



# **INDIAN MARITIME UNIVERSITY**

(A Central University, Govt. of India)  
Visakhapatnam Campus, Vangali, Sabbavaram  
VISAKHAPATNAM – 531035.

**SYLLABUS FOR THE LATERAL ENTRY COMMON ENTRANCE TEST (CET)  
for Admission into  
2<sup>nd</sup> year of B.Tech (NAOE) for session 2022-23**

## **SUBJECT NAMES AND DETAILED SYLLABUS**

- 1. ENGINEERING DRAWING**
- 2. MATHEMATICS**
- 3. APPLIED MECHANICS**
- 4. ENGINEERING MATERIALS**
- 5. STRENGTH OF MATERIALS**
- 6. WORKSHOP TECHNOLOGY**
- 7. FLUID MECHANICS AND HYDRAULIC MACHINES**
- 8. ENVIRONMENTAL STUDIES**
- 9. APPLIED PHYSICS**
- 10 APPLIED CHEMISTRY**

# 1. ENGINEERING DRAWING

## 1. Introduction to Engineering Drawing

1.1 Introduction to drawing instruments, materials, layout and sizes of drawing sheets and drawing boards.

1.2 Different types of lines in engineering drawing as per BIS specifications

1.3 Practice of vertical, horizontal and inclined lines, geometrical figures such as triangles, rectangles, circles, ellipses and curves, hexagonal, pentagon with the help of drawing instruments.

## 2. Dimensioning Technique

2.1 Necessity of dimensioning, method and principles of dimensioning

2.2 Dimensioning of overall sizes, circles, threaded holes, chamfered surfaces, angles, tapered surfaces, holes, equally spaced on P.C.D., counter sunk holes, counter bored holes, cylindrical parts, narrow spaces and gaps, radii, curves and arches

## 3. Scales

3.1 Scales –their needs and importance (theoretical instructions), type of scales, definition of R.F. and length of scale

3.2 Drawing of plain and diagonal scales

## 4. Orthographic Projections

4.1 Theory of orthographic projections

4.2 Projection of Points in different quadrant

4.3 Projection of Straight Line (1st and 3rd angle)

4.3.1. Line parallel to both the planes

4.3.2. Line perpendicular to any one of the reference plane

4.3.3. Line inclined to any one of the reference plane.

4.4 Projection of Plane – Different lamina like square, rectangular, triangular and circle inclined to one plane, parallel and perpendicular to another plane in 1<sup>st</sup> angle only

4.5 Three views of orthographic projection of different objects.

4.6 Identification of surfaces

## 5 Projection of Solid

5.1. Definition and salient features of Solid

5.2. Types of Solid (Polyhedron and Solid of revolution)

5.3 To make projections, sources, Top view, Front view and Side view of various types of Solid.

## 6. Sections

6.1 Importance and salient features

6.2 Drawing of full section, half section, partial or broken out sections, Offset sections, revolved sections and removed sections.

6.3 Convention sectional representation of various materials, conventional breaks for shafts, pipes, rectangular, square, angle, channel, rolled sections

6.4 Orthographic sectional views of different objects.

## 7. Isometric Views

7.1 Fundamentals of isometric projections and isometric scale.

7.2 Isometric views of combination of regular solids like cylinder, cone, cube and prism.

## 8. Introduction to AutoCAD

Basic introduction and operational instructions of various commands in AutoCAD. At least two sheets on AutoCAD of cube, cuboid, cone, pyramid, truncated cone and pyramid, sphere and combination of above solids.

## 2. MATHEMATICS

### 1. Algebra-1

1.1 Series: AP and GP; Sum, nth term, Mean

1.2 Binomial theorem for positive, negative and fractional index, Application of Binomial theorem.

1.3 Determinants: Elementary properties of determinant of order 2 and 3, Multiplication system of algebraic equation, Consistency of equation, Cramer's rule

### 2. Algebra-2

2.1 Vector algebra: Dot and Cross product, Scalar and vector triple product.

2.2 Complex numbers.

Complex numbers, Representation, Modulus and amplitude De Moivre theorem, its application in solving algebraic equations, Modulus function and its properties.

