

**Engineering Mathematics II**  
**EG 1201 SH**

**Year: I**  
**Semester: I**

**Total: 6 hours /week**  
**Lecture: 4 hour/week**  
**Tutorial: 2 hours/week**  
**Practical: hours/week**  
**Lab: hours/week**

**Course Description:**

This course consists of five units namely: Algebra, Conic sections, Geometry, Vectors, Statistics and Probability; which are basically necessary to develop mathematical knowledge and helpful for understanding as well as practicing their skills in the related engineering fields.

**Course Objectives:**

On completion of this course, students will be able to understand the concept of the following topics and apply them in the related fields of different engineering areas

- Ideas of algebraic relations between variables, complex number system, Matrices and determinants, linear equations and inequalities, linear programming
- Two- and three-dimensional geometry, Vectors and their products
- Statistics and Probability

**Unit 1: Algebra**

**[18 Hrs.]**

**1.1 Polynomial equations**

Quadratic equations, nature and relation between two roots, formation of quadratic equation, condition of common roots

**1.2 Complex numbers**

Definition, algebra, geometric representation, modulus, conjugate of complex numbers, square root, polar form, product and quotient of complex numbers, De Moivre's theorem and its applications to find the roots of complex numbers, properties of cube root of unity

**1.3 Matrices and Determinants**

Definitions, orders, types, algebraic operations, transpose of matrices and their properties without proofs. Definition, expansion and properties of determinants (without proofs), inverse of matrix

**1.4 Solution of system of linear equations**

Cramer's rule, inverse matrix method, row equivalent method

**1.5 Linear inequalities and graphs up to two variables**

**1.6 Linear programming by graphical method**

**Unit 2: Conic Sections**

**[6 Hrs.]**

**2.1 Parabola**

- Standard equation of parabola
- Equation of parabola vertex at any point (without proof)
- General equation (simple problems to find vertex, focus and equation of directrix)

**2.2 Ellipse and Hyperbola**

- Standard equation of ellipse and hyperbola (without proof)
- Equation of ellipse and hyperbola center at any point (without proof)
- Center, vertex, foci, directories of ellipse and hyperbola

**Unit 3: Geometry** **8hrs**

**3.1 Coordinate in Space**

- Rectangular Cartesian co-ordinates
- Distance and section formulas (without proofs)
- Direction cosine and ratio of a line, Projections
- Angle between two lines

**3.2 Planes**

- General equation of plane (without proofs)
- Equation of plane in intercept and normal forms (without proofs)
- Equation of plane through a point
- Angle of between two planes
- Length of perpendicular from a point on a plane

**Unit 4: Vectors** **10hrs**

**4.1 Definitions and Algebra of Vectors**

- Definitions, notations and representations of vectors
- Modulus and direction cosines of a vector
- Algebra of vectors, Types of vectors
- Linear dependent and independent vectors, Coplanar vectors

**4.2 Product of Two Vectors**

- Scalar product of two vectors, geometrical meaning, properties and angle between two vectors without proofs, simple applications in plane trigonometry
- Vector product of two vectors, geometrical meaning, properties and angle between two vectors without proofs, determinant form of vector product, simple applications in plane trigonometry, vector equation of a straight line

**Unit 5: Statistics and Probability** **[18 Hrs.]**

**5.1 Statistics**

- Revision: measures of central tendency (Mean, median, mode, quartiles, deciles and percentiles)
- Measure of dispersion (Range, mean deviation, quartile deviation and standard deviation)
- Skewness, Correlation (Karl Pearson's method), Regression analysis

**5.2 Probability**

- Basic terms of probability theory
- Concept of mutually exclusive events
- Definitions and basic laws of probability (without proofs)
- Probability in terms permutation and combination

**5.3 Theoretical Probability Distributions**

- Random and discrete random variables
- Binomial and normal distributions

**Tutorial**

**1. Algebra** **[12 Hrs.]**

- Polynomial equations [2 Hrs.]
- Complex numbers [3 Hrs.]
- Matrices and Determinants [4 Hrs.]
- Solution of system of linear equations [2 Hrs.]
- Linear inequalities and graphs up to two variables and linear programming by graphical method [1Hr]

<b>2. Conic Sections</b>	<b>[3 Hrs.]</b>
• Parabola	[2 Hrs.]
• Ellipse and Hyperbola	[1 Hrs.]
<b>3. Geometry</b>	<b>[4 Hrs.]</b>
• Coordinate in Space	[2 Hrs.]
• Planes	[2 Hrs.]
<b>4. Vectors</b>	<b>[5 Hrs.]</b>
• Definitions and Algebra of Vectors	[2 Hrs.]
• Product of Two Vectors	[3 Hrs.]
<b>5. Statistics and Probability</b>	<b>[6 Hrs.]</b>
• Statistics	[3 Hrs.]
• Probability	[2 Hrs.]
• Theoretical Probability Distributions	[1 Hrs.]

### Evaluation Scheme

#### Unit wise Marks division for Final

S. No.	Units	Short questions (2 marks)	Long questions (4 marks)	Total Marks
1	Algebra	4 x 2 = 8	4 x 4 = 16	24
2	Conic Sections	2 x 2 = 4	2 x 4 = 8	12
3	Geometry	2 x 2 = 4	2 x 4 = 8	12
4	Vectors	3 x 2 = 6	2 x 4 = 8	14
5	Statistics and Probability	3 x 2 = 6	3 x 4 = 12	18
		<b>14 x 2 = 28</b>	<b>13 x 4 = 52</b>	<b>80</b>

### Reference Books

1. Thapa G. B. et al., Engineering Mathematics (Volume II, Three Years Diploma), Sukunda Pustak Bhawan, Bhotahity, Kathmandu, Nepal
2. Bajracharya D. R. et al., Basic Mathematics (Grade XI/XII), Sukunda Pustak Bhawan, Bhotahity, Kathmandu, Nepal
3. Bajracharya B. C., Mathematics and Statistics for Economics, M K publishers and distributors, Bhotahity, Kathmandu, Nepal
4. A Text book of Statistics – B.C. Bajracharya
5. Elementary Statistics – H. C. Saxena
6. Nath et al., Engineering Mathematics II, Vidhyarthi Publisher and distributors, Bhotahity, Kathmandu, Nepal
7. Other references selected by the related lecturer(s) from among the texts available in the market that meet the content of this subject.

**Engineering Physics II**  
**EG 1202 SH**

**Year: I**  
**Semester: II**

**Total: 8 hours /week**  
**Lecture: 4 hour/week**  
**Tutorial: 2 hours/week**  
**Practical: hours/week**  
**Lab: 2 hours/week**

**Course Description**

This course in physics is designed to provide students with an understanding of the scientific laws of our physical world, and how physics contributes to life's activities in modern society. The course emphasizes both quantitative and qualitative aspects of physics, involving mathematical models and equations. The application of physics to social and environmental situations is well illustrated.

The practical component of this course is designed to supplement learning through the application of learned theory. The students will handle simple apparatus to do simple measurements, demonstrate simple electrical circuits, and apply their knowledge of physics to real life examples.

**Course objectives**

On completion of the course the student will be able to:

- Sustain interest in physics and its applications related to everyday experiences of their life
- Identify the social, economic, environmental and other implications of physics
- Describe physics as a coherent and developing framework of knowledge based on fundamental theories of the structures and processes of the physical world
- Demonstrate the skills of experimenting, observing, interpreting data and evaluating evidence to formulate generalizations and models
- Apply knowledge of physical principles to familiar and unfamiliar situations
- Apply facts, vocabulary and conventions to unit measurements and common measuring instruments
- Explain the definitions, laws, concepts, theories and models presented in this course.
- Describe the applications and implications of physical facts and principles.
- Explain the basic concept of Physics relevant to problems for the understanding and practicing related in engineering works.

