

ODISHA STAFF SELECTION COMMISSION UNIT – II, Bhubaneswar – 751001

No.HE-132/2022-6264 /OSSC;

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ADDENDUM

Pursuant to Clause-5 of Advertisement No. 5883/OSSC dated 20.09.2022 and Corrigendum No.6048/OSSC dated 01.10.2022 the detailed syllabus of Main Written Examination of Junior Laboratory Assistant under Director of Technical Education, Odisha, Cuttack, is annexed as Annexure-C for information of all concerned.

By order of Commission

ANNEXURE-C

Engineering Physics

UNIT 1 - UNITS AND DIMENSIONS

- 1. Physical quantities (Definition).
- 2. Definition of fundamental and derived units, systems of units (FPS, CGS, MKS and SI units).
- 3. Definition of dimension and Dimensional formulae of physical quantities.

4. Dimensional equations and Principle of homogeneity.

5. Checking the dimensional correctness of Physical relations.

UNIT 2 - SCALARS AND VECTORS

- 1. Scalar and Vector quantities (definition and concept), Representation of a Vector examples, types of vectors.
- 2. Triangle and Parallelogram law of vector Addition (Statement only). SimpleNumerical.
- 3. Resolution of Vectors Simple Numericals on Horizontal and Vertical components.
- 4. Vector multiplication (scalar product and vector product of vectors).

UNIT 3 - KINEMATICS

1. Concept of Rest and Motion.

- 2. Displacement, Speed, Velocity, Acceleration & FORCE (Definition, formula, dimension & SI units).
- 3. Equations of Motion under Gravity (upward and downward motion) no derivation.
- 4. Circular motion: Angular displacement, Angular velocity and Angular acceleration (definition, formula & SI units).
- 5. Relation between (i) Linear & Angular velocity, (ii) Linear & Angular acceleration).

6. Define Projectile, Examples of Projectile.

7. Expression for Equation of Trajectory, Time of Flight, Maximum Height and Horizontal Range for a projectile fired at an angle, Condition for maximum Horizontal Range.

UNIT 4 – WORK AND FRICTION

1. Work - Definition, Formula & SI units.

2. Friction – Definition & Concept.

3. Types of friction (static, dynamic), Limiting Friction (Definition with Concept).

4. Laws of Limiting Friction (Only statement, No Experimental Verification).

5. Coefficient of Friction - Definition & Formula, Simple Numericals.

6. Methods to reduce friction.

UNIT 5 - GRAVITATION

1. Newton's Laws of Gravitation – Statement and Explanation.

2. Universal Gravitational Constant (G) - Definition, Unit and Dimension.

3. Acceleration due to gravity (g)- Definition and Concept.

4. Definition of mass and weight.

5. Relation between g and G.

6. Variation of g with altitude and depth (No derivation – Only Explanation).

7. Kepler's Laws of Planetary Motion (Statement only).

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UNIT 6 - OSCILLATIONS AND WAVES

1. Simple Harmonic Motion (SHM) - Definition & Examples.

2. Expression (Formula/Equation) for displacement, velocity, acceleration of a body/ particle in SHM.

3. Wave motion - Definition & Concept.

- 4. Transverse and Longitudinal wave motion Definition, Examples & Comparison.
- 5. Definition of different wave parameters (Amplitude, Wavelength, Frequency, Time Period).
- 6. Derivation of Relation between Velocity, Frequency and Wavelength of a wave

7. Ultrasonics - Definition, Properties & Applications.

UNIT 7 - HEAT AND THERMODYNAMICS

1. Heat and Temperature - Definition & Difference

2. Units of Heat (FPS, CGS, MKS & SI).

3. Specific Heat (concept, definition, unit, dimension and simple numerical)

- 4. Change of state (concept), Latent Heat (concept, definition, unit, dimension and simple numerical)
- 5. Thermal Expansion Definition & Concept

6. Expansion of Solids (Concept)

7. Coefficient of linear, superficial and cubical expansions of Solids - Definition & Units.

8. Relation between α, β & Υ

9. Work and Heat - Concept & Relation.

10. Joule's Mechanical Equivalent of Heat (Definition, Unit)

11. First Law of Thermodynamics (Statement and concept only)

UNIT 8 - OPTICS

1. Reflection & Refraction - Definition.

2. Laws of reflection and refraction (Statement only)

3. Refractive index - Definition, Formula & Simple numerical.

4. Critical Angle and Total internal reflection - Concept, Definition & Explanation 5. Refraction through Prism (Ray Diagram & Formula only - NO derivation).

