



## ODISHA PUBLIC SERVICE COMMISSION

ADVERTISEMENT NO. 26 OF 2023-24

**Recruitment to the posts of Assistant Chemist in Group-B of Odisha Sub-ordinate Chemical Analysis Services Cadre under Steel & Mines Department.**

**WEBSITE : [www.opsc.gov.in](http://www.opsc.gov.in)**

Online applications are invited from the prospective candidates through the Proforma application form to be made available on the website (<https://www.opsc.gov.in>). The link for registration shall be available from **12.02.2024 to 16.03.2024** (Note: **16.03.2024 is the last date for submission of Registered Online Application**) for recruitment to **22 (Twenty-Two)** posts of **Assistant Chemist** in Group-B of Odisha Sub-ordinate Chemical Analysis Services Cadre under Steel & Mines Department in the Scale of Pay of Rupees 44900/- in Level -10, Cell-1 of the pay matrix as per ORSP Rules, 2017 with usual Dearness and other Allowances as may be sanctioned by the Government of Odisha from time to time.

### 2. **VACANCY POSITION:**

As per requisition filed by the Steel & Mines Department, Government of Odisha, the category wise vacancy position along with reservation thereof is given below: -

Sl. No.	Category	No. of Vacancies
1	2	3
1	Unreserved	11 (04-w)
2	SEBC	02 (01-w)
3	Scheduled Caste	04 (01-w)
4	Scheduled Tribe	05 (02-w)
<b>Total</b>		<b>22 (08-w)</b>

Out of the total 22 number of vacancies mentioned above, the reservation of vacancies in respect of Ex-Servicemen and Persons with Disabilities whose permanent disability is 40% & more are given below. The Candidates belonging to Ex-Servicemen and Persons with Disabilities shall be adjusted against the categories to which they belong.

Sl. No.	Sub-Category	No. of Posts
(i)	Ex-Servicemen	01
(ii)	Person with Disabilities Hearing Impairment (HI)	01

The physical requirements and functional classification of the Persons with Disabilities (having permanent disability 40% and more) who are eligible for the post of Assistant Chemist are as follows: -

Physical Requirements	Functional Classification
Code - S, ST, BN, W, SE, MF	Code - HI (with suitable aid), OA, OL, BL (MNR)
<b>Full Forms</b> S – work performed by sitting (on bench or chair) ST – work performed by standing BN - Work performed by bending W - Work performed by walking SE - work performed by seeing MF - Work performed by manipulating (with fingers)	<b>Full Forms</b> HI – Partially Deaf (with suitable aid) OA – One arm affected (R or L): - (a) impaired reach; (b) weakness of grip; (c) ataxia OL – One leg affected (R or L), BL(MNR) – Both legs affected but not arms (Mobility not restricted)

P.T.O.

- NOTE:** (a) In case of non-availability or availability of insufficient number of eligible women candidate(s) in any particular category, the unfilled vacancies of that category shall be filled up by eligible and suitable male candidate(s) of the same category.
- (b) Exchange of reservation between SC & ST categories shall not be considered.
- (c) The number of vacancies to be filled up on the basis of this recruitment is subject to change by Government without notice, depending upon the exigencies of public service at the discretion of the State Government.

**3. AGE:**

A candidate must have attained the age of **21 (Twenty-one)** years and must not be above the age of **38 (Thirty-Eight)** years as on the **1<sup>st</sup> day of January 2024** i.e., he/she must have been born **not earlier than 2<sup>nd</sup> January 1986 and not later than 1<sup>st</sup> January 2003.**

Provided that the upper age-limit prescribed above shall be relaxed by **five (05) years** for candidates belonging to the categories of Socially & Educationally Backward Classes (S.E.B.C.), Scheduled Caste (S.C.), Scheduled Tribe (S.T.), Women & Ex-Servicemen and **ten (10) years** for Persons with Disabilities whose **permanent disability is Forty percent (40%) and more** and having the **functional classification HI (with suitable aid), OA, OL & BL (MNR).**

**Although age relaxation is permissible to aforementioned PWD categories of persons, also mentioned in the table, reservation of post is only meant for persons with Hearing Impairment (HI with suitable aid) category, as requisitioned by the Government.**

**Persons with Disabilities belonging to SEBC/ SC/ ST categories are eligible for cumulative age relaxation benefit of fifteen (15) years.**

Date of birth entered in the High School Certificate or equivalent certificate issued by the concerned Board/Council will only be accepted by the Commission.