**Course Contents**

**Theory**

**Unit 1: Electrostatics, Current and Electromagnetism**

**[20hrs]**

**Sub-Unit 1.1: Electrostatics and capacitors**

**4hrs]**

- Elementary charges, charging by induction
- Faraday's Ice-pail experiment, electric field, lines of force
- Coulomb's law, intensity of electric field
- Electrostatic potential, equipotential surfaces, action of points
- Capacitors, types of capacitors
- Grouping of capacitors, action of dielectrics

- Simple Numerical Problems
- Sub-unit 1.2: Current Electricity** **[7 Hrs.]**
- D.C. current, strength of current
  - Potential difference across a conductor
  - Ohm' law and its verification
  - Resistance and resistivity
  - Connection of resistances
  - Galvanometer and its conversion into ammeter and voltmeter
  - Potentiometer and its use to measure emf
  - Wheat stone bridge
  - Kirchhoff's laws and their uses in simple circuits
  - Joule's law of heating
  - The rate of heating from the concept of p.d.
  - See- beck effect, Peltier effect, Thomson effect
  - Simple Numerical Problems
- Sub- unit 1.3: Magnetic effect of current and electromagnetism** **[6 Hrs.]**
- Magnetic forced and magnetic field of current
  - Force experienced by a charge moving in magnetic field
  - Force acting of current carrying conductor
  - Statement of Biot - Savart's law
  - Magnetic field due a long straight conductor and due to a circular coil
  - Force acting between two current carrying parallel conductors
  - Application of Ampere's law to calculate magnetic field due to a solenoid
  - Faraday's laws of electromagnetic induction
  - Lenz's law
  - Self- induction and mutual induction in coils
  - Working of transformer
  - Simple Numerical Problems
- Sub- unit 1.4: Alternating current** **[3 Hrs.]**
- Generation of A.C. by A.C. generator
  - Instantaneous and effective values of current and voltage
  - Relation between voltage and current in R and L circuit
  - Phase between current and voltage
  - Resonance and power in A.C. circuit
  - Simple Numerical Problems
- Unit 2: Waves and optics** **[13 Hrs.]**
- Sub- unit 2.1: Wave motion** **[3 Hrs.]**
- Wave motion and its type
  - Characteristics of wave motion
  - Wavelength, frequency and speed of waves
  - Velocity of waves in different media
  - Simple Numerical Problems
- Sub- unit 2.2: Sound waves** **[5 Hrs.]**
- Reflection, refraction, diffraction, interference
  - Beats and beat frequency
  - Determination of beat frequency
  - Progressive waves, stationary waves and their equations

<ul style="list-style-type: none"> <li>• Waves in pipes and strings</li> <li>• Fundamental mode and overtones in pipes and strings</li> <li>• Intensity of sound, intensity level and inverse square law</li> <li>• Simple Numerical Problems</li> </ul>	
<b>Sub-unit 2.3: Physical</b>	<b>[5 Hrs.]</b>
<ul style="list-style-type: none"> <li>• Coherent sources of light and interference</li> <li>• Phase difference and path difference</li> <li>• Young's double slit experiment</li> <li>• Diffraction and polarization of light</li> <li>• Brewster's law</li> <li>• Huygen's principle</li> <li>• Simple Numerical Problems</li> </ul>	
<b>Unit 3: Properties of matter</b>	<b>[10 Hrs.]</b>
<b>Sub unit 3.1: Elasticity</b>	<b>[4 Hrs.]</b>
<ul style="list-style-type: none"> <li>• Elasticity; Hooke's law</li> <li>• Stress, strain, Young's modulus, Bulk modulus and shear modulus.</li> <li>• Energy stored in stretched string</li> <li>• Simple Numerical Problems</li> </ul>	
<b>Sub-unit 3.2: Surface Tension</b>	<b>[3 Hrs.]</b>
<ul style="list-style-type: none"> <li>• Intermolecular attraction in liquid, surface tension</li> <li>• Cohesion and adhesion, angle of contact</li> <li>• Surface energy, capillary action</li> <li>• Simple Numerical Problems</li> </ul>	
<b>Sub-unit 3.3: Viscosity</b>	<b>[3 Hrs.]</b>
<ul style="list-style-type: none"> <li>• streamline and turbulent flows</li> <li>• Idea of liquid layers, velocity gradient, coefficient of viscosity</li> <li>• Viscous forces, Stoke's law, terminal velocity</li> <li>• Simple Numerical Problems</li> </ul>	
<b>Unit 4: Modern Physics</b>	<b>[17 Hrs.]</b>
<b>Sub-unit 4.1: Atomic Physics</b>	<b>[9 Hrs.]</b>
<ul style="list-style-type: none"> <li>• Motion of charged particles in electric and magnetic fields</li> <li>• <math>e/m</math> for electrons, Millikan's oil drop experiment</li> <li>• Photons, photoelectric effect, Stopping potential for photoelectrons</li> <li>• Einstein's photoelectric equation</li> <li>• Bohr's model for hydrogen atom</li> <li>• Energy level diagram and spectral series</li> <li>• X-rays; production, properties and applications</li> <li>• Introduction of Laser</li> <li>• Simple Numerical Problems</li> </ul>	
<b>Sub-unit 4.2: Semiconductors</b>	<b>[5 Hrs.]</b>
<ul style="list-style-type: none"> <li>• Valence electrons and Energy bands in solids</li> <li>• Intrinsic and doped p-type, n-type semiconductors</li> <li>• Charge carriers in semiconductors</li> <li>• Acceptors, donors, p-n junction diode</li> <li>• Depletion layer, forward and reverse biasing</li> <li>• Rectifying properties of a diode</li> </ul>	

- Simple Numerical Problems

**Sub-unit 4.3: Nuclear Physics**

[3 Hrs.]

- Laws of radioactive disintegration
- Half-life, mean-life and decay constant
- Stable and radioactive nuclei
- Binding energy, nuclear fission, critical mass and nuclear fusion
- Simple Numerical Problems

**Tutorial:**

The instructors should practice the numerical problems of following topics as indicated by credit hours

S. N.	Units	Sub Units	Credit hours	
1	Electricity	Electrostatics and Capacitors	4	14
		Current Electricity	5	
		Magnetic effect of current and Electromagnetism	3	
		Alternating Current	2	
2	Waves	Wave motions	2	8
		Sound waves	1	
		Physical Optics	2	
		Elasticity	3	
3	Properties of Matter	Viscosity	1	5
		Surface Tension	1	
		Semi-conductors	3	
4	Modern Physics	Nuclear Physics	3	3
<b>Total Hours</b>			<b>30</b>	<b>30</b>

**Engineering Physics Practical II**

[30 Hrs.]

1. Determine specific resistance of a wire.
2. Determine the frequency of A.C. mains.
3. Study current voltage characteristics of a junction diode.
4. Determine speed of sound by resonance air column method.
5. Determine Young Modulus.
6. Verify Ohm's law.
7. Determine force constant of a helical spring oscillation method.
8. Compare Emfs of two cells by using potentiometer.
9. Study characteristics curves of npn transistor.
10. Determine unknown resistance by Wheatstone bridge method.

**Learning materials:**

1. Advanced level physics by Nelkon and Parker, 5<sup>th</sup> and later editions
2. College physics by sears, Zemansky and Young, Fourth and later editions

**Textbooks for laboratory work:**

1. Physics Practical book by S.K. Neupane.

**Other learning materials:**

1. Reference to be selected by the related lecture(s) from among the texts available in the market that meet the content needs of this subject.
2. The related institute may develop its own textbook and approve from the related authority so as to have a prescribed textbook of this subject.

**Evaluation Scheme**

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

S. N.	Units	Sub Units	Credit hours		Total marks
1	Electricity	Electrostatics and Capacitors	7	20	12
		Current Electricity	4		
		Magnetic effect of current and Electromagnetism	6		12
		Alternating Current	3		
2	Waves	Wave motions	3	13	12
		Sound waves	5		
		Physical Optics	5		
3	Properties of Matter	Elasticity	4	10	8
		Viscosity	3		
		Surface Tension	3		
4	Modern Physics	Atomic Physics	9	17	16
		Semi-conductors	5		
		Nuclear Physics	3		
<b>Total credit hours</b>			<b>60</b>	<b>60</b>	<b>60</b>

**Engineering Chemistry II**  
**EG1203SH**

**Year: I**  
**Semester: II**

**Total: 8 hours /week**  
**Lecture: 4 hour/week**  
**Tutorial: 2 hours/week**  
**Practical: hours/week**  
**Lab: 2 hours/week**

**Course Description:**

This subject consists of three units related to nonmetals and their compounds, metals and their compounds and organic compounds and polymers.

