

BUREAU OF INDIAN STANDARDS
(Establishment Department)

C I R C U L A R

Subject: Filling up the vacancies in the post of Technical Assistant (Laboratory) through Limited Departmental Competitive Examination (LDCE) – reg.

In accordance with BIS (Recruitment to Laboratory Technical Posts Regulation, 2019, the 10% of post of Technical Assistant (Lab) are to be filled up by LDCE from amongst Senior Master Technician OR Master Technician with six years regular service in the grade OR Master Technician with six years combined regular service in the post of Master Technician and Senior Technician OR Senior Technician with ten years regular service in the grade with the essential educational qualification:

i. Bachelor's Degree in Science with (Chemistry or Microbiology or Physics or Bio-Technology or Food Technology or Bio-Chemistry or Electronics as one of the main subject) with minimum forty five per cent marks (forty per cent for the SC & ST)

OR

ii. Three years diploma in Mechanical or Electrical or Civil or Chemical or Electronics or Food Technology or Metallurgy with minimum forty five per cent marks (forty per cent for SC & ST)

2. Twelve (12) vacancies of Technical Assistant (Laboratory) are to be filled up through Limited Departmental Competitive Examination (LDCE). The vacancies shall be filled up in accordance with the procedure and Syllabus as per Annexure enclosed.

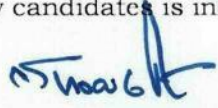
3. Applications are invited for appearing in the above stated exam from those candidates who will be eligible as on 01.01.2024.

4. To appear in the LDCE, the willing candidates who fulfill eligibility criteria may apply, in the enclosed proforma, and send the same by email to Establishment Department (estt@bis.gov.in) through their Departmental Heads by **04th September, 2023**.

5. It may please be noted that the options for appearing in the LDCE received other than on prescribed proforma and not received upto **04th September, 2023** shall not be entertained. The Date and Venue of the LDCE shall be notified accordingly.

6. All the Departmental Heads are requested to ensure that the contents of this Circular are brought to the notice of all the eligible officials as mentioned above in their Department/Section. They are also requested to encourage the eligible SC/ST category officials to apply and appear in LDCE so that employability of SC/ST category candidates is increased.

Encl: as above.


(Shoaib Akhter)
Director (Establishment)

Our Ref: Estt-VI/LDCE
Dated: **24th August 2023**

Circulated to: **All Departments at HQ including CL/Labs/NITS & Regional/Branch Offices of BIS through BIS Intranet.**

**Form for applying for appearing in
Limited Departmental Competitive Examination (LDCE)
for the post of Technical Assistant (Laboratory)**

i)	Employee No.:	
ii)	Name & Designation:	
iii)	Discipline:	
iv)	Place of Posting:	
v)	Category Gen/SC/ST/OBC, etc.:	
vi)	Date of Joining in BIS:	
vii)	Date of Birth:	
viii)	Present Pay Level & Grade:	
ix)	Essential Qualifications: (copy of certificate, mark sheet etc. as per BIS Recruitment to Laboratory Technical Posts Regulation, 2019 for LDCE)	
x)	Mobile No.	

I hereby submit my application certifying that the undersigned has fulfilled the eligibility criteria for appearing in the LDCE for the post of Technical Assistant (Lab).

Date: _____

Signature of the candidate

[Through Departmental Head Concerned]

Back to: Director (Establishment)

(scanned copy to be sent by email at estt@bis.gov.in)

Annexure
Procedure for conducting the Limited Departmental Competitive Examination
for Promotion to the post of Technical Assistant (Lab)