**4. EDUCATIONAL QUALIFICATION:**

A candidate must have **at least 2<sup>nd</sup> Class Post Graduate Degree in Chemistry or equivalent qualification such as Post Graduate Degree in Applied Chemistry or Industrial Chemistry or Analytical Chemistry** from any recognized University/ Institution.

**5. EXAMINATION FEE:**

The examination fee for all categories of candidates has been exempted as per **GA&PG Department Notification No. 9897/Gen, dt. 11.04.2022.**

**6. METHOD OF SELECTION:**

- i) The selection of candidates for recruitment to the posts of Assistant Chemist shall be made on the basis of **Written Examination & Viva Voce Test.**
- ii) The **written examination** shall comprise of **two (02) papers i.e., Paper – I (Organic & Analytical Chemistry) & Paper – II (Physical & Inorganic Chemistry), each carrying 100 marks.**
- iii) Each Paper shall consist of **100 questions**, each carrying **one (01) mark** of Multiple-Choice Questions (**MCQ**) pattern.
- iv) The duration of examination shall be **One & half (1 ½) Hours for each paper.**
- v) There shall be negative marking for each wrong answer/ response with a deduction of **25% (one-fourth) of marks** allotted to a particular question for both the papers.
- vi) The total marks for the **Viva Voce test** shall be **25 marks.**

- vii) The candidates shall be shortlisted for document verification and Viva Voce Test in the following manner: -

*"Where the number of vacancies is upto 02 (two), the number of candidates to be called for document verification/ Viva Voce Test will be 05 (five). Where the number of vacancies exceeds 02 (two), the number of candidates to be called for document verification/ Viva Voce will be thrice the number of vacancies."*

- viii) The broad syllabi for the said examination are appended as **Annexure – A** of this Advertisement.
- ix) On the basis of the result of the competitive examination (Written Examination & Viva Voce Test), the Commission shall prepare a list of successful candidates found suitable for appointment in order of merit subject to reservation for different categories.
- x) Where two or more candidates secure equal marks in the aggregate the following principle shall be adopted: -

If two or more candidates secure **equal marks in the aggregate**, the order of merit shall be determined in accordance with **highest marks secured** by such candidates **in the written examination**.

In case of **further tie** (i.e. marks obtained in aggregate & as well as written examination), the merit will be arranged **in order of date of birth (i.e. the older in age will be ranked higher)**.

**Note: - Any details relating to this recruitment like cut-off marks, answer keys, individual marks etc. shall only be declared on the website of the Commission after publication of the final results and select list.**

**7. PLACE OF EXAMINATION:**

The Written Examination will be held at Cuttack/ Bhubaneswar. Request for change of Examination Centre shall not be entertained.

**8. OTHER ELIGIBILITY CONDITIONS:**

- (i) The candidate must be a citizen of India;
- (ii) The candidate must be able to read, write & speak Odia and must have:-
- (a) passed Middle School Examination with Odia as a language subject, or
- (b) passed Matriculation or equivalent examination with Odia as a medium of examination in non-language subject, or
- (c) passed in Odia as language subject in the final examination of Class VII from a School or Educational Institution recognised by the Government of Odisha or the Central Government, or
- (d) passed a test in Odia of Middle English School Standard conducted by the School & Mass Education Department.
- (iii) He/ She should be of good mental condition and bodily healthy and free from any physical defect likely to interfere with the discharge of his/ her duties in the service and a candidate, who after such medical examination as the Government may prescribe, is not found to satisfy these requirements shall not be appointed to the service.
- (iv) A candidate, who has more than one spouse living will not be eligible for appointment unless the State Government has exempted his/her case from operation of this limitation for any good and sufficient reasons;
- (v) Government servants, whether temporary or permanent, are eligible to apply provided that they possess the requisite qualification and are within the prescribed age-limit as provided under Para - 3 & 4 of the Advertisement. They must submit **No Objection Certificate** issued by the Competent Authority during document verification.