**Course Objectives:**

After the completion of this subject, students will be able to

- Know about causes of hardness of water and its remedy.
- Develop the knowledge of physical and chemical properties of different materials.
- Explain about the manufacturing process of ammonia, Nitric acid and sulphuric acid.
- Know about alkali metals, alkaline earth metals and coinage metals and their properties.
- Prepare laboratory method and their properties of different compounds.
- Write IUPAC naming of organic compounds.
- Provide the student's background of basic concepts of chemistry required for understanding and practicing related in engineering works.

**Course Content:**

**Unit 1: Non-metals and their compounds:**

**[30 Hrs.]**

**1.1 Water:**

**[4 hours]**

- Introduction
- Sources of water
- Types of water
- Causes and types of hardness of water
- Methods of removal of temporary hardness by:
  - Boiling and Clark's methods
- Methods of removal of permanent hardness by:
  - Washing soda and permutit process and its advantages
- General concept on Water treatment for domestic and industrial purpose
  - Water for drinking purposes, water for boiler purposes, water for washing purposes
- Conditions of potable water
- Concept of amphoteric and universal solvent of water

**1.2 Ammonia:**

**[4 Hrs.]**

- Introduction
- Laboratory preparation of ammonia gas
- Manufacture of ammonia by Haber's process (ref. principle, condition for higher yield and process)
- Physical Properties
- Chemical properties:
  - Basic nature, dissociation, auto-ionization
  - Reduction reaction

- Combustion, catalytic oxidation of ammonia, oxidation of heated copper oxide
- Action with halogens(chlorine)
- Action with metals (Na Or K)
- Action with metallic salts solution like Iron, aluminum, zinc and chromium
- Formation of complex amines with the salts solutions of d block transitional elements like copper, silver, Nickel and Cobalt
- Action with Carbon dioxide
- Action with bleaching powder

- Uses

### 1.3 Nitric acid:

[8 Hrs.]

- Introduction
- Manufacture of nitric acid by Ostwald's process (ref. principle, process and advantages)
- Physical Properties
- Chemical properties:
  - Action of heat
  - Acidic character
  - Oxidizing character
    - action on non-metals like carbon, Sulphur, phosphorus and iodine
    - action on metalloids like arsenic and antimony
    - action on inorganic compounds like Sulphur dioxide, hydrogen sulphide and acidified ferrous sulphates
    - action on metals like Zinc, Magnesium, Iron, copper, mercury and silver
    - action on noble metals like gold and platinum (with aqua regia)
- uses
- Nitrogen cycle (explain with flow chart diagram)
- Nitrogen fixation and it occurs (natural and artificial)
- Fertilizers
  - Types of fertilizers
  - Functions of essential nutrients
  - Characteristics of fertilizers
  - Classification of chemical fertilizers (ref N,P,K and mix)
- Pollution and pollutant(introduction)
- Oxides of nitrogen and Sulphur as pollutant and acid rain

### 1.4 Halogens (Chlorine):

[3hrs]

- Introduction
- Laboratory preparation of chlorine
  - by applying heat
  - without application of heat
- Physical Properties
- Chemical properties:
  - action with hydrogen
  - action with water
  - action with sodium hydroxide, potassium hydroxide and calcium hydroxide
  - action with ammonia
  - oxidizing character:
    - action of chlorine in presence of water (ref Hydrogen sulphide, Sulphur dioxide, acidified ferrous sulphate)
    - action of chlorine in absence of water (ref, ferrous chloride, stannous chloride)

- Bleaching character
- Action with bromides and iodides
- Action with metals like copper, zinc, aluminum and iron
- Action with metalloids like arsenic and antimony
- Action with non-metals like Sulphur and phosphorus
- Action with organic compounds like methane and ethene

- uses

### **1.5 Hydrochloric acid:**

**[2 Hrs.]**

- Introduction
- Laboratory preparation of HCl gas and aqueous HCl
- Physical Properties
- Chemical properties:
  - acidic character
  - action with ammonia
  - reducing character (action with oxidizing agents)
    - action with manganese dioxide, potassium permanganate and potassium dichromate
  - action with AgNO<sub>3</sub>
  - formation of aqua regia
  - action with lead acetate
  - action nonmetals
  - action with air
- uses

### **1.6 Hydrogen sulphide:**

**[2 Hrs.]**

- Introduction
- Laboratory preparation of hydrogen sulphide (pure and dry state)
- Physical Properties
- Chemical properties:
  - Acidic character
  - Dissociation
  - Reducing properties
    - action with ferric chloride, halogens, acidified potassium permanganate, acidified potassium dichromate, Sulphur dioxide, sulphuric acid and nitric acid
  - Action with metals
  - Action with lead acetate
  - Precipitation of metals sulphide (acidic and basic medium)
- uses

### **1.7 Sulphuric acid:**

**[4 Hrs.]**

- Introduction
- Manufacture by contact process (ref principle, condition and process)
- Physical Properties
- Chemical properties:
  - action of heat
  - acidic nature
  - precipitation reaction
  - oxidizing agent (ref. nonmetals like Sulphur, carbon, phosphorus, hydrogen halide, hydrogen sulphide, metals)
  - dehydrating action, (ref. sugar, starch, formic acid, oxalic acid, alcohol, copper sulphates crystals)

– action with SO<sub>3</sub>

- uses

### **1.8 Carbon and its compounds:**

**[3 Hrs.]**

- Introduction
- Allotropy
- Allotropic form of carbon (just give flow sheet)
- Structure, properties and uses of diamond and graphite
- Oxides of carbon (Ref. sources of carbon dioxide & carbon mono oxide and its effect)
- Concept of greenhouse effect and global warming

## **Unit 2: Metals and their compounds**

**[15 Hrs.]**

### **2.1 General study of Metals and their components:**

**[5 Hrs.]**

- Introduction
- Distinguish between metals and non-metals (ref. physical and chemical properties: at least any fifteen differences)
- Occurrence of metals
- Definition and types of alloys (ref. ferrous and non-ferrous alloys)
- Purpose of making alloys
- Metalloids
- Amalgam
- Chemistry of metallic carbonate
  - General methods of preparation of metallic carbonate
    - by passing carbon dioxide into oxides or hydroxides
    - by heating bicarbonates
    - by double decomposition (preparation of insoluble carbonates)
  - General properties of metallic carbonates
    - action with water
    - action of heat
    - action with acids
- Chemistry of metallic sulphate
  - General methods of preparation of metallic sulphate
    - by treating metals with sulphuric acid
    - by treating the oxides, hydroxides, carbonates and sulphides of metals with sulphuric acid
    - by double decomposition (preparation of insoluble sulphates)
    - by roasting of sulphides
  - General properties of metallic sulphates
    - action with water
    - action of heat
- Chemistry of metallic chlorides
  - General methods of preparation of metallic chlorides (hydrated)
    - by treating metals with hydrochloric acid
    - by treating the oxides, hydroxides, carbonates and sulphides of metals with hydrochloric acid
    - by double decomposition (preparation of insoluble chlorides)
    - by treating metals with aqua regia
  - General properties of metallic chlorides
    - action with water
    - action of heat

- action with acid
- Chemistry of metallic nitrate
  - General methods of preparation of metallic nitrate
    - by treating metals with nitric acid
    - by treating the oxides, hydroxides and carbonates of metals with nitric acid
    - by double decomposition
  - General properties of metallic nitrate
    - action with water
    - action of heat

## 2.2 Alkali metals

[2 Hrs.]

- Introduction
- Periodic position
- General characteristic properties of alkali metals (ref. physical and chemical properties)
  - Physical properties:
    - Physical appearance, size of atoms, melting and boiling point, oxidation state, metallic character and electronegativity
  - Chemical properties:
    - Action of air, action of water, action with hydrogen, action with halogen
- Sodium
  - Introduction
  - Physical Properties
  - Chemical properties:
    - action with air, water, hydrogen, hydrogen chloride, ammonia, chlorine, Sulphur, carbon dioxide
    - reducing action
  - uses

## 2.3 Alkaline earth metals

[2 Hrs.]