6. Fiber Optics - Definition, Properties & Applications

UNIT 9 – ELECTROSTATICS & MAGNETOSTATICS

1. Electrostatics - Definition & Concept.

2. Statement & Explanation of Coulombs laws, Definition of Unit charge.

3. Absolute & Relative Permittivity (ε) – Definition, Relation & Unit.

4. Electric potential and Electric Potential difference (Definition, Formula & SI Units). 5. Electric field, Electric field intensity (E) – Definition, Formula & Unit.

6. Capacitance - Definition, Formula & Unit.

7. Series and Parallel combination of Capacitors No derivation, foreffective/Combined/total capacitance & Simple numericals). Formula

8. Magnet, Properties of a magnet.

9. Coulomb's Laws in Magnetism - Statement & Explanation, Unit Pole (Definition). 10. Magnetic field, Magnetic Field intensity (H) - (Definition, Formula & SI Unit).

11. Magnetic lines of force (Definition and Properties)

12. Magnetic Flux (Φ) & Magnetic Flux Density (B) - Definition, Formula & Unit.



UNIT 10 – CURRENT ELECTRICITY

1. Electric Current – Definition, Formula & SI Units.

2. Ohm's law and its applications.

3. Series and Parallel combination of resistors (No derivation, Formula for effective/Combined/total resistance & Simple numericals).

4. Kirchhoff's laws (Statement & Explanation with diagram).

5. Application of Kirchhoff's laws to Wheatstone bridge - Balanced condition of Wheatstone's Bridge - Condition of Balance (Equation).

UNIT 11 - ELECTROMAGNETISM & ELECTROMAGNETIC INDUCTION

Electromagnetism – Definition & Concept.

- Force acting on a current carrying conductor placed in a uniform magnetic field, Fleming's Left Hand Rule
- Faraday's Laws of Electromagnetic Induction (Statement only)

Lenz's Law (Statement)

Fleming's Right Hand Rule

• Comparison between Fleming's Right Hand Rule and Fleming's Left Hand Rule.

UNIT 12 - MODERN PHYSICS

LASER & laser beam (Concept and Definition)

Principle of LASER (Population Inversion & Optical Pumping)

Properties & Applications of LASER

Wireless Transmission – Ground Waves, Sky Waves, Space Waves (Concept & Definition)

Engineering Chemistry

A. PHYSICAL CHEMISTRY

1. Atomic structure: Fundamental particles (electron, proton & neutron Definition, mass and charge). Rutherford's Atomic model (postulates and failure), Atomic mass and mass number, Definition, examples and properties of Isotopes, isobars and isotones. Bohr's Atomic model (Postulates only), Bohr-Bury scheme, Aufbau's principle, Hund's rule, Electronic configuration (up to atomic no 30).

2. **Chemical Bonding:** Definition, types (Electrovalent, Covalent and Coordinate bond with examples (formation of NaCl, MgCl₂, H₂,Cl₂, O₂, N₂, H₂O, CH₄, NH₃, NH₄ +, SO₂).

3. Acid base theory: Concept of Arrhenius, Lowry Bronsted and Lewis theory for acid and base with examples (Postulates and limitations only). Neutralization of acid & base. Definition of Salt, Types of salts (Normal, acidic, basic, double, complex and mixed salts, definitions with 2 examples from each).

4. Solutions: Definitions of atomic weight, molecular weight, Equivalent weight. Determination of equivalent weight of Acid, Base and Salt.

Modes of expression of the concentrations (Molarity, Normality & Molality) with Simple Problems. pH of solution (definition with simple numericals)

Importance of pH in industry (sugar, textile, paper industries only)

5. Electrochemistry: Definition and types (Strong & weak) of Electrolytes with example. Electrolysis (Principle & process) with example of NaCl (fused and aqueous solution). Faraday's 1st and 2nd law of Electrolysis (Statement, mathematical expression and Simple numerical) Industrial application of Electrolysis- Electroplating (Zinc only).