- (vi) If a candidate has at any time, been debarred for a certain period/chance(s) by the Odisha Public Service Commission or other State Public Service Commission or U.P.S.C. from appearing at any examination/ Viva Voce Test, he/she will not be eligible for such recruitment for that specified period/chance(s);
- (vii) **Only those candidates, who are within the prescribed age limit and fulfil the requisite qualification etc. by the closing date of submission of online application will be considered eligible;**
- (viii) A candidate who claims change in his/her name after having passed the High School Certificate Examination or equivalent Examination, he/ she is required to furnish copy of publication of the changed name in the local leading daily newspaper as well as copy of notification in the Gazette in support of his /her change of name.

**9. IMPORTANT POINTS**

- (i) **Online Applications submitted to the OPSC, if found to be incomplete in any respect shall be liable to rejection without entertaining any correspondence with the applicants on that score.**
- (ii) **Admission to Examination will be provisional. If on verification at any stage before or after the Examination, it is found that a candidate does not fulfil all the eligibility conditions, his/ her candidature shall be liable to rejection. Decision of the Commission in regard to the eligibility or otherwise of a candidate shall be final.**
- (iii) This advertisement should not be construed as binding on the Government to make appointment.
- (iv) Concession meant for **S.E.B.Cs., S.Cs. & S.Ts.** by birth are admissible to the Socially & Educationally Backward Classes, Schedule Castes & Schedule Tribes of Odisha only.
- (v) **Community/ Caste status once mentioned by the candidates under the appropriate box of the online application form will be treated as final and the same shall not be changed subsequently under any circumstances.**
- (vi) **Any misrepresentation or suppression of information by the candidate in the Online Application, will result in cancellation of his/her candidature or penalty, as decided by the Commission be imposed on the candidate.**

**10. CERTIFICATES AND DOCUMENTS TO BE ATTACHED:**

The candidates who shall qualify in the written examination are required to download the hard copy of online application and submit the same during document verification. They are required to submit the true copies of the documents including originals as mentioned below along with their application form. **The candidates are required to mention on the copy of each document "submitted by me" and put their signature & date on the same.**

- (i) H.S.C. or equivalent certificate in support of declaration of age issued by the concerned Board/Council;
- (ii) Post Graduate Degree Certificate issued by a recognized University along with Mark-lists passed including fail marks, if any, issued by the concerned Board/Council/University.

**NOTE 1:**

- (a) **The candidates are to upload all the certificates/ documents as required by the system while filling up online application form, failing which their candidature shall be rejected.**

- (b) Candidates who have not been awarded percentage of marks, but only "GRADE MARKS", should, along with their applications, produce the Conversion Certificate from the concerned University indicating the actual equivalent percentage of marks and the conversion formula failing which, their applications are liable to be rejected.
- (iii) Four (04) recent passport size photographs (unsigned & unattested) which has been uploaded with online application form.
- (iv) Caste Certificate **by birth** in support of claim as S.C./ S.T./ S.E.B.C., wherever applicable **(Please see Note-2)**;
- (v) Required Odia Test pass certificate from the competent authority.
- (vi) Ex-Servicemen claiming reservation are required to submit/ upload Release Certificate issued as per Orissa Ex-Servicemen (Recruitment to State Civil Services and Posts) Rules, 1985 vide GA Deptt. Notification No. 22586/Gen, dt. 16.10.1985. Further, Ex-Servicemen candidates must submit an affidavit undertaking that he has not been appointed against any civil post after retirement from military service;
- (vii) Permanent Disability Certificate (indicating percentage of disability i.e., 40% and more) issued by the concerned Medical Board wherever applicable.
- (viii) No objection Certificate issued by the Competent Authority.
- (ix) Any proof of Identity.