- Introduction
- Periodic position
- General characteristic properties of Alkaline earth metals (ref. physical and chemical)
  - Physical properties:
    - Physical appearance, size of atoms, melting and boiling point, oxidation state, metallic character and electronegativity
  - Chemical properties:
    - Action with air, water, hydrogen, nitrogen, halogen, acids, non-metals
    - formation of alloys
- Distinguish between alkali and alkaline earth metals
- Calcium
  - Introduction
  - Physical Properties
  - Chemical properties:
    - action with oxygen, water, hydrogen chloride, sulphuric acid, hydrogen, nitrogen, chlorine, carbon
  - uses

## 2.4 Coinage metals

[2 Hrs.]

- Introduction
- Periodic position

- General characteristic properties of coinage metals (ref. physical and chemical properties)
  - Physical properties:
    - Physical appearance, size of atoms, melting and boiling point, malleability, ductility, conductivity, variable valency
  - Chemical properties:
    - Action with air, water and acids
    - Action of salt solution with metals like Zn, Mg, and Fe
    - Formations of alloys
- Copper
  - Introduction
  - Physical properties
  - Chemical properties:
    - action with air, water, acids, ammonia, chlorine, Sulphur
    - reducing action
    - displacement reaction
  - uses

## **2.5 Aluminum** **[1 Hr.]**

- Introduction
- Physical Properties
- Chemical properties:
  - action with air, water, Nitrogen, chlorine, carbon, Sulphur, acids, sodium hydroxide
- uses

## **2.6 Zinc** **[1 Hr.]**

- Introduction
- Physical Properties
- Chemical properties:
  - action with oxygen (philosopher's wool), water, sodium hydroxide, acids, chlorine, Sulphur
  - displacement reaction
- uses

## **2.7 Iron** **[1 Hr.]**

- Introduction
- Physical Properties
- Chemical properties:
  - action with air, water, chlorine, acids, Sulphur, carbon monoxide
  - displacement reaction
- uses

## **2.8 Lead** **[1 Hr.]**

- Introduction
- Physical Properties
- Chemical properties:
  - action with air, water (plumbosolvency), acids, chlorine, Sulphur, sodium hydroxide, acetic acid
- uses

## **Unit3: Organic compounds and polymers** **[15 Hrs.]**

### **3.1 Organic compounds** **[5 Hrs.]**

- Introduction
- vital force theory and downfall of vital force theory
- Classification of organic compounds
- Functional groups
- Homologous series
  - Definition
  - Characteristics of homologous series
- Nomenclature of organic compounds
- Concept of word root, suffix and prefix
- IUPAC naming of simple aliphatic compounds:
  - alkane, alkene, alkyne, halogen derivatives (monohalo only), alcohol, (monohydric alcohol only), ethers, aldehydes, ketones, carboxylic acid (mono carboxylic acid), nitroalkane, alkyl cyanides, alkyl isocyanides, amines
- writing the simple structural formula from the name of the compound (IUPAC)

### 3.2 Alkanes

[2 Hrs.]

- Introduction
- Hydrocarbon
  - Aliphatic hydrocarbon
    - saturated and unsaturated hydrocarbon
  - aromatic hydrocarbon
- Methane
- Introduction
- Physical properties
- Chemical properties
  - halogenation, nitration, action with air and steam, pyrolysis
- uses

### 3.3 Alkene

[2 Hrs.]

- Introduction
- **Ethylene**
- Physical properties
- Chemical properties:
  - addition reaction
    - addition of hydrogen, halogens, hydrogen chloride, water, sulphuric acid,
    - ozonolysis
    - Markonikov's rule and peroxide effect
  - oxidation reaction
    - with alkaline  $\text{KMnO}_4$ , with acidified  $\text{KMnO}_4$ , oxidation by air
  - polymerization
- uses

### 3.4 Alkyne

[2 Hrs.]

- Introduction
- Acetylene
- Physical properties
- Chemical properties:
  - Addition reaction
    - addition of hydrogen, halogens, halogens acid water, sulphuric acid, hydrogen cyanides, acetic acid
    - Ozonolysis
  - Substitution reaction

- action with sodium, ammoniacal silver nitrate, ammoniacal cuprous chloride
- Oxidation reaction
  - with alkaline  $\text{KMnO}_4$ , with chromic acid, oxidation by air
- Polymerization
- uses

### 3.5 Benzene

[3 Hrs.]

- Introduction
- Distinguish between aliphatic and aromatic compounds
- Aromaticity
- Huckel rule
- Physical properties of benzene
- Chemical properties of benzene:
  - Substitution reaction
    - Halogenations, nitration, Sulphonation, Friedel craft reaction
  - Addition reaction
    - Addition of hydrogen halogens and ozone
  - Oxidation reaction
    - action with air and combustions
- uses

### 3.6 Polymers

[1Hr]

- Introduction
- Polymers and polymerization
- Classification of polymer:
  - natural polymer
  - synthetic polymer
- Polythene
  - preparation and uses
- Polyvinyl chloride
  - preparation and uses
- Rubber
  - preparation and uses of natural rubber (ref. isoprene unit) and synthetic rubber (ref. Neoprene rubber)

## Tutorial

### Unit 1:

[14hrs]

Practice on causes, types and method of removal of hardness of water, Lab preparation of ammonia, chlorine, hydrogen chloride, hydrogen sulphide, Manufacture of ammonia, nitric acid and sulphuric acid, nitrogen cycle and chemical fertilizers, oxides of nitrogen and Sulphur as pollutant and acid rain, chemical properties of ammonia, nitric acid, chlorine, hydrogen chloride, hydrogen sulphide and sulphuric acid, allotropes of carbon, structure and properties of Diamond.

### Unit 2:

[9 Hrs.]

Practice on difference metals and non-metals, preparation and properties of metallic carbonate, chlorides, sulphate and nitrates, types and purpose of making of alloys, general characteristics of alkali metals, alkaline earth metals and coinage metals, chemical properties of different metals like sodium, calcium, aluminium, copper, Zinc, iron and lead

### Unit 3:

[7 Hrs.]

Practice on homologues series, functional group, IUPAC naming of simple aliphatic compounds, saturated and unsaturated hydrocarbon, chemical properties of methane, alkene,

alkyne and benzene, Huckel's rule, homopolymers and copolymers, preparation and uses of polyethene, polyvinyl chloride and rubber.

**Engineering Chemistry Practical II:**

**[30 Hrs.]**

1. Prepare and study the properties of hydrogen gas. [2hrs]
2. Prepare and study the properties of ammonia gas. [2hrs]
3. Prepare and study the properties of hydrogen Sulphide gas. (This gas should not be prepared individually in Woulf bottle but in Kipp's apparatus commonly) [2hrs]
4. Detect the acid radicals ( $\text{Cl}^-$ ,  $\text{NO}_3^-$ ,  $\text{SO}_4^{2-}$ ,  $\text{CO}_3^{2-}$ ) by dry and wet ways. (4hrs)
5. Detect the basic radicals ( $\text{Cu}^{++}$ ,  $\text{Al}^{+++}$ ,  $\text{Fe}^{+++}$ ,  $\text{Zn}^{++}$ ,  $\text{CO}^{++}$ ,  $\text{Ni}^{++}$ ,  $\text{Ca}^{++}$ ,  $\text{Ba}^{++}$ ,  $\text{Mg}^{++}$ ) by wet ways. [6hrs]
6. Detect the acid and basic radicals (complete salt analysis). [6hrs]
7. Investigate the action of acids on some metals (Zn, Mg, Fe, Al, Sn & Cu) (acids: HCl,  $\text{H}_2\text{SO}_4$ (dil.) &  $\text{HNO}_3$ (dil.)) [2hrs]
8. Compare the hardness of different types of water. [2hrs]
9. Prepare Bakelite (resin) in the laboratory. [2hrs]
10. Determine the condition in which corrosion takes place. [2hrs]

**References Books:**

1. Foundations of chemistry, Vol-2, M.K. Sthapit and R.R. Pradhananga, Taleju prakashan, Kathmandu
2. A Text book of Engineering Chemistry-vol II, Prakash Paudel, Siddhartha publication, Kathmandu
3. Engineering Chemistry, M.L. Sharma, K.M. Shrestha, P.N. Choudhary, Ekta Book,
4. A Text book of Chemistry, Jha and Guglani, surya publication, India
5. Elementary qualitative analysis, M.K. Sthapit and C.B. Tuladhar, Taleju Prakashan
6. Elementary practical chemistry, MK. Sthapit, Taleju Prakashan
7. Practical engineering chemistry for diploma level, Sumitri Bajracharya, Sabina Shrestha, Kathmandu institute of technology.