### 3. Trigonometry

3.1 Relation between sides and angles of a triangle: Statement of various formulae showing relationship between sides and angle of a triangle.

3.2 Inverse circular functions: Simple case only

### 4. Differential Calculus – I

4.1 Functions, limits, continuity, - functions and their graphs, range and domain, elementary methods of finding limits (right and left), elementary test for continuity and differentiability.

4.2 Methods of finding derivative, Trigonometric functions, exponential function, Function of a function, Logarithmic differentiation, Differentiation of Inverse trigonometric function, Differentiation of implicit functions.

### 5. Differential Calculus - II

5.1 Higher order derivatives, Leibnitz theorem (without proof). Simple applications. 5.2 Application - Finding Tangents, Normal, Points of Maxima/Minima, Increasing/Decreasing functions, Rate, Measure, velocity, Acceleration, Errors and approximation.

### 6. Integral Calculus - I

Methods of Indefinite Integration:-

6.1 Integration by substitution.

6.2 Integration by rational function.

6.3 Integration by partial fraction.

6.4 Integration by parts.

6.5 Integration of special function

### 7. Integral Calculus - II:

7.1 Meaning and properties of definite integrals, Evaluation of definite integrals.

7.2 Application : Length of simple curves, Finding areas bounded by simple curves Volume of solids of revolution, centre of mean of plane areas.

7.3 Simpson's 1/3rd and Simpson's 3/8th rule and Trapezoidal Rule: their application in simple cases. Numerical solutions of algebraic equations; Bisections method, Regula-Falsi method,

Newton-Raphson's method (without proof), Numerical solutions of simultaneous equations; Gauss elimination method (without proof)

8. Co-ordinate Geometry (2 Dimension)

8.1 Circle, Equation of circle in standard form. Centre - Radius form, Diameter form.

9. Co-ordinate Geometry (3 Dimension)

9.1 Straight lines and planes in space, Distance between two points in space, direction cosine and direction ratios, finding equation of a straight line

### **3. APPLIED MECHANICS**

1. Introduction

1.1 Concept of engineering mechanics definition of mechanics, statics, dynamics, application of engineering mechanics in practical fields. Definition of Applied Mechanics.

1.2 Definition, basic quantities and derived quantities of basic units and derived units

1.3 Different systems of units (FPS, CGS, MKS and SI) and their conversion from one to another for density, force, pressure, work, power, velocity, acceleration

1.4 Concept of rigid body, scalar and vector quantities

2. Laws of forces

2.1 Definition of force, measurement of force in SI units, its representation, types of force: Point force/concentrated force & uniformly distributed force, effects of force and characteristics of a force

2.2 Different force systems (coplanar and non-coplanar), principle of transmissibility of forces, law of superposition

2.3 Composition and resolution of coplanar concurrent forces, resultant force, method of composition of forces, laws of forces, triangle law of forces, polygon law of forces - graphically, analytically, resolution of forces, resolving a force into two rectangular components

2.4 Free body diagram

2.5 Equilibrant force and its determination

2.6 Lami's theorem

2.7 Types of Load, supports, Beams - analysis for simply supported, cantilever beams

3. Moment

3.1 Concept of moment

3.2 Moment of a force and units of moment

3.3 Varignon's theorem (definition only)

3.4 Principle of moment and its applications

3.5 Parallel forces (like and unlike parallel force), calculating their resultant

3.6 Concept of couple, its properties and effects

3.7 General conditions of equilibrium of bodies under coplanar forces

3.8 Position of resultant force by moment

4. Friction

4.1 Definition and concept of friction, types of friction, force of friction

4.2 Laws of static friction, coefficient of friction, angle of friction, angle of repose, cone of friction

4.3 Equilibrium of a body lying on a horizontal plane, equilibrium of a body lying on a rough inclined plane.

4.4 Calculation of least force required to maintain equilibrium of a body on a rough inclined plane subjected to a force:

