tumba College of Technology Rwanda, 2009
5. Dr. Rajendra Shrestha, "Reference Book on Beginner's Micro Hydropower Plant", Graphic International Nepal.

Evaluation Scheme:
The questions will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below:

Unit	Chapter	Topics	Marks
1	1 & 4	all	**16**
2	2	all	**16**
3	3	all	**16**
4	5	all	**16**
5	6 & 7	all	**16**
Total			**80**

AVIONICS
ME78506

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : II**
Practical : 3/2

Course Objectives

To familiarize the students on the basic application of electronics & control system in aircraft. To introduce the basic concepts of navigation & communication systems of aircraft.

Course Outlines:

1. Introduction to Avionics (4 hours)
- 1.1. Needs of Avionics
- 1.2. Different components of avionics
- 1.3. System & integration of avionics

2. Digital Avionics (10 hours)
- 2.1. Introduction to digital system
  - 2.1.1.Needs of digital system in aircraft
  - 2.1.2.Digital computers, Microprocessors & Memories
- 2.2. Introduction to digital avionics
  - 2.2.1.Avionics system architecture & data buses
  - 2.2.2.Introduction of flight deck & cockpit
  - 2.2.3.Control and display technologies CRT, LED, LCD, EL
  - 2.2.4.Plasma panel - Touch screen - Direct voice input (DVI)

3. Introduction to Avionics System (10 hours)
- 3.1. Flight control system
- 3.2. Auto Flight
- 3.3. Communication System
- 3.4. Navigation System
- 3.5. Utility System

4. Electrical & Control System (9 hours)
- 4.1. Batteries & Charger
- 4.2. Electrical Power (AC/DC) Generation
- 4.3. Emergency Power Generator
- 4.4. Power Distribution
- 4.5. Voltage regulation, Circuit protection, Surge Protection & Lighting Arrestor
- 4.6. External/ Ground Power
- 4.7. External & Internal Light used in aircraft

5. Instruments in Aircraft (9 hours)
- 5.1. Pitot static: altimeter,
- 5.2. Air speed indicator, vertical speed indicator;
- 5.3. Gyroscopic: artificial horizon, attitude director, direction indicator, horizontal situation indicator, turns and slip indicator, turn coordinator
- 5.4. Compasses: direct reading, remote reading;
- 5.5. Vibration indicating systems — HUMS
- 5.6. Ground Proximity Warning Systems;
- 5.7. Other indication and warning indicator

6. On Board Maintenance System (3 hours)
- 6.1. Central maintenance computers
- 6.2. Data loading system
- 6.3. Electronic library system & Printing
- **6.4.** Monitoring & Control system

Laboratory/ Project Works:
Practical means project work and report have to be submitted at the end of the course. The report should be around 20-30 pages plus appendix.
- Case study
- Site visit

References:

1. Middleton, D.H., Ed., "Avionics Systems, Longman Scientific and Technical", Longman Group UK Ltd., England.
2. Spitzer, C.R., "Digital Avionic Systems", Prentice Hall, Englewood Cliffs, N.J., USA.
3. . Brain Kendal, "Manual of Avionics", The English Book House, , New Delhi.
4. Aircraft Manufacturer's Manuals & Handbooks

Evaluation Scheme:

The questions will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below:

Unit	Chapter	Topics	Marks
1	1 & 6	all	**16**
2	2	all	**16**
3	3	all	**16**
4	4	all	**16**
5	5	all	**16**
Total			**80**

ADVANCE MECHANICAL DESIGN
ME78507

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : II**
Practical : 3/2

Course Objectives: To make students able to

- Analyze the design failure on failed design or existing product failed due to design.
- Improve the performance of existing design from required modification.
- Introduce new materials in design.
- Realize the need on the benefits to product quality by production and industrial design.