i)	Name Of The Examination	Limited Departmental Competitive Examination for promotion to the post of Technical Assistant (Lab)
ii)	Eligibility	(a) Senior Master Technician; or (b) Master Technician with six years regular service in the grade or Master Technician with six years combined regular service in the post of Master Technician and Senior Technician; or (c) Senior Technician with ten years regular service in the grade, and Possessing: (i) Bachelor's Degree in Science (with Chemistry or Microbiology or Physics or Bio-Technology or Food Technology or Bio-Chemistry or Electronics as one of the main subject) with minimum forty five percent marks (forty percent. for the Scheduled Castes and the Scheduled Tribes) or (ii) Three years diploma in Mechanical or Electrical or Civil or Chemical or Electronics or Food Technology or Metallurgy with minimum forty five per cent marks (forty per cent for SC & ST) <i>(In accordance with BIS Recruitment to Laboratory Technical Posts Regulation, 2019 for Limited Departmental Competitive Examination (LDCE))</i>
iii)	Scheme and Weightage	Eligible employees shall be assessed for promotion on the basis of the following components and the relative weightage for each component shall be as follows:- a) Written Examination - 100 marks b) Skill Test -Qualifying Test only c) Annual Performance Appraisal Report (APAR) - 50 marks
iv)	Syllabus Of Written Exam	The examination of two hour duration, shall consist of two parts covering the following:- (i) Objective questions - 60 marks (30 questions of 2 mark each)- At least 02 questions from each UNIT will be available. (ii) Subjective questions - 40 marks (10 questions of 4 marks each) -At least 01 question from each UNIT will be available.
v)	Written Exam Pass Mark	Sixty per cent [Fifty per cent for Scheduled Castes and Scheduled Tribes]
vi)	Skill Test	Skill Test is a qualifying test only.
vii)	Marks For Annual Performance Assessment Reports (APAR)	Marks for Annual Performance Assessment Reports (APAR) for the previous five years shall be allotted, out of a maximum of 10 marks for each year, according to the grading in Annual Performance Assessment Reports on the following basis: Outstanding-8 to 10; Very Good-6 to 7.9; Good-4 to 5.9; Average-0 to 3.9.
viii)	Selection Procedure	a) A select list will be prepared in order of merit of the candidates on the basis of the total marks obtained in written examination and those who qualify skill test. For determining the merit of the candidates, in addition to 100 marks allotted to LDCE (written exam), 50 marks shall be allotted APAR. b) The select list shall be referred to the Selection Committee for Group 'B' and Group 'C'; c) The recommendation of the Selection Committee 'B' and 'C' shall be submitted to the Director General for approval.

Chemistry**UNIT 1: Problems based on Volumetric and Gravimetric analysis**

1. Molecular mass, mole, weak and strong electrolytes Equivalent mass and Gram-equivalent
2. Strength, Normality and Molarity of a solution, Normality equation
3. Problems based on Volumetric and Gravimetric analysis.

UNIT 2: Analysis of Water

1. Impurities in water, Hardness, Units of Hardness and Calcium carbonate equivalent.
2. Estimation of chloride ion, free chlorine, Dissolved Oxygen, Alkalinity and Hardness

UNIT 3 : Treatment of Water

1. Quality of water for domestic and Boiler feed
2. Lime-Soda Process, Zeolite Process and Ion-Exchange Process for softening of water 3.
- Filtration, Sedimentation and Disinfection of water in Waterworks.

UNIT 4: Corrosion and Lubricants

1. Dry and Wet corrosion, Galvanic corrosion, Concentration corrosion, Pitting corrosion and Stress corrosion.
2. Protection of corrosion by Proper designing, Alloying, Cathode protection and Coating methods
3. Types and Mechanism of Lubricants, Characteristics of lubricants like Viscosity, Acid Value, Saponification value, Cloud point, Pour point, Flash point and Fire point.

UNIT 5: Polymerization, Metals and Alloys

1. Polymers, addition and condensation polymerization, co-polymerization. Examples
2. Cast iron, Steel and Heat treatment
3. Necessity of making alloys, Composition, properties and uses of Brass, Bronze, Gun metal, Invar and Duralumin

Physics

UNIT- 1

Electrostatics:- Coulomb's law, electric field and potential due to a point charge and a number of charges, potential difference between two points, equipotential surfaces, electric field at a point due to a uniformly charged thin sheet, capacitor, capacitance of a parallel plate capacitor, energy stored in a capacitor, combination of capacitors (series and parallel).

D.C. Circuits: - Kirchhoff's law, application of Kirchhoff's law to the wheat-stone bridge, post office box, meter bridge and potentiometer. Heating effect of current, heat produced by electric current in a conductor and Joules law of electrical heating. Determination of 'J' by electrical method.

UNIT 2

Electromagnetism:- Motion of charge particles in uniform magnetic and electric field, Biot-savart law, magnetic field around a current carrying conductor, at the centre of circular loop and at any point on the axis of circular loop, force experienced by a moving charge and a current carrying conductor in a uniform magnetic field, Torque: on current loop, force between two parallel current carrying conductors, definition of an ampere, principle and working of a moving coil galvanometer, conversion of galvanometer into ammeter and voltmeter.