**Other learning materials:**

1. Other references to be selected by the related lecturer(s) from among the texts available in the market that meet the content needs of this subject.
2. The related institute may develop its own textbook and approve from the related authority so as to have a prescribed as a textbook of this subject.

**Evaluation Scheme**

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

Units	Chapter	Hours	Marks distribution
1	Water	5	4
	Ammonia	4	4
	Nitric acid	8	8
	Halogens (Chlorine),	3	4
	Hydrochloric acid, Hydrogen sulphide	4	4
	Sulphuric acid, Carbon and its compound	7	8
2	General study of metals and their components: Alloys	5	4
	Alkali metals, sodium, Aluminium	3	4
	Alkaline earth metals, calcium, Zinc	3	4
	Coinage metals, copper, Iron, lead	4	4
3	Organic compounds, alkane	6	4
	Alkene, Alkyne	4	4
	Benzene, polymer	4	4
	<b>Total</b>	<b>60</b>	<b>60</b>

**Note:** There may be minor deviation in marks distribution. Choice question can be asked from different chapters.

**Workshop Practice I  
EG 1201 CE**

**Year: I**

**Semester: II**

**Total: 8hours /week  
Lecture: 2 hours/week  
Tutorial: hours/week  
Practical: 6 hours/week  
Lab: hours/week**

**Course description:**

This course intends to impart basic knowledge and skills on electricity and bench works.

**Course objectives:**

After the completion of this course students will be able to:

1. Define electricity;
2. Familiarize with metal works;
3. Perform house wiring works.
4. Perform simple metal works.

**Part I: Electricity**

**Total: 4hours /week  
Lecture: 1 hour/week  
Tutorial: hours/week  
Practical: 3 hours/week**

**Course description:**

This part of the course focuses on familiarization of electricity and its application. It intends to impart knowledge and skills on Electrical accessories, Electrical energy, Electric symbols, House appliances and building wiring.

**Course objectives:**

After the completion of this course, students will be able to:

1. Define electricity;
2. Identify electric symbols and accessories;
3. Identify tools/equipment and its safety requirement of wiring system;
4. Identify major components of electrical system and its installation procedure and
5. Connect lighting circuits and signal circuits.

**Course Contents:**

**Theory**

**Unit 1: Electricity**

**[1 Hr.]**

- 1.1. Introduction
- 1.2. History of electricity
- 1.3. Generation of electricity
- 1.4. Scope of electricity
- 1.5. Types of current

**Unit 2: Fundamentals of electric circuits**

**[4 Hrs.]**

- 2.1. Definition of voltage, current, resistance and their relationship
- 2.2. Types of conductors

- 2.3.Types of circuits
  - 2.3.1. Series circuit
  - 2.3.2. Parallel circuit
- 2.4 Measurement of current, voltage, resistance and power
  - 2.4.1. Ampere meter
  - 2.4.2. Volt meter
  - 2.4.3. Ohm meter
  - 2.4.4. Power meter/ Watt meter/Energy meter
- 2.5 Related numerical problems on circuits

**Unit 3: Electrical Energy Transformation** **[2 Hrs.]**

- 3.1.Transformer, its function and application
- 3.2.Isolator, its function and application
- 3.3.Electric poles, its function and application
- 3.4.Safety and precautions

**Unit 4: Measuring Instruments and Protecting Devices** **[1 Hr.]**

- 4.1.Foot and meter/scale (Linear measuring instruments)
- 4.2.Vernier caliper/caliper
- 4.3.Standard wire gauge
- 4.4.Feeler gauge/radius gauge
- 4.5.Micrometer/voltmeter
- 4.6.Minature Circuit breaker (MCB)
- 4.7.Fuses and fuse types
- 4.8.Check line with color chalk dust powder
- 4.9.Straightedge and line

**Unit 5: Source of Power** **[2 Hrs.]**

- 5.1.Definition
- 5.2.D.C. system
- 5.3.A.C. system
- 5.4.Phases (single and three phases lines)
- 5.5.Inverter system
- 5.6.Solar power system

**Unit 6: Electric Symbols** **[1 Hr.]**

- 6.1.Introduction
- 6.2.Types of symbols
- 6.3.Identification
- 6.4.Application

**Unit 7: Earthing** **[2 Hrs.]**

- 7.1.Definition of electric shock
- 7.2.Effects of electric shock on human body
- 7.3.Levels of electric shock
- 7.4.Introduction of earthing
- 7.5.Function and application
- 7.6.Earthing methods and testing
- 7.7.Safety and precaution in earthing

**Unit 8: Electric Wiring Procedure** **[2 Hrs.]**

- 8.1. Marking procedure and interpolation of wiring diagram
- 8.2. Setting out back ground on wall surface
- 8.3. Drilling holes for fixing wire and cables and switch boxes
- 8.4. Fixing accessories components or position
- 8.5. Installation of wires/cables to masonry wall by placing safety foundation
- 8.6. Fixing PVC insulated wires and cables branching boxes using clips and saddles
- 8.7. Fixing accessories on position

### Practical

**Project 1: Draw/interpret Drawings and Diagrams:** **[5 Hrs.]**

- 1.1 Simple electrical drawings
- 1.2 Free hand plan/schematic diagram
- 1.3 Layout diagram
- 1.4 Wiring diagram.

**Project 2: Connect the following Lighting Circuits on Board:** **[32 Hrs.]**

- 2.1. One-way switch one light and one socket [4 Hrs.]
- 2.2. Two-way switch two lights and two sockets [5hrs]
- 2.3. Intermediate switches, two fluorescent lamps [5 Hrs.]
- 2.4. Multi-position switches and incandescent lamps [7 Hrs.]
- 2.5. Dimmer switches and incandescent lamps. [7 Hrs.]
- 2.6. Time switches and lamps [4 Hrs.]

**Project 3: Connect the following Signal Circuits:** **[8 Hrs.]**

- 3.1. Electrical bell [2 Hrs.]
- 3.2. Electric door opener [3 Hrs.]
- 3.3. Ceiling fan with fan regulator [3 Hrs.]

**References:**

1. Malla, N.B., (latest edition). Introduction of Electricity volume 1.
2. Malice, S. K., (latest edition). Electric Trade Theory and Practical.

**Evaluation Scheme**

S.N.	Description	Time (hours)	Marks
1	Draw/Interpret drawings and diagrams	5	5
2	Connect lighting circuits on boards	32	25
3	Connect the signal circuits	8	5
4	Viva from theory		5
	Total		40

## Part II: Bench work

**Total: 4hours /week**  
**Lecture: 1 hour/week**  
**Tutorial: hours/week**  
**Practical: 3 hours/week**

### Course Description:

This part of the course focuses on familiarization of bench work and its application. It intends to impart knowledge and skills on bench works techniques and metal tools making procedures.

### Course Objectives:

After the completion of this course, students will be able to:

1. Introduce bench work;
2. Identify bench work tools and its types;
3. Classify the various techniques of metal joining processes by hand
4. Prepare general types of tools and equipment
5. Handle measuring instruments, hand tools, power tools with personal safety

### Course Contents:

#### Unit 1: Bench work

[1 Hrs.]

- 1.1 Introduction
- 1.2 Importance and its Application in Engineering work
- 1.3 Safety measures used in workshop

#### Unit 2: Lying Tools

[2 Hrs.]