1. Introduction (4 hours)

1.1 The meaning of design for production
1.2 Product development stage analysis
1.3 Process type
1.4 Product specification
1.5 Cost and value analysis
1.6 Cost and performance analysis

2. The meaning of Appreciable Product Design (4 hours)

2.1 Criteria for Successful and Appreciable Design
2.2 The basis for selection of best design – Function, Aesthetics Appropriateness of Technology, Ergonomics, Innovation
2.2.1 Value and Cost of the Product

3. Design against Different types of Failures (9 hours)

3.1 Fatigue Failure – Introduction
3.1.1 Fatigue Design Criteria
3.1.2 Design against Failure
3.2 Shock and Impact Failure – Introduction
3.2.1 Impact Based Design
3.3 Fracture and Failure Analysis
3.3.1 Objectives of Fracture Mechanics Technology
3.3.2 Energy Theory
3.3.3 Critical Stress

4. Interaction of materials, manufacturing and design (5 hours)

4.1 Design for manufacturability
4.2 Selecting manufacturing process
4.3 Design for casting, forging, sheet metal forming, machining, welding
4.4 Design for assembly, corrosion resistance and environment
4.5 Products after retirement

5. Designing for Substitute Materials (8 hours)

5.1 Designing with Plastics – Introduction
5.1.1 Plastic Properties
5.1.2 Plastic Products
5.1.3 Recycling of Plastics
5.2 Designing with Rubber – Introduction
5.2.1 Rubber Properties
5.2.2 Rubber Products
5.2.3 Recycling of Rubber
5.3 Designing with Ceramics – Introduction
5.3.1 Ceramic Properties
5.3.2 Ceramic Products
5.3.3 Recycling of Ceramics
5.4 Designing with Wood – Introduction
5.4.1 Wood Properties
5.4.2 Wood Products
5.4.3 Recycling of Wood

6. Designing for 'X' methodologies (9 hours)

6.1 Safety and Reliability
6.1.1 Design for Safety
6.1.2 Defect Free and Fail Safe Design
6.2 The Meaning of Reliability
6.2.1 Design for Reliability
6.2.2 Reliability Techniques
6.2.3 Fault Tree Methods
6.2.4 Failure Mode and Effective Analysis
6.2.5 Approach to Reliable Design
6.3 Elements of Integrating Reliability into Design Process
6.4 Causes of Unreliability
6.5 Methods of Assuring Reliability
6.6 Factor of Safety and Reliability
6.7 'K' out of 'N' units Reliability Calculation

7. Human Engineering Considerations (6 hours)

7.1 Ergonomics
7.1.1 Objective of Ergonomics
7.1.2 Advantages of Ergonomics
7.1.3 Application of Ergonomics
7.1.4 Approaches adopted by Ergonomics
7.1.5 Scope of Ergonomics
7.2 Human Engineering
7.2.1 The man – machine system
7.2.2 Potential capabilities of man and machine
7.2.3 Man- machine system design comparison

7.3 Design of controls
7.4 Design of displays
7.5 Population stereotypes and interaction between man and machine

Practical:
The laboratory work will be closely connected with lecture and classroom work, and should generally be of a qualitative nature.

1 Critic writing exercise on project thesis by undergraduate students
2. Convert a selected sketch to actual working component.
3. Development analysis and technical advancement study of selected product.
4. Concept development for design and decision making by pair comparison.
5. New product design and development.

References

1. Arther H.Burr and John B. Cheatham , "Mechanical Analysis and Design", Prentice – Hall of India Pvt. Ltd.
2. Arun Shukla , "Practical Fracture Mechanics in Design" Publisher Dekkar.
3. A.K.Chitale, R.C.Gupta, " Production Design and Manufacturing", Prentice – Hall of India Pvt. Ltd.
4. Karl T. Ulrich, Steven D. Eppinger , "Production Design and Development" : Tata – McGraw Hill International Edition.

Evaluation Schemes
The question will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table:

Unit	Chapter	Topics	Marks
1	1 & 2	all	**16**
2	3	all	**16**
3	4 & 7	all	**16**
4	5	all	**16**
5	6	all	**16**
Total			**80**