UNIT 3

Expansion of solids: - concept of linear expansion (α) superficial expansion (β) and cubical expansion (γ). Relation between (α), (β) and (γ); Experimental determination of coefficient of linear expansion (α), Searle's apparatus.

Heat Transfer: - Modes of heat transfer, coefficient of thermal conductivity and its determination by Searle's and Lee's disc methods, thermal conduction through compound media (both series and parallel).

UNIT 4

Geometrical optics: - Refraction through prism, lens formula; principle, working and magnifying power of astronomical telescope and microscope (simple and compound).

Wave Optics: - Huygens's principle, reflection and refraction of a wave at plane surface, refraction and interference of light waves; Young's experiment; Newton's ring, application of interference.

UNIT 5

Acoustics and Ultrasonic: - Reflection, and absorption of sound waves by materials; definition of pitch, loudness, quality and intensity of sound waves, unit of intensity (bel and decibel); Echo and reverberation and reverberation time, control reverberation time. Acoustics insulation (qualitative treatment only of reverberation). Production of ultrasonic waves by magnetostriction and piezoelectric effect, detection and properties of ultrasonic; application to drilling, cold welding, cleaning, flaw detection and exploration (sonar).

Electrical**UNIT 1****DC CIRCUITS:**

Basic concepts of charge, current, voltage, resistance, power, energy and their units, conversion of units of work, power and energy from one form to other, ohm's law, resistances in series and parallel, laws of resistance, grouping of cells in series, parallel and mixed combination, simple numerical problems.

UNIT 2**Network Theorems:**

Mesh and Nodal Analysis, Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Maximum Power Transfer Theorem, Conversion of Star to Delta and vice versa, Numerical Problems

UNIT 3**ELEMENTS OF GENERATION TRANSMISSION & DISTRIBUTION SYSTEM:**

Elementary block diagram of Thermal, Hydro, Nuclear & Power Diesel Plant and its brief description, pictorial diagram of 3ph Transmission and Distribution system, showing transformer, primary & secondary transmission line and all other accessories, simple numerical problems.

UNIT 4**ARRANGEMENT OF SUPPLY SYSTEM & DISTRIBUTION SYSTEM:**

Supply system from pole to distribution box, function of series line, energy meter, main switch and distribution box, High & low voltage distribution system, Identification of 3ph, neutral & earth wire on voltage distribution system; brief description on Polyphase circuit.

UNIT 5:**DOMESTIC INSTALLATION & SAFETY MEASURE:**

Distribution between light and fan circuits, single phase power circuits, sub ckts, various accessories & parts of installation, types of earthing, functions of earthing, IE rules for electric installation & wiring, common safety.

Mechanical**UNIT 1****TRANSMISSION OF POWER:**

Different modes of power transmission Belt drive: Material of belt, flat belt V belt open and cross belt device, length of belt (without derivation), Velocity ratio, slip, angle of contact, derivation of tension ratio for flat belt., Power transmitted through belts.

Advantage of V-belt over flat belt. Simple numerical problems. $T_1/T_2 = e^{\mu\theta}$

Chain Drive: Classification Clutch: Principle of clutch, comparison between chain and belt drive.

Pulleys: Introduction, types of pulleys.

Gears: Spur, helical, bevel, spiral, worm gear, rack and pinion, Gear trains: simple & Compound gears train and simple numerical problems.

UNIT 2

Steam generators: Introduction, classification, Differentiation between fire tube and water Tube boilers. Simple vertical boiler, Babcock & Wilcox boiler, Cochran boiler, Boiler accessories and mountings,

Turbines: Introduction & classification of steam turbine, concept of reaction and Simple impulse turbine, comparison between impulse & reaction turbines, losses in steam turbine.

Hydraulic turbine: Classification, construction, working of pelton wheel, Francis turbine and application of reaction and impulse turbine.

UNIT 3**Internal Combustion Engines:**

1. Classification & application of I.C. engine commonly used spark ignition engine and compression engines.

2. Working principles of two stroke petrol and diesel engine

3. Ignition system in petrol engine.

4. Simple carburetor

5. Cooling and lubrication system of IC engines.

Lubricants: Introduction, method of lubrication: Petrol System, mixed, Splash, force system,

UNIT 4

Pumps Construction and Working of reciprocating, centrifugal and gear pump,

Air compressor: Working of various type of air compressor and their application

Material Handling: Tower and bridge crane, jaw Crushers, Hydraulic jack and hydraulic Lift.