**NOTE-2:** (i) Candidates claiming and belonging to S.T. /S.C. / S.E.B.C Category **by birth** are required to submit copy of the relevant Caste Certificate as mentioned in their online application form and issued by the Competent Authority in the prescribed form.

(ii) Candidates of SEBC category (other than Creamy Layer) must submit copy of Caste Certificate issued by the Competent Authority within the last three years by the closing date for submission of online application form in the prescribed format. The SEBC Certificate which is more than three years old by the closing date of submission of online application form is liable for rejection.

(iii) Women candidates belonging to S.E.B.C./ S.C./S.T. categories are required to submit Caste Certificates **by birth** showing "daughter of .....". Caste Certificates by virtue of marriage (i.e., showing "wife of .....") are not acceptable and liable to rejection.

(iv) O.B.C. CERTIFICATES WILL **NOT BE ACCEPTED** IN LIEU OF S.E.B.C. CERTIFICATES AND CANDIDATES SUBMITTING OBC CERTIFICATES ARE LIABLE FOR REJECTION.

(v) Community (Caste status) once mentioned by the candidates shall not be changed under any Circumstances.

(vi) The competent authorities are District Magistrate/ Collector or Additional District Magistrate or Sub-divisional Magistrate/Sub-Collectors or Executive Magistrates or Revenue Officers, not below the rank of Tahasildar/ Additional Tahasildar of Government of Odisha;

**NOTE-3:** Post Graduate Degree Certificate, Caste Certificate, Odia Test Pass Certificate, Release Certificate of Ex-Servicemen [issued as per Orissa Ex-Servicemen (Recruitment to State Civil Services and Posts) Rules, 1985 vide GA Deptt. Notification No. 22586/Gen, dt. 16.10.1985] and Disability Certificate of Persons with Disabilities (indicating % of permanent disability) must have been issued by the competent authority within the last date fixed for submission of online application form.

11. **GROUND OF REJECTION OF APPLICATION:**

Applications of candidates will be rejected by the Commission on any of the following grounds:-

- (a) In-complete online application form.
- (b) Non-submission of hard copy of online application form at the time of verification of original documents.
- (c) Not signing Declaration (full signature) in the hard copy of online application form.
- (d) Not coming within the age limit as mentioned in Para - 3 of Advertisement (Overage relaxation shall not be allowed to P.W.D. candidates with less than 40% permanent disability/ temporary disability).
- (e) Not having requisite qualification as provided under Para - 4 of Advertisement.
- (f) Not furnishing copies of certificates/documents as provided under Para - 10 of Advertisement.
- (g) Not passing Odia test (M.E. standard) /not furnishing Odia test pass certificate/ evidence as prescribed under Para-8 (ii) of the advertisement.
- (h) Submission of wrong information/ false information about qualification/ Age/ O.T. Pass evidence/ Category status (SEBC/ SC/ ST/ Women/ Ex-Servicemen/ PWD) etc.
- (i) Suppression of facts / information about eligibility, if any.
- (j) Any other ground as per the decision of the Commission.