- a) Acting along the inclined plane horizontally
- b) At some angle with the inclined plane

## 5. Centre of Gravity

- 5.1 Concept, definition of centroid of plain figures and centre of gravity of symmetrical solid bodies
- 5.2 Determination of centroid of plain and composite lamina using moment method only, centroid of bodies with removed portion
- 5.3 Determination of center of gravity of solid bodies - cone, cylinder, hemisphere and sphere; composite bodies and bodies with portion removed

## 6. Simple Machines

- 6.1. Definition of effort, velocity ratio, mechanical advantage and efficiency of a machine and their relationship, law of machines
- 6.2. Simple and compound machine
- 6.3. Definition of ideal machine, reversible and self-locking machine
- 6.4. Effort lost in friction, Load lost in friction, determination of maximum mechanical advantage and maximum efficiency
- 6.5. System of pulleys (first, second, third system of pulleys), determination of velocity ratio, mechanical advantage and efficiency
- 6.6. Working principle and application of wheel and axle, Weston's Differential Pulley Block, simple screw jack, worm and worm wheel, single and double winch crab.  
Expression for their velocity ratio and field of their application

# 4. ENGINEERING MATERIALS

## 1. Introduction

Material, History of Material Origin, Scope of Material Science, Overview of different engineering materials and applications, Classification of materials, Thermal, Chemical, Electrical, Mechanical properties of various materials, Present and future needs of materials, Overview of Biomaterials and semi-conducting materials, various issues of Material Usage-Economical, Environment and Social.

## 2. Crystallography

Fundamentals: Crystal, Unit Cell, Space Lattice, Arrangement of atoms in Simple Cubic Crystals, BCC, FCC and HCP Crystals, Number of atoms per unit Cell, Atomic Packing Factor. Deformation: Overview of deformation behavior and its mechanism, behavior of material under load control and strain control.

Failure Mechanisms: Overview of failure modes, fracture, fatigue and creep.

## 3. Metals and Alloys

Ferrous Materials: Different iron ores, Raw materials in production of iron and steel.

Basic process of iron-making and steel-making, Classification of iron and steel.

Cast Iron: Different types of Cast Iron, manufacture and their use. Classification of Grey cast iron and S.G. iron

Steels: Steels and alloy steel, Classification of plain carbon steels, Properties and usage of different types of Plain Carbon Steels, Effect of various alloys on properties of steel, Uses of alloy steels (high speed steel, stainless steel, spring steel, silicon steel)

Non Ferrous Materials: Properties and uses of Aluminum, Copper and Zinc and their alloys

#### 4. Heat Treatment

Purpose of heat treatment, Solid solutions and its types, Formation and decomposition of Austenite, Martensitic Transformation – Simplified Transformation Cooling Curves.

Various heat treatment processes- hardening, tempering, annealing, normalizing, Case hardening and surface hardening and hardenability of steels, Selection of case carburizing and induction hardening steels.

#### 5. Plastics

Important sources of plastics, Classification-thermoplastic and thermoset and their uses, various trade names of plastics, Plastic coatings, food grade plastics. Applications of plastics in automobile and domestic use.

Rubber classification - Natural and synthetic. Selection of rubber

#### 6. Advanced Materials

Composites-Classification, properties, applications

Ceramics-Classification, properties, applications

Adhesives – Classification, properties and applications

Smart materials - properties and applications.

#### 7. Miscellaneous Materials

Overview of Tool and Die materials, Materials for bearing metals, Materials for Nuclear Energy, Refractory materials.