UNIT 5

Refrigeration and Air Conditioning System: Introduction, unit of refrigeration, coefficient of performance, vapour compression cycle, simple vapour absorption cycle. Applications. Air conditioning System: Purpose of air conditioning, Factor affecting air conditioning, Some definition relating to psychometric parameters like dry bulb temp., wet bulb temp., humidity etc. Window air conditioner and desert cooler.

CIVIL

Unit- 1

Introduction: Definition of concrete, brief introduction to properties of concrete, advantages of concrete uses of concrete in comparison to other building materials.

Cement- Physical properties- consistency, initial setting time and final setting time, soundness and fineness. Hydration of cement, heat of hydration, different types of cement.

Unit- 2

Aggregates: Classification of aggregates according to shape and size. Fineness modulus of aggregates, grading of aggregates properties of aggregates, strength, Toughness, hardness, durability, bulk density and water absorption.

Unit- 3

Proportioning of concrete: Object of proportioning of concrete, preliminary test, works test, controlled concrete and ordinary concrete. Strength required for various types of concrete mixes. Methods of concrete mix design, fineness modulus method, water cement ratio. Importance of water quality, law and the conditions under which the law is valid, internal moisture, temperature and age use of CRR charts.

Concreting operations: Storing of cement and aggregates, batching Mixing, hand mixing and machine mixing , Transportation of concrete, placement of concrete, compaction, finishing and curing of concrete, Jointing, location of construction joints, expansion joints, Defects in concrete, identification and method of repair.

Unit- 4

Durability of concrete: Factors affecting durability, permeability of concrete, Sulphate attack, thermal properties and fire resistance, expansion and contraction joints, repair of cracks.

Special purpose concrete: Introduction to readymix concrete, high strength concrete, light weight concrete, fiber reinforced concrete. Ferrocement and its uses.

Unit- 5

Properties of concrete in plastic stage: Quality control of concrete, workability, tests on workability, factors affecting workability, segregation, bleeding properties of concrete in the hardened state strength, toughness, durability, hardness impermeability and dimensional changes admixtures, accelerators and retarders and their use. Concreting under special conditions, cold weather concreting and hot weather concreting.

Unit- 6

Bricks: Introduction, raw materials for brick manufacturing and properties of good brick making earth, manufacturing of bricks, preparation of clay (Manual/ mechanically), moulding: hand moulding and machine moulding, hand moulding brick table, drying of bricks, burning of bricks, types of kilns (Bull's Trench kiln and Hoffman's kiln, process of burning, size and weight of standard brick, traditional brick, refractory brick, clay-fly ash bricks, sun dried bricks, classification of bricks as per BIS: 1077, Size of brick-IS

specification, commercial sizes, Testing of common building bricks as per BIS: 3495, compressive strength, water absorption, efflorescence, dimensional tolerance test, special bricks, building tiles, types of tiles, wall, ceiling, roofing and flooring tiles, Terrazo, ceramic, PVC, linoleum tiles, their properties and uses, stacking of bricks and tiles at site.

Unit- 7

Cement: Introduction, raw materials manufacture of ordinary Portland cement, flow diagram for wet and dry process, properties and uses of ordinary Portland cement, testing of cement as per BIS: Strength of cement, fineness by sieving, consistency, soundness, setting times, Special cements and their uses, storage of cement.

Lime: Introduction, lime as one of the cementing materials, Natural source for the manufacture of lime, definition of terms quick lime, fat lime, hydraulics, calcinations and slaking of lime, IS classification of lime, testing of lime.

Unit- 8

Timber and wood based products: Identification of different types of timber, Teak, Deodar, shisham, sal, Mango, Kail and Chir, Market forms of converted timber as per BIS. Seasoning of timber, purpose, method of seasoning, kiln seasoning as per BIS. Defects in timber, decay in timber, preservation of timber and methods of treatment as per BIS, Properties of timber and specification of structural timber, common structural timbers in India, their availability and uses – teak, deodar, Chir, Kail, Shisham, Sal and Mango, plywood, veneers and veneering, manufacturing plywood(brief description only), uses of plywood, other wood based products, their brief description of manufacture and uses, laminated board, black board, fibre board, hard board and gypsum board, applications of board in false ceiling and wall panelling.

