

ENGINEERING MATHEMATICS I

SH 401

Lecture : 3
 Tutorial : 2
 Practical : 0

Year : I
 Part : I

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 Gamma 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

COMPUTER PROGRAMMING

CT 401

Lecture : 3
 Tutorial : 0
 Practical : 3

Year : I
 Part : I

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. Programming Languages: FORTRAN (4 hours)

- 11.1. Character set
- 11.2. Data types, Constants and variables
- 11.3. Arithmetic operations, Library Functions
- 11.4. Structure of Fortran program
- 11.5. Formatted and Unformatted Input/Output Statements
- 11.6. Control Structures: Goto, Logical IF, Arithmetic IF, Do loops
- 11.7. Arrays: one dimensional and two dimensional

Practical

- Minimum 6 sets of computer programs in C (from Unit 4 to Unit 10) and 2 sets in FORTRAN (from Unit 11) should be done individually. (30 marks out of 50 marks)
- 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", Bhundipuram 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

ENGINEERING DRAWING I

ME 401

Lectures : 1
 Tutorial : 0
 Practical : 3

Year : I
 Part : I

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 & 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. M. C. Luintel, "Engineering Drawing (Vol.I)", Athrai Publication (P) Limited.
2. W. J. Luzadder, "Fundamentals of Engineering Drawing", Prentice Hall.
3. T. E. French, C. J. Vierck, and R. J. Foster, "Engineering Drawing and Graphic Technology", Mc Graw Hill Publishing Co.
4. A. Mitchell, H. C. Spencer and J. T. Dygdone, "Technical Drawing", F. E. Giescke, Macmillan Publishing Co.
5. N. D. Bhatt, "Elementary Engineering Drawing", Charotar Publishing House, India.
6. P. S. Gill, "A Text Book of Engineering Drawing", S. K. Kataria and Sons, India
7. R. K. Dhawan, "A Text Book of Engineering Drawing", S. Chand and Company Limited, India

ENGINEERING PHYSICS

SH 402

Lecture : 4
Tutorial : 1
Practical : 2

Year : I
Part : I

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 Fraunhofer'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:

1. To determine the acceleration due to gravity and radius of gyration of the bar about an axis passing through its center of gravity.
2. To determine the value of modulus of elasticity of the materials given and moment of inertia of a circular disc using torsion pendulum.
3. To determine the angle of prism and dispersive power of materials of the prism using spectrometer.
4. To determine the wavelength of sodium light by Newton's rings.
5. To determine the wavelength of He-Ne laser light and use it to measure the thickness of a thin wire by diffraction of light.
6. To study the variation of angle of rotation of plane of polarization using concentration of the cane sugar solution
7. To determine the specific rotation of the cane sugar solution using polarimeter.
8. 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.
9. To determine the capacitance of a given capacitor by charging and discharging through resistor.
10. To plot a graph between current and frequency in an LRC series circuit and find the resonant frequency and quality factor.
11. To determine dielectric constant of a given substance and study its variation with frequency by resonance method.
12. To determine the susceptibility of a solution of given materials by Quincke's method.
13. 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.

APPLIED MECHANICS**CE 401****Lecture : 3****Year : I****Tutorial : 2****Part : I****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

Tutorials:

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.

BASIC ELECTRICAL ENGINEERING**EE 401****Lecture : 3****Tutorial : 1****Practical : 3/2****Year : I****Part : I****Course Objective:**

To understand 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 (2 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 (5 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 Cliffs, New Jersey
2. I.M Smith, "Haughes Electrical Technology", Addison-Wesley, ISR Rprint

ENGINEERING MATHEMATICS II

SH 451

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

ENGINEERING DRAWING II

ME 451

Lecture : 1
 Tutorial : 0
 Practical : 3

Year : I
 Part : II

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 Publishing Co.
3. F. E. Giescke, A. Mitchell, H. C. Spencer and J. T. Dygdone, "Technical Drawing", Macmillan Publishing Co.
4. N. D. Bhatt, "Machine Drawing", Charotar Publishing 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.

BASIC ELECTRONICS ENGINEERING

EX 451

Lecture : 3
 Tutorial : 1
 Practical : 3/2

Year : I
 Part : II

Course Objective:

To understand the language of electronics, elements and their functionality. To understand 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, varactors 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; shift 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, data 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

ENGINEERING CHEMISTRY

SH 453

Lecture : 3**Tutorial : 1****Practical : 3****Year : I****Part : II****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 $\text{SO}_x, \text{NO}_x, \text{CO}, \text{CO}_2, \text{O}_3$ 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 pond 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 Sulphur 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 (3 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 E1 and E2
 - 10.5 Factors governing SN^1 , SN^2 , E1 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 6 Periods

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

FUNDAMENTALS OF THERMODYNAMICS AND HEAT TRANSFER

ME 452

Lectures : 3
Tutorial : 1
Practical : 3/2

Year : I
Part : II

Course Objective:

To develop basic concepts, laws of thermodynamics and heat transfer and their applications.

- 1. Introduction (3 hours)**
 - 1.1 Definition and Scope of Engineering Thermodynamics
 - 1.2 Value of energy to society
 - 1.3 Microscopic versus Macroscopic Viewpoint
 - 1.4 Concepts and Definitions
 - 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.

WORKSHOP TECHNOLOGY

ME 453

Lecture : 1
Tutorial : 0
Practical : 3

Year : I
Part : II

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 Vice
- 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**(1 hours)**

- 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
 - 5.3.5 Introduction
 - 5.3.6 Types of Shapers
 - 5.3.7 Physical Construction
 - 5.3.8 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.
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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