- 2.1 Introduction of layout tools: (scriber, punch, divider, surface plate, v-block, Vernier calliper and Vernier height gauge)
- 2.2 Types of layout tools
- 2.3 Handling procedure of layout tools
- 2.4 Repair and maintenance of the layout tools
- 2.5 Hammer/Hammering
  - 2.5.1 Introduction of the ball, cross, straight, claws and soft hammers.
  - 2.5.2 Selection of hammer for driving, chipping, punching, puling nails, riveting and fitting.
  - 2.5.3 Holding and replacing handle.
  - 2.5.4 Handling of hammering tools.
- 2.6 Wrenches
  - 2.6.1 Introduction to single, double, pipe and the adjustable wrenches
  - 2.6.2 Handling of wrenches
  - 2.6.3 Identification of bench, machine, pipe and chain vices.

#### Unit 3: Cutting tools

[4 Hrs.]

- 3.1 Chisels
  - Introduction to cross diamond and round chisels
  - Selecting the angle of the chisels and removing metal from the surface
  - Holding the hammer and chisel and chipping processes.
  - Uses of the chipping guard, care and maintenance of work place and tools.
- 3.2 Handsaw and sawing
  - Selection of hand saw, blade, cutting metal.
  - Method of the holding the work piece and rules of sawing.
- 3.3 Files and filing
  - Identification of the parts, shapes, sizes, cuts of the files.

- Selection of file for the shaping different types of the metal and surface finish with accuracy of  $\pm 0.2\text{mm}$ .
  - Method of the holding, balancing and the direction of the filing
- 3.4 Reamer and reamering
- Types of the reamers, hand, taper and adjustable reamers
  - Selection of holding device, reamer; drill speed.
  - Method of reamering on the metal
- 3.5 Thread and threading
- Introduction to taps, dies, handle kinds of the thread, size, angle, main part of the thread and uses.
  - Method of producing the thread by the taps and dies, lathe machine, rolling, pressing
- 3.6 Scraper and scraping
- Identification of flat, three side and curve scraper
  - Method of the scraping and the qualities of the surface

**Unit 4: Measuring instrument** **[1 Hr.]**

- 4.1 Identification of Vernier calliper, micrometre, try square, bevel protractor, wire, and filler radius and thread gauge.
- 4.2 Parts of measuring instrument
- 4.3 Rules of the measuring instrument.

**Unit 5: Rivet and Riveting** **[1Hr]**

- 5.1 Identification of rivets, size, head, metal, riveting sets punches.
- Calculation of length, diameter of rivet and head.
  - Procedure of the riveting and the joints mistakes.

**Unit 6: Solder and Soldering** **[1 Hr.]**

- 6.1 Introduction to soldering iron, types of solder, cleaning tools and the fluxes.
- Selection of source of heat and temperature
  - Process of cleaning and joining work metal

**Unit 7: Shear and shearing** **[1 Hr.]**

- Identification of hands, press, torch, snip, shear tools.
- Selection of method of the shearing sheet, rod, and square, flat angle metal

**Unit 8: Bend and bending** **[1 Hr.]**

- Introduction to bending devices, vice pliers, range, hand bar and fork
- Selection of folding, radius bending and rolling devices
- Method of bending the metal bar, flat and the plate
- Bending the metal into many shapes

**Unit 9: Power tools** **[2 Hrs.]**

- 9.1 Drill machines
- Identification of hand drill machine, bench, gang, colon and radial drill machine.
  - Selection of correct type of the machine
  - Correct method of using the drilling machine
  - Selection of correct speed and the fit for different size of the drill and the metal
- 9.2 Drill and drilling
- Identification of different kinds of drill size, purpose and angle
  - Selection of work and drill, holding tools and equipment

- Operation of all types of drill machine of the drill holes of acceptable standards.
- Operation of the drill machines and the functioning by coolant

**Unit 10: The sheet metal work [1 Hr.]**

10.1 Hand tool metal

- Identification of types of the sheet metal, mild steel, galvanized steel, copper, brass, aluminum familiar with sizes and thickness of the sheet metals.
- Measurement of the sheet with gauge and instruments.

10.2 Marking tools

- Identification and uses of sheet metal marking tools, scribe, rules, try square, punch, divider, trammel and depth gauge.
- Selection of marking and sheet metal tools and uses such as the hand snipes, stacks, punch plat, hatchet, blow horn, hand punch, pop riveters fork devices, hammers, fly cutter, groove, seaming tools.

10.3 Power tools

- Identification of bending, rollers, folders, and edge forming, sawing, crimping, spot welding and polishing parts

**Practical:**

1. Perform straight, curve and dot marking: [1 Hr.]
2. Measure with rules, Vernier caliper, gauge [1 Hr.]
3. Perform hammering by ball, cross and soft straight pin. [1 Hr.]
4. Perform sawing by power hand saw. [2 Hrs.]
5. Perform filing with single, double and rasp cut. [2 Hrs.]
6. Perform chiseling by the flat, cross, concave and power chisel. [2 Hrs.]
7. Perform hand and adjustable reamering. [2 Hrs.]
8. Perform threading with tap and dies. [2 Hrs.]
9. Perform flat and curve scrapping on the metal surface [1 Hr.]
10. Perform riveting with riveting sets pup riveter [2 Hrs.]
11. Operate power tools for drilling, folding, rolling, radius bending, spot welding, grinding, beading, crippling, edge forming, hacksaw machines. [5 Hrs.]
13. Make hammer by using the skill of measuring, marking, sawing, filing, drilling, thread cut using a Tool steel 1 pc of size 25x25x155mm [12 Hrs.]
14. Make store box by using the skill of measuring, marking, hemming, seaming, cutting, folding, riveting using a G.I. sheet 22 gauge of 400x500 mm [12 Hrs.]

**References:**

1. Rajput, R.K., (latest edition). Manufacturing process.
2. Chaudhary, S.K., Chaudhary, A.K., Roy, N., (2007). Workshop technology manufacturing processes (Vol -1), Media Promoters & Publishers Pvt. Ltd.

**Evaluation Scheme**

S.N	Description	Time (hours)	Marks
1	Perform marking and measurement	2	4
2	Perform hammering or sawing	3	4
3	Perform filing or chiseling	4	8
4	Perform reamering or threading	4	8
5	Perform scrapping or riveting	3	4
6	Operate power tools	5	8
7	Viva from theory		4
	Total		40

## Engineering Drawing II EG 1201 AR

**Year: I**  
**Semester: II**

**Total: 4 hours /week**  
**Lecture: hours/week**  
**Tutorial: hours/week**  
**Practical: 4 hours/week**  
**Lab: hours/week**

### **Course description:**

This course is designed to impart knowledge and skills on drawing pictorial view (in isometric and oblique) of the solid, surface development and intersection between two elements.

Instructors are requested to manage and deliver the related theoretical contents at drawing room just before conducting the specific practical work. All the theoretical and practical classes should be conducted with in total time of 60 Hours as allotted.

### **Course objectives:**

After the completion of this course, students will be able to:

1. Analyze/ draw the different orthographic projections;
2. Analyze/draw the different pictorial projections;
3. Draw surface development and
4. Analyze/ draw intersection.

### **Course Contents:**

#### **Theory**

#### **Unit 1. Axonometric Projection: [0.5 Hr.]**

- 1.1. Types of axonometric projection,
- 1.2. Introduction of axonometric projection
- 1.3. Isometric and oblique projection.