Paints and Varnishes: Purpose and use of paints, types of paints, oil paints, water paints and cement paints, oil paints constituents of an oil paint, raw materials used for different constituents of oil paints and their properties, preparation of an oil paint, Characteristics of a good oil paints, Application on wood and metal surfaces.

Cement Paints: Commonly available cement paints, their properties and uses, Application of cement paints, Varnishes and polish types, properties and their uses, lacquers and enamels their properties and uses.

Metals: Ferrous metals composition, properties and uses of cast iron, steel (mild and high tension steel), requirements of mild steel as per BIS, non-ferrous, properties and uses of the following nonferrous metals in Civil Engineering works – Copper, lead, Zinc, tin and aluminium, Commercial forms of ferrous and nonferrous metals.

Plastics: Important commercial products of plastics used in Civil Engineering construction, Asbestos based products, Commercial forms and their uses, Insulating materials for sound and thermal insulation, Geo-textiles, construction chemicals like water proofing components, epoxies, sulphides, polymers.

Glass: Types of glasses their properties, Commercial forms and uses, plate glass, wired glass, bullet resisting glass, coloured glass, fibre glass, foamed glass, glass wool, float glass, glass reinforced plastic, water proofing materials: Bitumen sheets and felts, Chemical admixtures, composite materials.

Chemical Engg

Unit 1:

Atomic Structure, Chemical Bonding and Solutions

Rutherford model of atom, Bohr's theory (expression of energy and radius to be omitted), and hydrogen spectrum explanation based on Bohr's model of atom, Heisenberg uncertainty principle, Quantum numbers - orbital concept.

Shapes of s, p and d orbitals, Pauli's exclusion principle, Hund's rule of maximum multiplicity Aufbau rule, electronic configuration.

Type of chemical bonding: ionic, covalent, metallic and hydrogen bonds. Example of each type. Hybridization, sp³, sp², sp, example: BeCl₂, BF₃, CH₄, NH₃, H₂O; structure of diamond, graphite.

Solution - idea of solute, solvent and solution, methods to express the concentration of solution molarity (M = mole per liter), ppm, mass percentage, volume percentage and mole fraction.

Unit 2: Water

Graphical presentation of water distribution on Earth (pie or bar diagram). Classification of soft and hard water based on soap test, salts causing water hardness, unit of hardness and simple numerical on water hardness.

Quantitative measurement of water hardness by EDTA method, total dissolved solids (TDS) alkalinity estimation.

- 1) Water softening techniques - soda lime process, zeolite process and ion exchange process.
- 2) Municipal water treatment (in brief only) - sedimentation, coagulation, filtration, sterilization.

Water for human consumption for drinking and cooking purposes from any water sources and enlist Indian standard specification of drinking water (collect data and understand standards).

Unit 3: Engineering Materials

Natural occurrence of metals - minerals, ores of iron, aluminium and copper, gangue (matrix), flux, slag, metallurgy - brief account of general principles of metallurgy. Extraction of iron from haematite ore using blast furnace, aluminium from bauxite along with reactions, reactions during copper extraction. Alloys – definition, purposes of alloying, ferrous alloys and non-ferrous with suitable examples, properties and applications.

General chemical composition, composition based applications

Port land cement and hardening, Glasses Refractory and Composite materials.

Polymers - monomer, homo and co polymers, degree of polymerization, simple reactions involved in preparation and their application of thermoplastics and thermosetting plastics (using PVC, PS, PTFE, nylon - 6, nylon - 66, Bakelite only), rubber and vulcanization of rubber.

Unit 4: Chemistry of Fuels and Lubricants

Definition of fuel and combustion of fuel, classification of fuels, calorific values (HCV and LCV), calculation of HCV and LCV using Dulong's formula.

Proximate analysis and ultimate analysis of coal solid fuel

petrol and diesel - fuel rating (octane and cetane numbers),

Chemical composition, calorific values and applications of LPG, CNG, water gas, coal gas, producer gas and biogas.

Lubrication - function and characteristic properties of good lubricant, classification with examples, lubrication mechanism - hydrodynamic and boundary lubrication, physical properties (viscosity and viscosity index, oiliness, flash and fire point, cloud and pour point only) and chemical properties (coke number, total acid number saponification value) of lubricants.

Unit 5: Electro Chemistry

Electronic concept of oxidation, reduction and redox reactions.

Definition of terms: electrolytes, non-electrolytes with suitable examples, Faradays laws of electrolysis and simple numerical problems.