6. Corrosion: Definition of Corrosion, Types of Corrosion- Atmospheric Corrosion, Waterline corrosion. Mechanism of rusting of Iron only. Protection from Corrosion by (i)

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B. INORGANIC CHEMISTRY

- 7. **Metallurgy:** Definition of Mineral, ores, gangue with example. Distinction between Ores And Minerals. General methods of extraction of metals,
 - i) Ore Dressing
 - ii) Concentration (Gravity separation, magnetic separation, Froth floatation & leaching)
 - iii) Oxidation (Calcinations, Roasting)
 - iv) Reduction (Smelting, Definition & examples of flux, slag)

v) Refining of the metal (Electro refining, & Distillation only)

8. Alloys: Definition of alloy. Types of alloys (Ferro, Non Ferro & Amalgam) with example. Composition and uses of Brass, Bronze, Alnico, Duralumin

C. ORGANIC CHEMISTRY

9. **Hydrocarbons**: Saturated and Unsaturated Hydrocarbons (Definition withexample) Aliphatic and Aromatic Hydrocarbons (Huckle's rule only). Difference between Aliphatic andaromatic hydrocarbons.

IUPAC system of nomenclature of Alkane, Alkene, Alkyne, alkyl halide and alcohol (up to 6 carbons) with bond line notation.

Uses of some common aromatic compounds (Benzene, Toluene, BHC, Phenol, Naphthalene, Anthracene and Benzoic acid) in daily life.

D. <u>INDUSTRIAL CHEMISTRY</u>

10. Water Treatment: Sources of water, Soft water, Hard water, hardness, types of Hardness (temporary or carbonate and permanent or non-carbonate), Removal of hardness by lime soda method (hot lime & cold lime—Principle, process & advantages) Advantages of Hotlime over cold lime process.

Organic Ion exchange method (principle, process, and regeneration of exhausted resins)

- 11. **Lubricants**: Definition of lubricant, Types (solid, liquid and semisolid with examples only) and specific uses of lubricants (Graphite, Oils, Grease), Purpose of lubrication
- 12. **Fuel**: Definition and classification of fuel, Definition of calorific value of fuel, Choice of good fuel.

Liquid: Diesel, Petrol, and Kerosene --- Composition and uses.

Gaseous: Producer gas and Water gas (Composition and uses). Elementary idea about LPG,CNG and coal gas (Composition and uses only).

13. **Polymer**: Definition of Monomer, Polymer, Homo-polymer, Co-polymer and Degree of polymerization. Difference between Thermosetting and Thermoplastic, Composition and uses of Polythene, & Poly-Vinyl Chloride and Bakelite.

Definition of Elastomer (Rubber). Natural Rubber (it's draw backs). Vulcanisation of Rubber. Advantages of Vulcanised rubber over raw rubber.

14. **Chemicals in Agriculture:** Pesticides: Insecticides, herbicides, fungicides-Examples and uses.

Bio Fertilizers: Definition, examples and uses.

O.

ENGINEERING MATHEMATICS-I

1. MATRICES AND DETERMINANTS

- a) Types of matrices
- b) Algebra of matrices
- c) Determinant
- d) Properties of determinant
- e) Inverse of a matrix (second and third order) (Question should be on second order matrix)
- f) Cramer's Rule (Question should be on two variables)
- g) Solution of simultaneous equations by matrix inverse method(Question should be on two variables)

2. TRIGONOMETRY

- a) Trigonometrical ratios
- b) Compound angles, multiple and sub-multiple angles (only formulae)
- c) Define inverse circular functions and its properties (no derivation)

3. CO-ORDINATE GEOMETRY IN TWO DIMENSIONS (Straight line)

- a) Introduction of geometry in two dimension
- b) Distance formulae, division formulae, area of a triangle (only formulae no derivation)
- c) Define slope of a line, angle between two lines (only F), condition of perpendicularity and parallelism.
- d) Different forms of straight lines (only formulae)
 - i.One point form (ii) two point form (iii) slope form (iv) intercept form
 - (v) Perpendicular form
- e) Equation of a line passing through a point and (i) parallel to a line (ii) Perpendicular to
- f) Equation of a line passing through the intersection of two lines
- g) Distance of a point from a line

4. CIRCLE

a) Equation of a circle

- i. center radius form
- ii. general equation of a circle
- iii. end point of diameter form

5. CO-ORDINATE GEOMETRY IN THREE DIMENSIONS

- a. Distance formulae, section formulae, direction ratio, direction cosine, angle between two lines (condition of parallelism and perpendicularity)
- b. Equation of a plane
 - i) General form, angle between two planes, perpendicular distance of a point from a plane, equation of a plane passing through a point and
 - i) parallel to a plane (ii) perpendicular to a plane

6. SPHERE

- a. Equation of a sphere
- i. center radius form
- ii. general form
- iii. two end points of a diameter form (only formulae and problems)

V.