#### **Unit 2. Oblique Drawing: [0.5 Hr.]**

- 2.1. Oblique drawing
- 2.2. Measurement in receding axis
- 2.3. Rules for placing object in oblique (box method)
- 2.4. Cavalier and Cabinet projection
- 2.5. Making of Angle, Circular arc in oblique drawing

#### **Unit 3. Isometric Drawing: [0.5 Hr.]**

- 3.1 Isometric scale
- 3.2 Angle of receding axis
- 3.3 Isometric drawing and isometric projection
- 3.4 Isometric and Non-isometric line
- 3.5 Making of angle, circular arc in isometric view

#### **Unit 4. Projection of True length and shape of oblique line and shape: [0.5 Hr.]**

- 4.1. Introduction of oblique line
- 4.2. True length and angle to HP/VP of oblique line
- 4.3. True shape of oblique plane
- 4.4. Revolving method
- 4.5. Replacing Method

#### **Unit 5. Projection of intersection of line and plane [1 Hr.]**

- 5.1. Method of finding of intersection point
- 5.2. Method of finding the seen and hidden part of line

5.3. Method of finding the angle between plane and line

**Unit 6. Projection of Intersection plane and plane:** [0.5 Hr.]

- 6.1. Line of intersection
- 6.2. Seen and hidden part of plane
- 6.3. Finding the dihedral angle between two planes

**Unit 7. Projection of points and line on the surface of geometrical solids:** [0.5 Hr.]

- 7.1. Finding the points and lines by generating method
- 7.2. Finding the points and line by cutting plane method

**Unit 8. Projection of intersection between line and geometrical solids:** [0.5 Hr.]

- 8.1. Projection of piercing point by generating method
- 8.2. Projection of piercing point by cutting plane method

**Unit 9. Section:** [0.5 Hr.]

- 9.1. Introduction of section and its needed
- 9.2. Sectional plane and sectional views
- 9.3. Projection of sectional views
- 9.4. Type of section- Longitudinal and cross section- Full section, half section, offset section, detail section etc.

**Unit 10. Projection of intersection between planes and simple geometrical solids and its Surface development with true shape of cut portion:** [0.5 Hr.]

- 10.1. Introduction sectional plane and solid
- 10.2. Understanding the development of surfaces
- 10.3. Method of development
- 10.4. Method for development of cut surfaces

**Unit 11. Projection of intersection between surfaces of solids:** [1.5 Hrs.]

- 11.1. Introduction about surfaces of solids
- 11.2. Type of cutting plane (Vertical/Horizontal projecting plane)
- 11.3. Determination of line/curve of intersection
- 11.4. After the intersection of two solids that shape will be occurring of touched at touched portion

**Practical (Class work sheet)**

**Sheet No 1:** [10 Hrs.]

- 1. Make the oblique view using by models or work pieces.
- 2. Make oblique view by six models on flat or inclined surfaces.
- 3. Make oblique view by six models on round and inclined/ flat surfaces.

**Sheet No 2:** [10 Hrs.]

- 1. Make the isometric view by models or work pieces.
- 2. Make oblique view by six models on flat or inclined surfaces.
- 3. Make oblique view by six models on round and inclined/ flat surfaces.

**Sheet No 3:** [3 Hrs.]

- 1. Find the true length of oblique line by revolving method. (At least three exercise on true length by revolving method)
- 2. Find the true shape of oblique plane (Triangle) by replacing (Auxiliary view) method

**Sheet No 4:** [3 Hrs.]

- 1. Perform projection drawing of intersection of line a triangular plane showing the point of intersection,

2. Draw true shape of plane and angle between plane and line on the edge of given plane (At least two exercises should be done).

**Sheet No 5:** [3 Hrs.]

Perform projection drawing of intersection plane and plane (two triangular planes) showing line of intersection and dihedral angle between two planes. (At least three exercises should be done).

**Sheet No 6:** [1 Hr.]

1. Perform projection drawing of pyramid and cone with line(s) and point(s) of the surface finding in HP or VP as missing in one plane.

**Sheet No 7:** [3 Hrs.]

1. Perform projection drawing of full section and half sectional view of model which has through hole (At least two exercises should be done of this topic).

**Sheet No 8:** [2 Hrs.]

1. Draw intersection between line and cylinder, pyramid cone, and sphere, showing the piercing points.

**Sheet No 9:** [10 Hrs.]

1. Perform/draw square prism, pentagonal prism, hexagonal prism, cylinder and cone cut by a vertical projecting plane (Inclined to HP and perpendicular to VP) with true shape.
2. Perform/draw square, pentagonal, hexagonal, base pyramid, cone and sphere cut by a vertical projecting plane (inclined to HP and perpendicular to VP) with true shape.
3. Exercise on above mentioned pyramid and cone cut by a horizontal projecting plane (inclined to VP and perpendicular to HP)
4. Perform/draw surface development of prism (Triangular, square, pentagonal, hexagonal base), cylinder at simple position (uncut state).
5. Perform/draw surface development of pyramid and cone after the cut by sectional plane (truncated solid).

**Sheet No 10:** [8 Hrs.]

Perform/draw projection drawing of intersection of two surfaces of two solids (intersection of two solids) on:

1. Vertical (right) prism and horizontal prism of different size.
2. Vertical (right) cylinder and horizontal cylinder of different size.
3. Vertical (right) cylinder and horizontal prism.
4. Vertical (right) cone and prism.
5. Vertical (right) cone and cylinder.
6. Vertical (right) pyramid and prism.

**References:**

1. Luzzadar W. I Fundamental of Engineering drawing. Prentice-Hall of India.
2. S. Bogolyubov and A. Voinov, Engineering drawing. Mir Publishers, Moscow.
3. S. K Bogolyubov, Exercises in Machine Drawing. Mir publishers, Moscow.
4. K. Venugopal Engineering Drawing and Graphics, New age international (p) Ltd. India.
5. Gill P. S. Engineering Drawing, S. K. Kataria and sons India.
6. M. B. Shah and B.C. Rana, Engineering Drawing, Pearson India.
7. N. D. Bhatta and Panchal V.M. Engineering Drawing Charotar publishing House India.

**Applied Mechanics**  
**EG 2102 CE**

**Year: I**  
**Semester: II**

**Total: 6 hours /week**  
**Lecture: 3 hours/week**  
**Tutorial: 2 hours/week**  
**Practical: hours/week**  
**Lab: 2/2 hours/week**

**Course Description:**

This course focuses on analysis and effect of various types of forces on the particle and rigid body at rest. The course familiarizes with the frictional phenomenon on engineering problems. It includes the evaluation of properties of plane bodies as center of gravity and moment of inertia. The course focuses on the analysis of internal forces/stresses in beams and trusses.

**Course Objectives:**

After the completion of this course, students will be able to:

1. Understand the basic laws of motion, vector and its laws, concept of particle and rigid body and application of equations of static equilibrium;
2. Describe the different types of forces that may act on the body, resolve the forces; determine resultant of a given force system;
3. Understand the laws of friction forces, be familiar with the frictional force on the body and analysis of typical problems;
4. Be familiar with the distributed forces (Centre of gravity, Centroid, Moment of Inertia) and be able to determine CG and MI for simple plane and solid figures;
5. Be familiar with structures (beam and truss), support systems, loading systems, be able to evaluate the reactions and forces in the truss members;

**Course Contents:**

**Theory**

**Unit 1: Introduction: Forces Acting on Particle and Rigid Body** **[6 Hrs.]**

- 1.1 Definition of Mechanics and scope of Applied Mechanics
- 1.2 Concept of Particle, Rigid Body, Deformable Body
- 1.3 Review of vectors and its laws;
- 1.4 Definition of a force, units, representation by a vector and by Bow's notation, Characteristics of a Force and its Effects,
- 1.5 Classification of Forces Based to Plane and Line of Action: Internal, External, Translational, Rotational, Coplanar, Non-Coplanar, Concurrent, Non-Concurrent, Like Parallel and Unlike Parallel Forces.
- 1.6 Resolution and Composition of Forces: Methods of resolution, Perpendicular Components and Non-Perpendicular Components,
- 1.7 Principle of Transmissibility of Forces
- 1.8 Resolution of a Force in to a Force and a Couple
- 1.9 Moment of a Force: Definition, Measurement of Moment of a Force, Units, Geometrical Interpretation of Moment, Classification of Moments According to Direction of Rotation, Sign Convention, Law of Moments, Varignon's Theorem of Moment and its Application,
- 1.10 Couple: Definition, Units, Measurement of a Couple, Properties of Couple, its use.