Elementary concept of pH and buffer.

Industrial Application of Electrolysis –

- Electrometallurgy
- Electroplating
- Electrolytic refining.

Application of redox reactions in electrochemical cells –

- Primary cells - dry cell,
- Secondary cell - commercially used lead storage battery, fuel and Solar cells.

Introduction to Corrosion of metals –

- definition, types of corrosion (chemical and electrochemical), H₂ liberation and O₂ absorption mechanism of electrochemical corrosion, factors affecting rate of corrosion.

Internal corrosion preventive measures –

- Purification, alloying and heat treatment and

External corrosion preventive measures:

- a) metal (anodic, cathodic) coatings,
- b) organic inhibitors.

Biochemistry**Unit 1**

The foundations of biochemistry Cellular and chemical foundations of life

Unit 2

Water Unique properties, weak interactions in aqueous systems, ionization of water, buffers, water as a reactant and fitness of the aqueous environment.

Unit 3

Carbohydrates and glycobiology

Monosaccharides - structure of aldoses and ketoses, ring structure of sugars, conformations of sugars, mutarotation, anomers, epimers and enantiomers, structure of biologically important sugar derivatives, oxidation of sugars. Formation of disaccharides, reducing and non-reducing disaccharides. Polysaccharides – homo- and heteropolysaccharides, structural and storage polysaccharides. Structure and role of proteoglycans, glycoproteins and glycolipids (gangliosides and lipopolysaccharides). Carbohydrates as informational molecules, working with carbohydrates

Unit 4

Lipids Building blocks of lipids - fatty acids, glycerol, ceramide. Storage lipids - triacyl glycerol and waxes. Structural lipids in membranes – glycerophospholipids, galactolipids and sulpholipids, sphingolipids and sterols, structure, distribution and role of membrane lipids. Plant steroids. Lipids as signals, cofactors and pigments

Unit 5

Amino acids Structure and classification, physical, chemical and optical properties of amino acids

Unit 6

Nucleic acids Nucleotides - structure and properties. Nucleic acid structure – Watson-Crick model of DNA. Structure of major species of RNA - mRNA, Tran and rRNA. Nucleic acid chemistry - UV absorption, effect of acid and alkali on DNA. Other functions of nucleotides - source of energy, component of coenzymes, second messengers.

Unit 7

Vitamins Structure and active forms of water soluble and fat soluble vitamins, deficiency diseases and symptoms, hypervitaminosis

Unit 8

Introduction to cell biology Prokaryotic (archaea and eubacteria) and eukaryotic cell (animal and plant cells), cells as experimental models.

Tools of cell biology Light microscopy, phase contrast microscopy, fluorescence microscopy, confocal microscopy, electron microscopy, FACS. Centrifugation for subcellular fractionation.

Structure of different cell organelles Structure of nuclear envelope, nuclear pore complex. ER structure. Organization of Golgi. Lysosome. Structure and functions of mitochondria, chloroplasts and peroxisomes. Zellweger syndrome.

Unit 9

Protein trafficking Selective transport of proteins to and from the nucleus. Regulation of nuclear protein import and export. Targeting proteins to ER, smooth ER and lipid synthesis. Export of proteins and lipids from ER and into ER. Lipid and polysaccharide metabolism in Golgi. Protein sorting and export from Golgi. Mechanism of vesicular transport, cargo selection, coat proteins and vesicle budding, vesicle fusion. Protein import and mitochondrial assembly, protein export from mitochondrial matrix. Import and sorting of chloroplast proteins.

Unit 10

Cytoskeletal proteins Structure and organization of actin filaments. Treadmilling and role of ATP in microfilament polymerization, organization of actin filaments. Non-muscle myosin. Intermediate filament proteins, assembly and intracellular organization. Assembly, organization and movement of cilia and flagella.

Cell wall and extracellular matrix Prokaryotic and eukaryotic cell wall, cell matrix proteins. Cell-matrix interactions and cell-cell interactions. Adherence junctions, tight junctions, gap junctions, desmosomes, hemidesmosomes, focal adhesions and plasmodesmata.

Cell cycle, cell death and cell renewal Eukaryotic cell cycle, restriction point, and checkpoints. Cell division. Apoptosis and necrosis - brief outline. Salient features of a transformed cell.

Electronics**Unit 1**

Semiconductors and its properties.

PN Junction formation and construction of Diode.

Diode circuits as rectifiers, Diode based waveform shaping circuits.