**NB: Application /candidature of a candidate shall be rejected at any stage of recruitment process whenever discrepancy is noticed/ detected.**

12. **HOW TO APPLY:**

- (a) Candidates must go through the details of this Advertisement available in the Website of OPSC before filling up online application form.
- (b) Candidates must apply online through the concerned Website of the OPSC at <http://opsc.gov.in>. Applications received through **any other mode** would not be accepted and summarily rejected.
- (c) **Before filling up the online application form, the candidates must go through detailed instructions available at OPSC portal.**
- (d) The online application form is automated, and system driven and will guide the candidate seamlessly in filling the application. The requisite options shall be enabled, and information shall be asked as per data furnished by the candidate. Before filling up the information, ensure that accurate information is fed, for edit option is limited & on confirmation there is no scope for further edit even if wrongful entry has been made while filling up application.
- (e) Candidates are requested to upload the scanned image of latest passport size photograph along with scanned image of his/her full signature and scanned image of Left-hand Thumb Impression (LTI) in the online application form. Uploaded photograph, Specimen (full) signature and LTI must be clearly identifiable / visible, otherwise the application of the candidate is liable to be rejected by the Commission and no representation from the candidate will be entertained.

**P.T.O.**

- (f) Candidates should keep at least two copies of latest passport size photograph which is uploaded to the online application form for future use.
- (g) On successful submission of the online Registration, a unique "Permanent Public Service Account Number (PPSAN)" will be assigned to the applicant. Candidates are required to take a printout of the finally submitted online Registration and finally submitted Online Application forms and put his/ her signature under the declaration for submission to OPSC along with copies of requisite certificate & documents as and when asked.
- (h) The candidates are advised to submit the Online Application Form well in advance without waiting for the closing date to avoid last hour rush.
- (i) Certificate of Admission to the written examination to the eligible candidates will be uploaded in the Website of the OPSC prior to the date of written examination which will be published in the Website of the Commission and Newspapers. The candidates are required to download their Admission Certificate from the Website of the Commission and produce the same at the Examination centre for admission to the written examination. No separate correspondence will be made on this score.
- (j) Notice to candidates for Written Examination/ Document Verification/ Viva Voce Test and "Attestation form"/ "Bio-Data form" shall be uploaded in the website of OPSC prior to the date of Written Examination/ Document Verification/ Viva Voce Test.
- (k) Any complaint on the conduct of examination must be sent to the Grievance Wing of the Commission by e-Mail ([opsc@nic.in](mailto:opsc@nic.in)) within 07 (Seven) days of completion of the examination.

**13. FACILITATION COUNTER:**

To resolve any technical problem faced in filling up online Registration and Application forms, candidate may contact OPSC Technical Support over Telephone No. 0671-2304707 between 10.30 A.M. to 1.30 P.M. & 2.00 P.M. to 5.30 P.M. on any Odisha Government working days.

In case of any guidance/information on this advertisement & recruitment, candidates may go through the FAQ available in the website of the Commission or contact the O.P.S.C. Facilitation Counter over Telephone No. 0671-2304141/ 2305611 & Extn. - 205 on any working day between 10.30 A.M. to 01.30 P.M. & 02.00 P.M. to 5.30 P.M.

The candidates are required to visit the website of the Commission at <https://opsc.gov.in> for detailed information about important notices, rejection of applications, the date & time of Written Examination/Document Verification/ Viva Voce Test and also keep track of publication of various notices to the effect in the leading local daily newspapers for information.

**CLOSING DATES**

- 1. ONLINE REGISTRATION AND SUBMISSION OF ONLINE REGISTERED APPLICATIONS CAN BE DONE IN THE WEBSITE FROM 12.02.2024 TO TILL 16.03.2024 (11:59 P.M).**
- 2. ONLY ONLINE APPLICATIONS RECEIVED WITHIN THE DEADLINE I.E., 16.03.2024 SHALL BE ACCEPTED.**

**NB: - THE ONLINE APPLICATIONS, IF FOUND DEFECTIVE IN ANY RESPECT IS LIABLE TO BE SUMMARILY REJECTED.**

**CUTTACK  
DATE – 02.02.2024**

  
**SECRETARY  
ODISHA PUBLIC SERVICE COMMISSION  
CUTTACK**

**SYLLABUS FOR WRITTEN EXAMINATION OF ASSISTANT CHEMIST****PAPER – I (ORGANIC AND ANALYTICAL CHEMISTRY)****Full Marks - 100****Unit -I: Basic Concepts of organic chemistry & Stereochemistry**

- a) Electronic Displacements: Inductive, electrometric, resonance and mesomeric effects, hyperconjugation and their applications; Dipole moment; Organic acids and bases; their relative strength. Electrophiles and Nucleophiles; Nucleophilicity and basicity; Types, shape, and relative stability of carbocations, carbanions, free radicals and carbenes.