#### 8. Identification and Testing of Materials (Destructive and NDT)

Destructive testing: Stress testing, Harness testing

Non-destructive testing: Eddy-current, Magnetic-particle, Liquid penetration, radiographic, Ultrasonic and visual testing

### **5. STRENGTH OF MATERIALS**

#### 1. Stresses and Strains

1.1. Basic assumptions; Concept of load, stress and strain

1.2. Tensile compressive and shear stresses and strains

1.3. Concept of Elasticity, Elastic limit and limit of proportionality.

1.3.1. Nominal and true stress-strain diagrams.

1.3.2 Hook's Law

1.3.3. Young Modulus of elasticity

1.3.4. Nominal stress

1.3.5. Yield point, plastic stage

1.3.6 Ultimate strength and breaking stress

1.3.7. Percentage elongation

1.3.8. Proof stress and working stress

1.3.9. Factor of safety

1.3.10 Poisson's Ratio

1.3.11 Shear modulus

1.3.12 Deflection and stiffness

1.4. Concepts of fatigue, creep and stress concentration

1.5. Thermal stresses

## 2. Resilience

- 2.1 Resilience, proof resilience and modulus of resilience
- 2.2 Strain energy due to direct stresses
- 2.3 Stresses due to gradual, sudden and falling load.

## 3. Moment of Inertia

- 3.1. Concept of moment of inertia and second moment of area
- 3.2 Radius of gyration
- 3.3 Theorem of perpendicular axis and parallel axis (without derivation)
- 3.4 Second moment of area of common geometrical sections: Rectangle, Triangle, Circle; Second moment of area for L-section, T-section and I-section
- 3.5 Section modulus

## 4. Bending Stresses

- 4.1 Concept of Bending stresses
- 4.2. Theory of simple bending
- 4.3. Use of the equation  $y = M/I = E/R$
- 4.4. Concept of moment of resistance
- 4.5. Bending stress diagram
- 4.6. Calculation of maximum bending stress in beams of rectangular, circular, and T-section.
- 4.7 Permissible bending stress Section modulus for rectangular, circular and symmetrical I-section.

## 5. Torsion

- 5.1. Concept of torsion- difference between torque and torsion.
- 5.2. Use of torque equation for circular shaft
- 5.3. Comparison between solid and hollow shaft with regard to their strength and weight.
- 5.4. Power transmitted by shaft
- 5.5 Concept of mean and maximum torque
- 5.6 Concept of Principal stresses, principal planes and maximum shear stress.
- 5.7 Determination of shaft diameter under combined bending and torsion.

## 6. Shear Force and Bending Moment

- 6.1 Concept of beam and form of loading
- 6.2 Concept of end supports-Roller, hinged and fixed
- 6.3 Concept of bending moment and shearing force
- 6.4 S.F. and B.M. Diagram for cantilever and simply supported beams with and without overhang subjected to concentrated load and U.D.L.

## 7. Columns

- 7.1. Concept of column, modes of failure
- 7.2. Types of columns
- 7.3. Buckling load, crushing load
- 7.4. Slenderness ratio
- 7.5. Factors effecting strength of a column
- 7.6 End restraints
- 7.7 Effective length
- 7.8 Strength of column by Euler Formula
- 7.9. Rankine-Gordon formula

## 8. Thin Cylinder and Spherical Shells

8.1 Introduction to longitudinal stresses, circumferential or hoop stresses and radial stresses

8.2 Longitudinal and circumferential stresses in thin cylinder

8.3 Longitudinal and circumferential stresses in thin Spherical shells

## 9. Slope and Deflections of Beams:

9.1 Definition of slope and deflection, sign convention. Circular bending. Calculation of maximum slope and deflection for the following standard cases by double integration or moment area method.

- a) Cantilever having point load at the free end
- b) Cantilever having point load at any point of the span
- c) Cantilever with uniformly distributed load over the entire span
- d) Cantilever having U.D.L. over part of the span from free end
- e) Cantilever having U.D.L. over a part of span from fixed end
- f) Simply supported beam with point load at centre of the span.
- g) Simply supported beam with U.D. L. over entire span.

## **6. WORKSHOP TECHNOLOGY**

### 1. Welding

#### 1.1 Welding Process

Principle of welding, Classification of welding processes, Advantages and limitations of welding, Industrial applications of welding, Welding positions and techniques, symbols. Safety precautions in welding.