Bipolar Junction Transistor, construction and operation.

BJT Biasing circuits, different types.

Amplifier, Single stage, CE, CB, CC, operation and uses. Feedback amplifier, advantages & disadvantages, basic closed loop analysis.

Other Semiconductor Devices: Operation and use of LED, JFET, DIAC, MOSFET

Unit 2

Opamp: Characteristics of ideal operational amplifier Pin Configuration of IC 741, Analysis of simple operational amplifier circuits: concept of virtual ground; non-inverting amplifier and inverting amplifier Applications: voltage follower, summer, differentiator, integrator

Oscillator: Positive feedback and condition of oscillation R-C phase-shift oscillator, Wien bridge oscillator

Unit 3

Boolean Algebra: Boolean algebra, De Morgan's theorem, simplification of Boolean expression, Number system, range extension of numbers, Different codes: Gray code, ASCII code and different BCD codes and their uses

Logic Gates: NOT, OR, AND, NOR, NAND, EX-OR, EX-NOR gates Simplification of logic functions, Realizations of logic expressions using logic gates

Metallurgy

Unit -1

Definitions, behaviour of gasses, vapours and gaseous moisture, materials balances in metallurgical processes

Unit-2

First law of thermodynamics, Heat and work changes in reversible processes, Concept of Heat Capacity, Enthalpy energy balance in metallurgical processes, Reversible adiabatic process

The Carnot cycle, concept of entropy, Entropy changes in reversible, irreversible processes and universe, Clausius inequality, Combined statement of first and second law, Entropy change for irreversible chemical reactions

Helmholtz free energy and the Gibbs free energy, Free-energy equations in differential form, Thermodynamic potentials, The Maxwell relations, Criteria of equilibrium and spontaneity (or irreversibility), The Gibbs-Helmholtz equation, Third law of thermodynamics.

Unit-3

Concept of chemical potential, Chemical potential of oxygen, partial molar quantities, Integral molar quantities, Raoult's law and Henry's law, Alternative standard states, Sievert's law, Mixing function, Excess function, Regular solution, concept of interaction parameter

Unit-4

Fugacity, Activity, standard state, equilibrium constant, Van't Hoff reaction isotherm, Le Chatelier's Principle, Free-energy Charts and Ellingham diagrams, Gas-solid reaction, Van't Hoff equation, Sigma Function (Σ), Clausius-Clapeyron Equation, Trouton's Rule.

Unit-5

Types of electrochemical cells, Laws of electrolysis, determination of thermodynamics quantities using reversible electrochemical cells, Electrochemical cell based on solid electrolytes,

Types of reaction, Order of reaction, Determination of order and rate constant of a reaction,

Atomic Structure and chemical Bonding: Quantum mechanical approach, Schrödinger wave equation, wave function, Quantum state, Periodic Table, electronic configuration and atomic structure. Bonding in solids, different types of bonds, Bond energy, effect of bonding on material properties.

Unit-6

Structure of Solids : The crystalline and the noncrystalline states – Metals and Alloys, Ceramics, semiconductors and polymers; Crystal structure – concept of lattice and crystal, Translational periodicity and symmetry, crystal systems, space lattice, representation of atomic position, lattice directions and lattice planes in cubic and hexagonal systems; atomic packing,

voids in FCC, BCC and HCP crystals; crystal imperfections– point defect, line defect, surface defect and volume defect; equilibrium concentration of point defect.

Unit-7

Solidification of metals and alloys including Rapid Solidification Technology.

Phase diagrams: The phase rule, single component system. Binary phase diagrams with reference to a few important metallic systems.

Unit-8

Corrosion and oxidation of materials: The principles of corrosion; Protection against corrosion; Mechanism of oxidation; Oxidation resistant materials.

Unit-9

Introduction to Materials (Classification, Selection and Applications): Metals and Alloys, Intermetallic, Polymers, Glasses and Ceramics, Composite Materials, nano-crystalline materials.

Food Technology**UNIT 1**

Compositional, Nutritional and Technological aspects of Plant foods

- I. Cereals and Millets
- II. Pulses
- III. Fats and Oils
- IV. Fruits and Vegetables

UNIT 2

Compositional, Nutritional and Technological aspects of Animal foods

- I. Flesh Foods - Meat, Fish, Poultry
- II. Milk and Milk Products

Unit 3

Food Microbiology

Principles of Food Preservation, microorganisms associated with foods- bacteria, yeast and mould, Importance of bacteria, yeast and molds in foods. Classification of microorganisms based on temperature, pH, water activity, nutrient and oxygen requirements, typical growth curve of micro-organisms. Classification of food based on pH, Food infection, food intoxication, definition of shelf life, perishable foods, semi perishable foods, shelf stable foods.