ENGINEERING MATHEMATICS – II

1) VECTOR ALGEBRA

- a) Introduction
- b) Types of vectors (null vector, parallel vector, collinear vectors)(in component form)
- c) Representation of vector
- d) Magnitude and direction of vectors
- e) Addition and subtraction of vectors
- f) Position vector
- g) Scalar product of two vectors
- h) Geometrical meaning of dot product
- i) Angle between two vectors
- j) Scalar and vector projection of two vectors
- k) Vector product and geometrical meaning(Area of triangle and parallelogram)

2) LIMITS AND CONTINUITY

- a) Definition of function, based on set theory
- b) Types of functions
 - i) Constant function
 - ii) Identity function
 - iii) Absolute value function
 - iv) iv) The Greatest integer function
 - v) Trigonometric function
 - vi)Exponential function
 - vii) Logarithmic function
- c) Introduction of limit
- d) Existence of limit
- e) Methods of evaluation of limit

i)
$$\lim_{x\to 0} \frac{x^n - a^n}{x - a} = na^{n-1}$$

i)
$$\lim_{x\to 0} \frac{x^n - a^n}{x - a} = na^{n-1}$$

ii) $\lim_{x\to 0} \frac{a^x - 1}{x} = \log_e a$

iii)
$$\lim_{x\to 0} \frac{e^x-1}{x} = 1$$

v)
$$\lim_{x\to 0} \frac{(1+x)^{1/x}}{(1+1)} = e$$

$$vi) \lim_{x\to 0} \frac{\log(1+x)}{x} = 1$$

$$vii) \lim_{x\to 0} \frac{\sin x}{x} = 1$$

viii)
$$\lim_{x\to 0} \frac{\tan x}{x} = 1$$

e) Definition of continuity of a function at a point and problems based on it

3) DERIVATIVES

- a) Derivative of a function at a point
- b) Algebra of derivative
- c) Derivative of standard functions

$$x^{n}$$
, a^{x} , $\log_{a} x$, e^{x} , $\sin x$, $\cos x$, $\tan x$, $\cot x$, $\sec x$, $\csc x$, $\sin^{-1} x$, $\cos^{-1} x$, $\tan^{-1} x$, $\cot^{-1} x$, $\sec^{-1} x$, $\csc^{-1} x$

d) Derivative of composite function (Chain Rule)

- e) Methods of differentiation of
 - i) Parametric function
 - ii) Implicit function
 - iii) Logarithmic function
 - iv) a function with respect to another function
 - f) Applications of Derivative
 - i) Successive Differentiation (up to second order)
 - ii) Partial Differentiation (function of two variables up to second order)
 - g) Problems based on above

4) INTEGRATION

- a) Definition of integration as inverse of differentiation
- b) Integrals of standard functions
- c) Methods of integration
 - i) Integration by substitution
 - ii) Integration by parts

d) Integration of the following forms
i)
$$\int \frac{dx}{x^2 + a^2}$$
 ii) $\int \frac{dx}{x^2 - a^2}$ iii) $\int \frac{dx}{a^2 - x^2}$ iv) $\int \frac{dx}{\sqrt{x^2 + a^2}}$ v) $\int \frac{dx}{\sqrt{x^2 - a^2}}$ vi) $\int \frac{dx}{\sqrt{a^2 - x^2}}$ vii) $\int \frac{dx}{\sqrt{x^2 - a^2}}$ viii) $\int \sqrt{a^2 - x^2} dx$ ix) $\int \sqrt{a^2 + x^2} dx$ x) $\int \sqrt{x^2 - a^2} dx$