#### 1.2 Gas Welding

Principle of operation, Types of gas welding flames and their applications, Gas welding equipment - Gas welding torch, Oxy acetylene cutting torch, Blow pipe, Pressure regulators, Filler rods and fluxes

#### 1.3 Arc Welding

Principle of operation, Arc welding machines and equipment, A.C. and D.C. arc welding, Effect of polarity, current regulation and voltage regulation, Electrodes: Classification, B.I.S. specification and selection, Flux for arc welding. Requirements of pre heating, post heating of electrodes and work piece. Welding defects and their testing methods.

#### 1.4 Other Welding Processes

Resistance welding: Principle, advantages, limitations, working and applications of spot welding, seam welding, projection welding and percussion welding, Atomic hydrogen welding, Shielded metal arc welding, submerged arc welding, Welding distortion, welding defects, methods of controlling welding defects and inspection of welded joints. Welding defects and inspection.

#### 1.5 Modern Welding Methods

Methods, Principle of operation, advantages, disadvantages and applications of Tungsten inert gas (TIG) welding, other welding process, Metal inert gas (MIG) welding, Thermit welding, Electro slag welding, Electron beam welding, Ultrasonic welding, Laser beam welding, Robotic welding

### 2. Pattern Making

Types of pattern, Pattern material, Pattern allowances, Pattern codes as per B.I.S., Introduction to cores, core boxes and core materials, Core making procedure, Core prints, positioning of cores.



### 3. Moulding and Casting

#### 3.1 Moulding Sand

Properties of moulding sand, their impact and control of properties viz. permeability, refractoriness, adhesiveness, cohesiveness, strength, flow ability, collapsibility, various types of moulding sand, Testing of moulding sand. Safety precautions in foundry.

#### 3.2 Mould Making

Types of moulds, Step involved in making a mould, Molding boxes, hand tools used for mould making, molding processes: Bench molding, floor molding, pit molding and machine molding, molding machines squeeze machine, jolt squeeze machine and sand slinger.

#### 3.3 Casting Processes

Charging a furnace, melting and pouring both ferrous and non-ferrous metals, cleaning of castings, Principle, working and applications of Die casting: hot chamber and cold chamber, Investment and lost wax process, centrifugal casting.

#### 3.4 Gating and Riser System

Elements of gating system, Pouring basin, sprue, runner, gates, Types of risers, location of risers, Directional solidification

#### 3.5 Melting Furnaces

Construction and working of Pit furnace, Cupola furnace, Crucible furnace tilting type, Electric furnace

#### 3.6 Casting Defects

Different types of casting defects, testing of defects: radiography, magnetic particle inspection and ultrasonic inspection.

### 4. Metal Forming Process

4.1 Press Working- Types of presses, type of dies, selection of press die, die material. Press Operations-Shearing, piercing trimming, punching, notching, shaving, gearing, embossing, stamping.

4.2 Forging- Open die forging, closed die forging, Press forging, upset forging, swaging, up setters, roll forging, cold and hot forging.

4.3 Rolling- Elementary theory of rolling, Types of rolling mills, Thread rolling, roll passes, Rolling defects and remedies.

4.4 Extrusion and Drawing- Type of extrusion- Hot and Cold, Direct and indirect, pipe drawing, tube drawing, wire drawing.

### 5. Plastic Processing

5.1 Industrial use of plastics, situation where used.

5.2 Injection moulding-principle, working of injection moulding machine.

5.3 Compression moulding-principle, and working of compression moulding machine.

5.4 Potential and limitations in the use of plastics

## **7. FLUID MECHANICS AND HYDRAULIC MACHINES**

### 1. Introduction

1.1 Fluids: Real and ideal fluids

1.2 Fluid Mechanics, Hydrostatics, Hydrodynamics, Hydraulics

### 2. Properties of Fluids

2.1 Mass density, specific weight, specific gravity, viscosity, surface tension, cohesion, adhesion and, capillarity, vapour pressure and compressibility. Newton's Law of viscosity, Newtonian and Non-Newtonian fluids.