Unit 4

Food Preservation by Low temperature

Freezing and Refrigeration: Introduction to refrigeration, cool storage and freezing, definition, principle of freezing, freezing curve, changes occurring during freezing, types of freezing i.e. slow freezing, quick freezing, introduction to thawing, changes during thawing and its effect on food.

Unit 5

Food Preservation by high temperature

Thermal Processing- Commercial heat preservation methods: Sterilization, commercial sterilization, Pasteurization, and blanching.

Unit 6

Food Preservation by Moisture control

Drying and Dehydration - Definition, drying as a means of preservation, differences between sun drying and dehydration (i.e. mechanical drying), heat and mass transfer, factors affecting rate of drying, normal drying curve, names of types of driers used in the food industry. (9 lectures) Evaporation – Definition, factors affecting evaporation, names of evaporators used in food industry.

Unit 7

Food Preservation by Irradiation

Units of radiation, kinds of ionizing radiations used in food irradiation, mechanism of action, uses of radiation processing in food industry, concept of cold sterilization.

Microbiology

Unit 1: Methods in Micro-Biology

Sterilization - Disinfection, Isolation, Purification and preservation of Microbes, Principles of staining of Microorganisms, Microscopy; Light Phase Contract, Epifluorescence and Election microscopy antibiotics. Assay of antibiotics

Unit 2: Advanced Techniques

Principles and application of Gel filtration, in exchange and affinity, high-pressure liquid chromatography (HPLC) as chromatography (GC) Electrophoresis, Electro focussing, ultracentrifugation ELISA technique Fluorescent Antibody Technique, Radioactive isotopes autoradiography.

Unit 3:

Microbial genetics - mutations and variations genetics of Neurospora. Aspergillus and Saccharomyces hetero and bacteriophages, plasmids Transduction Conjugation, episomes and transposons Transformation. Genetic Improvement of Micro-organisms, gene cloning and modern R-DNA- techniques to improve biotechnologically important micro-organisms.

Unit 4:

Industrial Micro-biology: Production of ethanol and alcoholic beverages, organic acids, Polysaccharides, Amino acids Vitamins. Enzymes growth regulators, cultivation of micro-antibiotics fermentation techniques continuous organisms, patents terms and regulations. Microbial leaching of ores.

Agricultural Microbiology: Distribution of Micro-organisms, organic matter decomposition Microbiology and biochemistry, bio-fertilizers denitrification and microbial transformation of iron, sulphur and Phosphorus Ecto and Endo-mycorrhizal association in plants and their significance. Microbial pesticides - Microbial degradation of pesticides.

Environmental microbiology: Microbiology of Water and Air-Microbial assessment of water quality, safe disposal of sewage and industrial effluents. Wastewater treatment and pollution control. Management of organic wastes; utilization of agricultural wastes through microbial degradation. Microbial composting. Disposal of municipal. Domestic and industrial wastes through the microbial process. Recycling of sewage water. Microbial deodorization and decolouration of effluents

Food Microbiology: Role of microbes in preparation of Sauer - Kraut bread and pickles. Preservation of food sources of spoilage of food, food infection, food toxicity and control of food-borne micro-organisms, food adulteration and legislation. Microbes as food single-cell protein production, mushroom production.

Unit 5: Dairy Bacteriology

Microbiology of milk - Pathogenic bacteria in milk - Spoilage of fresh milk and milk products-
Prevention & Preservation of milk and milk products - production of fermented Dairy products.

Unit 6: Microbial diseases and their control

Plant diseases – Damping-off, rots and wilts, mildew smells and rusts Bovine - and leaf spots.
Animal diseases - Anthrax foot mouth disease Rinderpest Human diseases - tuberculosis -
leprosy- tetanus - Diphtheria, typhoid-Cholera-HIV's.

Unit 7: Microbial Biotechnology

Developments in microbial biotechnology and Genetic manipulation - recombinant DNA
technology techniques. Applications of biotechnology - production of antibiotics, enzymes.
Insulin, growth hormones interferons - monoclonal antibodies.