Aromaticity: Hückel's rule, aromatic character of arenes, cyclic carbocations/carbanions and heterocyclic compounds with suitable examples. Different types of substitutions ( $SN^1$ ,  $SN^2$ ,  $SN^i$ ,  $SN^1CB$ ), Elimination and free radical reaction. Name reactions (Aldol and Benzoin condensation, Knoevenagel condensation, Perkin, Cannizzaro and Wittig reaction, Claisen condensation, Dieckmann and Reformatsky reactions)

**b) Stereochemistry**

Fischer Projection, Newmann and Sawhorse Projection formulae; Geometrical isomerism: cis–trans and syn-anti isomerism E/Z notations with C.I.P rules.

Optical Isomerism: Optical Activity, Specific Rotation, Chirality/Asymmetry, Enantiomers, Molecules with one and two chiral-centres, Distereoisomers, meso-structures, Racemic mixture and resolution, inversion. Relative and absolute configuration: D/L and R/S designations.

Types of cycloalkanes and their relative stability, Baeyer strain theory, Conformational analysis of alkanes (ethane and n-butane): Relative stability with energy diagrams. Energy diagrams of cyclohexane: Chair, Boat, and Twist boat forms.

**Unit -II: Introduction to analytical chemistry and data processing**

Role of analytical chemistry, classification of analytical methods, types of instrumental analysis - Errors of analysis, classification, source and minimization of errors, absolute and relative errors, accuracy and precision, significant figures, mean value and deviation, average and standard deviation, median value, range, confidence intervals. Sampling in analysis. Definition, theory of sampling, technique of sampling, statistical criteria of good sampling, stratified sampling, transmission, and storage of samples.

**Unit – III : Analysis of Soil and Water**

Analysis of Soil: Sampling, Carbonate, Organic carbon, and organic matter, Total nitrogen, ammonia and nitrates, Total determination of major soil constituents by fusion analysis, silica and total combined oxides of iron, aluminium, and titanium, Determination Ca, Mg, Na, K, phosphate, boron, Co, Cu, Zn, Exchangeable cations, Cation exchange capacity, chemical analysis as a measure of soil fertility.

Analysis of Water: Sources of water, classification of water for different uses, types of water pollutants and their effects, Analytical methods for the determination of ions in water:  $CO_3^{2-}$ ,  $HCO_3^-$ ,  $F^-$ ,  $Cl^-$ ,  $SO_4^{2-}$ ,  $PO_4^{3-}$ ,  $NO_3^-$ . Analytical methods for the determination of cations in water:  $Fe^{2+}$ ,  $Fe^{3+}$ ,  $Ca^{2+}$ ,  $Mg^{2+}$ ,  $Cr^{3+}$ ,  $As^{5+}$ ,  $Pb^{2+}$ ,  $Hg^{2+}$ ,  $Cu^{2+}$ ,  $Zn^{2+}$ ,  $Cd^{2+}$ ,  $Co^{2+}$ . Determination of Dissolved oxygen (D.O), Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD), standards for drinking water.



**Unit – IV : Analytical Methods**

- a) Solvent Extraction and Ion exchange: Principles, classification of extraction, mechanism of extraction, extraction equilibria, techniques of extraction, application in analytical chemistry. Ion exchange: Type of ion exchange resins, synthesis and characteristics of ion exchange resins, action of ion exchange resins, ion exchange equilibria, technique of ion exchange, application of ion exchange in analytical chemistry.