### 3. Hydrostatic Pressure

3.1 Pressure, intensity of pressure, pressure head, Pascal's law and its applications.

3.2 Total pressure, resultant pressure, and centre of pressure.

3.3 Total pressure and centre of pressure on horizontal, vertical and inclined plane surfaces of rectangular, triangular, trapezoidal shapes and circular, Pressure on curved surfaces

### 4. Measurement of Pressure

4.1 Atmospheric pressure, gauge pressure, vacuum pressure and absolute pressure. 4.2 Piezometer, simple manometer and differential manometer, micro-manometers, Bourdon gauge and dead weight pressure gauge.

### 5. Fundamentals of Fluid Flow

5.1 Types of Flow: Steady and unsteady flow, laminar and turbulent flow, uniform and non-uniform flow, stream line, stream tubes, streak line and path line.

5.2 Discharge and continuity equation (flow equation)

5.3 Types of hydraulic energy: Potential energy, kinetic energy, pressure energy

5.4 Bernoulli's theorem; statement and description.

### 6. Flow Measurements

Brief description with simple numerical problems of:

6.1 Venturimeter and orifice meter

6.2 Pitot tube

6.3 Orifices and mouthpieces

6.4 Current meters

6.5 Notches and weirs

### 7. Flow through Pipes

7.1 Definition of pipe flow; Reynolds number, laminar and turbulent flow- explained through Reynold's experiment

7.2 Critical velocity and velocity distributions in a pipe for laminar flow

7.3 Head loss in pipe lines due to friction, sudden expansion and sudden contraction, entrance, exit, obstruction and change of direction, siphons.

7.4 Hydraulic gradient line and total energy line.

7.5 Pipes in series and parallel

7.6 Water hammer phenomenon and its effects

### 8. Fundamentals of pumps and turbines

Reciprocating pump, centrifugal pumps, impulse and reaction turbines

## **8. ENVIRONMENTAL STUDIES**

### 1. Introduction

1.1 Basics of ecology, eco system - concept, and sustainable development, Resources - renewable and non-renewable.

## 2. Air Pollution

2.1 Source of air pollution. Effect of air pollution on human health, economy, plant, animals. Air pollution control methods.

## 3. Water Pollution

3.1 Impurities in water, Cause of water pollution, Source of water pollution. Effect of water pollution on human health, Concept of dissolved O<sub>2</sub>, BOD, COD. Prevention of water pollution- Water treatment processes, Sewage treatment. Water quality standard.

## 4. Soil Pollution

4.1 Sources of soil pollution

4.2 Types of Solid waste- House hold, Hospital, From Agriculture, Biomedical, Animal and human, excreta, sediments and E-waste

4.3 Effect of Solid waste

4.4 Disposal of Solid Waste- Solid Waste Management

## 5. Noise pollution

Source of noise pollution, Unit of noise, Effect of noise pollution, Acceptable noise level, Different method of minimize noise pollution.

## 6. Environmental Legislation

Introduction to Water (Prevention and Control of Pollution) Act 1974, Introduction to Air (Prevention and Control of Pollution) Act 1981 and Environmental Protection Act 1986, Role and Function of State Pollution Control Board and National Green Tribunal (NGT), Environmental Impact Assessment (EIA).

## 7. Impact of Energy Usage on Environment

Global Warming, Green House Effect, Depletion of Ozone Layer, Acid Rain. Ecofriendly Material, Recycling of Material, Concept of Green Buildings.

# 9. APPLIED PHYSICS

## 1. Heat and Thermodynamics

1.1 Difference between heat and temperature

1.2 Modes of transfer of heat (Conduction, convection and radiation)

1.3 Different scales of temperature and their relationship

1.4 Expansion of solids, liquids and gases, coefficient of linear, surface and cubical expansions and relation amongst them

1.5 Heat conduction in a metal rod, Temperature gradient, Concept of Co-efficient of thermal conductivity, Uses and effects of Heat conduction in daily life.