i)
$$\int_a^a f(x) dx = \int_a^a f(a-x) dx$$

ii)
$$\int_a^b f(x) dx = -\int_a^a f(x) dx$$

e) Definite integral, properties of definite integrals
i)
$$\int_{a}^{a} f(x) dx = \int_{a}^{a} f(a-x)dx$$
ii) $\int_{a}^{b} f(x) dx = \int_{b}^{a} f(x) dx$
iii) $\int_{a}^{c} f(x) dx = \int_{a}^{b} f(x) dx + \int_{b}^{c} f(x) dx$, $a < b < c$

iv)
$$\int_{-a}^{a} f(x) dx = 0$$
, if $f(x) = \text{odd}$

iv)
$$\int_{-a}^{a} f(x) dx = 0$$
, if $f(x) = \text{odd}$
= $2 \int_{0}^{a} f(x) dx$, if $f(x) = even$
f) Application of integration

- - i) Area enclosed by a curve and X axis
 - ii) Area of a circle with centre at origin

5) DIFFERENTIAL EQUATION

- a) Order and degree of a differential equation
- b) Solution of differential equation
 - i) 1st order and 1st degree equation by the method of separation of variables
 - ii) Linear equation $\frac{dy}{dx}$ + Py = Q, where P,Q are functions of x

ENGINEERING MECHANICS

FUNDAMENTALS OF ENGINEERING MECHANICS

a) Fundamentals.

Definitions of Mechanics, Statics, Dynamics, Rigid Bodies,

b) Force

Force System.

Definition, Classification of force system according to plane & line of action. Characteristics of Force & effect of Force. Principles of Transmissibility & Principles of Superposition. Action & Reaction Forces & concept of Free

Body Diagram.

c) Resolution of a Force.

Definition, Method of Resolution, Types of Component forces, Perpendicular components & non-perpendicular components.

d) Composition of Forces.

Definition, Resultant Force, Method of composition of forces, such as

- i. Analytical Method such as Law of Parallelogram of forces & method ofresolution.
- ii. Graphical Method.Introduction, Space diagram, Vector diagram, Polygon law of forces.
- iii. Resultant of concurrent, non-concurrent & parallel force system by Analytical& Graphical Method.
- e) Moment of Force.

Definition, Geometrical meaning of moment of a force, measurement of moment of a force & its S.I units. Classification of moments according to direction of rotation, sign convention, Law of moments, Varignon's Theorem, Couple – Definition, S.I. units, measurement of couple, properties of couple.

2. EQUILIBRIUM

- a) Definition, condition of equilibrium, Analytical & Graphical conditions of equilibrium for concurrent, non-concurrent & Free Body Diagram.
- b) Lamia's Theorem Statement, Application for solving various engineering problems.

3. FRICTION

a) Definition of friction, Frictional forces, Limiting frictional force, Coefficient of Friction.

Angle of Friction & Repose, Laws of Friction, Advantages & Disadvantages of Friction.

- b) Equilibrium of bodies on level plane Force applied on horizontal & inclined plane (up &down).
- c) Ladder, Wedge Friction.

4. CENTROID & MOMENT OF INERTIA

- a) Centroid Definition, Moment of an area about an axis, centroid of geometrical figures such as squares, rectangles, triangles, circles, semicircles & quarter circles, centroid of composite figures.
- b) Moment of Inertia Definition, Parallel axis & Perpendicular axis Theorems. M.I. of plane lamina & different engineering sections.

5. SIMPLE MACHINES

a) Definition of simple machine, velocity ratio of simple and compound gear train, explain simple & compound lifting machine, define M.A, V.R. & Efficiency& State the relation between them, State Law of Machine, Reversibility of Machine, Self Locking Machine.

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- b) Study of simple machines simple axle & wheel, single purchase crabwinch & double purchase crab winch, Worm & Worm Wheel, Screw Jack.
- c) Types of hoisting machine like derricks etc, Their use and working principle. No problems.

6. DYNAMICS

- a) Kinematics & Kinetics, Principles of Dynamics, Newton's Laws of Motion, Motion of Particle acted upon by a constant force, Equations of motion, De-Alembert's Principle.
- b) Work, Power, Energy & its Engineering Applications, Kinetic & Potential energy& its application.
- c) Momentum & impulse, conservation of energy & linear momentum, collision of elastic bodies, and Coefficient of Restitution.