**Unit 2: Equilibrium of Forces:****[8 Hrs.]**

- 2.1 Conditions of Equilibrium for a Particle and Rigid Body;
- 2.2 Analytical and Graphical Conditions of Equilibrium for Concurrent, Non-Concurrent and Parallel Force System;
- 2.3 Free Body Diagrams, Construction of Free Body Diagrams
- 2.4 Equations of Static Equilibrium: Two and Three Dimensional analysis of Particle, Two Dimensional analysis of Rigid Body
- 2.5 State and Prove: Triangle Law of Forces, Parallelogram law of Forces
- 2.6 Polygon Law of Forces and Lami's Theorem, Application of Lami's Theorem to Solve Various Problems.
- 2.7 Equivalent Forces: Definition of Equilibrant, Differentiate Resultant and Equilibrant, Equilibrant of Concurrent and Non-Concurrent force System.
- 2.8 Resultant and Equilibrium of Moments and Couples

**Unit 3: Friction:****[5 Hrs.]**

- 3.1 Friction: Definition, Causes, Advantages, Disadvantages, Types, and Force of Friction.
- 3.2 Laws of Friction: Static and Dynamic Friction and Their Coefficients
- 3.3 Different status (No Friction, Certain Friction, Impending Motion and Motion)
- 3.4 Sliding and Tipping Condition of the Body
- 3.5 Angle of Friction and its Meaning, Angle of Repose, Relation between Angle of Friction Angle of Repose and Coefficient of Friction.
- 3.6 Equilibrium of Bodies on Level Plane; Equilibrium of Bodies on Inclined Plane:
- 3.7 External Forces Parallel to the Plane, External Forces in Inclined Plane.

**Unit 4: Centre of Gravity (CG) and Centroid:****[5 Hrs.]**

- 4.1 Concept of Centre of Gravity, Center of Mass, Centroid (Plane Figures), Axis of Symmetry,
- 4.2 Centroid of Composite lines (straight line, arc, semicircle and quarter circle)
- 4.3 Centroid of Composite Figures (Rectangle, Triangle, Circle/Semi-circle/Quarter circle /Circular sector, Parabola/Semi-parabola and Ellipse)
- 4.4 Centroid of Area under curve by the method of Integration
- 4.5 Centroid of Built-up Plane Figures
- 4.6 Center of Gravity of Simple Solids: Cylinder, Sphere, Hemisphere, Cube, Cone and Rectangular Block (Ready to use formulae).

**Unit 5: Moment of Inertia (MoI):****[7****Hrs.]**

- 5.1 Concept of Moment of Inertia, First Moment and Second Moment of Area
- 5.2 Axial and Polar Moment of Inertia
- 5.3 Moment of Inertia of Regular Areas (Rectangle, Triangle, Circle and Ellipse) about their Centroidal axes
- 5.4 Perpendicular and Parallel axis Theorems for Moment of Inertia
- 5.5 Moment of Inertia of Composite Area
- 5.6 Radius of Gyration
- 5.7 Application of Moment of Inertia in Engineering Problems
- 5.8 Concept of Principal Moment of Inertia and Application in Engineering Problems.
- 5.9 MoI of L, T, I- and channel sections. Section modulus

**Unit 6: Analysis of Statically Determinate Beams:** [3 Hrs.]

- 6.1 Definition of Structure and Mechanism
- 6.2 Plane and Space Structures
- 6.3 Determinacy and Stability (Static and Geometric) of the Structures. Degree of freedom.
- 6.4 Different types of Load and Support in the Structures
- 6.5 Definition and Types of Beam
- 6.6 Calculation of Support Reactions: Examples on Beams, Trusses, Links and Beams with Internal Hinge

**Unit 7: Axial Force, Shear Force and Bending Moments** [6 Hrs.]

- 7.1 External and internal forces (Axial Force, Shear Force, and Bending Moment) in the Structural Members: Definition of Axial Force (AF), Shear Force (SF) and Bending Moment (BM), Sign Convention and Calculations and Plotting.
- 7.2 Concept of Superposition of AF, SF and BM in Beams.
- 7.3 Relationship between Load, Shear Force and Bending Moment
- 7.4 Calculations of AF, SF and BM and Draw Corresponding Diagrams for Cantilever, Simply Supported and Overhanging Beams Subjected to Uniformly Distributed Load (UDL), Concentrated and Uniformly Varying Load (UVL).

**Unit 8: Analysis of Statically Determinate Plane Truss** [5 Hrs.]

- 8.1 Concept and definition of Trusses, Joints Formation and Load Transfer Mechanisms in the Truss. Classification: Perfect, imperfect, redundant and deficient, relation between members and joints, assumption in the analysis.
- 8.2 Types of Truss Based on Their Uses
- 8.3 Calculation of Member Force by the Method of Joints: Examples with Merits and Demerits.
- 8.4 Calculation of Member Force by the Method of Sections: Examples with Merits and Demerits.

**Tutorials:** [30 Hrs]

Assist students for conceptual & critical problem solving

1. Problems on vectors addition, subtraction, multiplication, projection of vectors and components
2. Problems on characteristics of force and their effects on rigid bodies
3. Resolution of forces into different components
4. Simple problems on transmissibility of forces
5. Problems on parallel forces, couples and moments
6. Equilibrium of forces: Problems related to triangle law of forces, parallelogram law of forces polygon law of forces and Lami's theorem. Equilibrium of concurrent, non-concurrent and parallel force system. Resultant and equilibrant force. Moments, couples, resultant of parallel forces and moments.
7. Problems related to equilibrium of bodies on level plane; equilibrium of bodies on inclined planes considering frictional forces and external forces parallel to the plane, inclined to the plane.
8. Problems related to CG composite lines: straight line, arc, semicircle and quarter circle. CG of composite figures: Rectangle, triangle, circle/semi-circle/quarter circle/circular sector, parabola/semi-parabola and ellipse. CG of Area under curve by the method of integration.

9. Problems related to MoI of regular areas: Rectangle, triangle, circle/semi-circle/quarter/circle and ellipse. Perpendicular and parallel axis theorems. MoI of simple composite areas.
10. Problems on reactions of beams, trusses, links in beams, beams with internal hinge, portal frame.
11. Problems on calculations of AF, SF, BM and plotting for cantilever, simply supported, overhanging beams subjected to UDL, Concentrated and UVL.
12. Problems related to calculation of member force by the method of joints in simple trusses. Determination of member force by the method of sections for simple trusses.

### Practical (Laboratory)

[15 Hrs]

1. Verify Triangle law of forces, Parallelogram law of forces and Lami's theorem
2. Verify Principle of Moments
3. Determine Centroid of Plane Figures (Rectangle, Triangles, Circle and Ellipse, L-Section, I-Section)
4. Determine Moment of Inertia by Flywheel
5. Determine Support Reactions of Simply Supported and Cantilever Beam with different types of Loading
6. Determine Support Reactions and Member Force of Simply supported Truss
7. Determine shear force at different sections on a simply supported beam under points loads
8. Determine bending moment at different sections on a simply supported beam under different types of loading.

### Textbooks:

1. R. S. Khurmi, "*Applied Mechanics and Strength of Materials*", Nirja Construction and Development Pvt. Ltd., Ram Nagar, New Delhi
2. F. P. Beer & E. R Johnston Jr, "*Vector Mechanics for Engineers - Statics*", McGraw-Hill
3. I. H. Shames, "*Engineering Mechanics - Statics and Dynamics*", New Delhi, Prentice Hall of India
4. R. C. Hibbeler, "*Engineering Mechanics*", McMilan Publishing Company, New York

### References:

1. M. R. Dhital, "*A Course Manual on Applied Mechanics I (Statics)*", IOE, Pulchowk Campus
2. R. Suwal, "*A Text Book of Applied Mechanics*", R & R Engineering Consultancy Pvt. Ltd

### Evaluation Scheme

Unit	Chapters	Hours	Marks
1	Introduction: Forces Acting on Particle and Rigid Body	6	12
2	Equilibrium of Forces	8	16
3	Friction	5	8
4	Centre of Gravity (CG) and Centroid	5	8
5	Moment of Inertia (MoI)	7	12
6	Analysis of Statically Determinate Beams	3	4
7	Axial Force, Shear Force and Bending Moments	6	12
8	Analysis of Statically Determinate Plane Truss	5	8
<b>Total</b>		<b>45</b>	<b>80</b>