Fundamentals of Spectroscopy : Instrumentation, Theory and Applications of IR, NMR (Proton & Carbon 13), Mass & Raman Spectroscopy.

Chromatographic methods: Basic principles and applications of chromatographic techniques (Paper, TLC, Ion exchange, HPLC, GLC).

Spectroscopic methods: atomic adsorption Spectroscopy - Principles and applications of AAS in chemical analysis. Flame photometric methods – Principles, interface in flame photometry, application in quantitative analysis. Nephelometric method- Principle and applications in analysis.

- b) X-ray diffraction method: Weiss indices, Miller indices, Laue method, Bragg's law, and applications in determination of crystal structure.

Electron spin resonance: Principles, zero field splitting and Kramer's degeneracy, factors affecting the g value, hyperfine splitting, and applications to sample radicals.

Thermal analytical methods: Thermogravimetric analysis (TGA), Derivative Thermogravimetric analysis (DTG), Applications of thermogravimetry. Differential Thermal Analysis (DTA)- Applications of differential thermal analysis in simultaneous TG-DTA curves, CD, CV, Polarography.

**Unit – V : Analysis of Ore**

General techniques of analysis applied to complex materials- Scope of metallurgical analysis - General methods of dissolution of complex materials -Various chemical methods for the effective separation of the constituents in the complex materials. Analysis of ores: Iron ore- Analysis of the Constituents – Moisture , loss of ignition, Total Iron, ferrous Iron ,Ferric Iron, alumina , silica, Titania, Lime, Magnesia, Sulphur, phosphorus, manganese, alkalis, combined water, Carbon in blast furnace, flue dust and sinter. Manganese Ore - Analysis of the Constituents – Total Manganese,  $MnO_2$ ,  $SiO_2$ ,  $BaO$ ,  $Fe_2O_3$ ,  $Al_2O_3$ ,  $CaO$ , P and S Chromite Ore - Analysis of the Constituents – Chromium,  $SiO_2$ ,  $FeO$ ,  $Al_2O_3$ ,  $CaO$ , &  $MgO$ . Aluminium Ore (Bauxite) - Analysis of the Constituents – Silica, Alumina,  $Fe_2O_3$ , Titania,  $MnO$ ,  $P_2O_5$ ,  $CaO$ ,  $MgO$ , vanadium, zirconium, and alkalis.

## Paper-II (Physical & Inorganic Chemistry)

Full Marks - 100

### Unit-I (Energetics)

a) **Thermodynamics:** Laws of thermodynamics, thermodynamic functions, standard states for gases, liquids and solids, internal energy, enthalpy, entropy and free energy and calculations between them. Activity, fugacity and mean activity coefficients, Debye-Huckel Limiting Law, thermodynamics of Mixing and Mixtures of Volatile Liquids— ideal and Real Solutions and Activity-Excess Functions for non-ideal solutions.. Non-equilibrium thermodynamics.

b) **Photochemistry & Chemical Dynamics:**

Characteristics of electromagnetic radiation, Lambert-Beer's law and its limitations, physical significance of absorption coefficients. Laws, of photochemistry, quantum yield, actinometry, examples of low and high quantum yields, photochemical equilibrium and the differential rate of photochemical reactions, photosensitised reactions, quenching. Role of photochemical reactions in biochemical processes, photostationary states, chemiluminescence.

Empirical rate laws, Theories of reaction rate, Determination of reaction mechanism, Reaction in solutions, catalytic reaction kinetics, Techniques for fast kinetics viz, flow method, relaxation method, flash photolysis , NMR method.

### Unit – II : Electrochemistry & Solid state Chemistry

a) Electromotive force of a cell and its measurement, Nernst equation; Standard electrode (reduction) potential and its application to different kinds of half-cells. Application of EMF, determination of activity coefficients and transference numbers. Debye-Huckel–Onsager treatment and its extension, ion solvent interactions. Debye-Huckel-Bjerrum model. Solution of Strong electrolytes. Debye-Huckel theory for activity coefficient of electrolytic solutions; determination of activity and activity coefficients; ionic strength.