1.6 Isothermal and Adiabatic process

1.7 Zeroth, First and second law of thermodynamics, Heat engine, Carnot cycle.

1.8 Fundamentals of refrigeration and air-conditioning.

## 2. Wave motion and its applications (12 periods)

2.1 Wave motion, transverse and longitudinal wave motion with examples, sound and light waves, relationship among wave velocity, frequency and wave length and its application

- 2.2 Wave equation, phase, phase difference, principle of superposition of waves
- 2.3 Simple Harmonic Motion (SHM): definition and characteristic, expression for displacement, velocity, acceleration, time period, frequency in SHM, Energy of a body executing SHM, simple pendulum, concept of simple harmonic progressive wave
- 2.4 Free, Damped and forced oscillations, Resonance with examples, Q-factor
- 2.5 Definition of pitch, loudness, quality and intensity of sound waves, intensity level, Echo and reverberation, Sabine formula for reverberation time, coefficient of absorption of sound, methods to control reverberation time and their applications, Acoustics of building defects and remedy.
- 2.6 Ultrasonics –production, detection, properties and applications in engineering and medical applications

## **10. APPLIED CHEMISTRY**

### 1. Fuels and Lubricants

- 1.1 Definition of fuel, classification of fuels, characteristics of good fuel, relative merits of gaseous, liquid and solid fuels
- 1.2 Calorific value-higher calorific value, lower calorific value, determination of calorific value of solid or liquid fuel using Bomb calorimeter
- 1.3 Coal - types of coal and proximate analysis of coal
- 1.4 Fuel rating – Octane number and Cetane number, fuel-structural influence on Octane and Cetane numbers
- 1.5 Gaseous fuels – chemical composition, calorific value and applications of natural gas (CNG), LPG, producer gas, water gas and biogas.
- 1.6 Elementary idea on – hydrogen as future fuels, nuclear fuels.
- 1.7 Lubricants: Definition and properties, mechanism, industrial application and its function in bearings.
- 1.8 Synthetic lubricants and cutting fluids.

### 2. Water

- 2.1 water resources on Earth
- 2.2 Classification of water – soft water and hard water, action of soap on hard water, types of hardness, causes of hardness, units of hardness – mg per liter and parts per million (ppm), pH and buffer solutions and their applications.
- 2.3 Disadvantages caused by the use of hard water in domestic and boiler feed water, priming and foaming and caustic embrittlement in boilers.
- 2.4 Removal of hardness -Permutit process and Ion-exchange process.
- 2.5 Physico-Chemical methods for Water Quality Testing
  - a) Determination of pH using pH meter, total dissolved solids (TDS)
  - b) Testing and Estimation of- alkalinity, indicator their types and application total hardness by EDTA method and O' Hener's Method.
  - c) Understanding of Indian Water Quality standards as per WHO
- 2.6 Natural water sterilization by chlorine and UV radiation and reverse osmosis.
- 2.7 Municipality waste water treatment. Definition of BOD and COD.

### 3. Electrochemistry

Redox Reaction, Electrode Potential, Nernst equation, Electrochemical cell (Galvanic and Electrolytes); Nernst equation.

### 4. Corrosion and its Control

4.1 Definition of corrosion and factors affecting corrosion rate.

4.2 Theories of:

a) Dry (chemical) corrosion- Pilling Bedworth rule

b) Wet corrosion in acidic atmosphere by hydrogen evolution mechanism

4.3 Definition of passivity and galvanic series

4.4 Corrosion control:

a) Metal coatings – Cathodic protection, Cementation on Base Metal Steel – Application of Metal Zn (Sherardizing), Cr (Chromozing) and Al (Aluminizing), sacrificial protection and impressed current voltage

b) Inorganic coatings – Anodizing and phosphating,

c) Organic coatings - use of paints varnishes and enamels

d) Internal corrosion preventive measures- alloying (with reference to passivating, neutralizing and inhibition) and heat treatment (quenching, annealing)