Thermodynamics of electrified interface equations. Derivation of electro-capillarity, Lippmann equations (surface excess), methods of determination. Structure of electrified interfaces, Helmholtz-Perrin, Guoy–Chapman, Stern models.

Over potentials, exchange current density, derivation of Butler– Volmer equation, Tafel plot. Introduction to corrosion, homogenous theory, forms of corrosion, corrosion monitoring and prevention methods.

b) Nature of the solid state, law of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry, symmetry elements and symmetry operations, qualitative idea of point and space groups, seven crystal systems and fourteen Bravais lattices; X-ray diffraction, Bragg's law, a simple account of rotating crystal method and powder pattern method. Analysis of powder diffraction patterns of NaCl, CsCl and KCl.. Defects in crystals. Electrical properties, Metals, insulators, semiconductors, super conductors, band theory of solids. Solid state reactions: Classification, brief account of the experimental methods of study of solid state reactions.

**Phase Diagram:** Phase behaviour of one and two component systems (solid-solid, solid-liquid, solid-vapour, liquid-liquid, liquid-vapour equilibrium). Ehrenfest classification of phase transitions.

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### Unit – III

#### a) **Symmetry and Group Theory**

Symmetry elements and Symmetry operation, Groups and Subgroups, Symmetry point group. Schonflies symbols, Matrix representations of groups. Character of a representation. The Great Orthogonality theorem (without proof) and its importance. Character tables and their uses. Derivation of character table for  $C_{2v}$ ,  $C_{3v}$ .

#### b) **Electronic Spectra of Transition Metal Complexes.**

Spectroscopic ground states, Orgel diagrams for  $d^1$ - $d^9$  states in  $O_h$  and  $T_d$  symmetry, Tanabe-Sugano diagrams for  $d^2$  configuration in  $O_h$  and  $T_d$  symmetry. Calculations of  $Dq$ ,  $B$  and  $\beta$  parameters.

### Unit – IV

#### a) **Metal-Ligand Bonding**

Crystal-Field Theories:

Limitation of Crystal Field Theory, Molecular orbital theory for Octahedral, Tetrahedral and Square Planar Complexes,  $\sigma$  and  $\pi$  bonding in Molecular Orbital Theory. Application of MOT to Correlation diagrams.

#### b) **Chemistry of Transition & Inner Transition Elements**

Coordination chemistry of Transition Metal ions, Stabilization of Unusual oxidation states, Stereochemistry of coordination compounds, Splitting of d-orbitals in Low symmetry environment, Jahn-Teller effect, Interpretation of Electronic Spectra including Charge Transfer Spectra, Spectrochemical series, Nephelauxetic series, Fluxional molecules, Iso and Hetero Poly acids. Structures of Mixed Metal Oxides: Spinel & Inverse Spinel, Ilmenite and Perovskite structure, Coloured Minerals and Gem quality crystals. Chemistry of Lanthanides and Actinides: Oxidation state, Spectral and Magnetic Properties, Stereochemistry, Use of Lanthanide Compounds as Shift reagents, Actinide contraction, Oxidation states, Comparisons between Lanthanides and Actinides

### Unit – V

#### a) **Chemistry of Main Group elements A & B**

General characteristics, Allotropes, Structure and Reactions of simple and industrially important compounds: Boranes, Carboranes, Silicones, Silicates, Boron nitride, Borazines and Phosphazenes. Hydrides, Oxides and Oxoacids of pnictogens (N, P), chalcogens (S, Se & Te) and halogens, Xenon compounds, Pseudo halogens and Interhalogen compounds

#### b) **Environmental pollution and remedies**

Important aspects and control of Air Pollution and Noise Pollution, Treatment of solid and hazardous waste based on characterization, sanitation methods for protection of community health, Steps for sustainable development of green environment.