Dayananda Sagar University

Syllabus for Ph. D Entrance Test- 2025

PART B

I) Mathematics

Section 1: Linear Algebra

Finite dimensional vector spaces; Linear transformations and their matrix presentations, rank; systems of linear equations, Eigen values and Eigen vectors, minimal polynomial, Cayley-Hamilton Theorem, diagonalization, Jordan-canonical form, Hermitian, Skew-Hermitian and unitary matrices; Finite dimensional inner product spaces, Gram-Schmidt ortho-normalization process, self-adjoint operators, definite forms

Section 2: Complex Analysis

Analytic functions, conformal mappings, bilinear transformations; complex integration: Cauchys integral theorem and formula; Liouvilles theorem, maximum modulus principle; Zeros and singularities; Taylor and Laurents series; residue theorem and applications for evaluating real integrals.

Section 3: Real Analysis

Sequences and series of functions, uniform convergence, power series, Fourier series, functions of several variables, maxima, minima; Riemann integration, multiple integrals,line, surface and volume integrals, theorems of Green, Stokes and Gauss; metric spaces, compactness, completeness, Weierstrass approximation theorem; Lebesgue measure, measurable functions; Lebesgue integral, Fatouslema, dominated convergence theorem.

Section 4: Ordinary Differential Equations

First order ordinary differential equations, existence and uniqueness theorems for initial value problems, systems of linear first order ordinary differential equations, linear ordinary differential equations of higher order with constant coefficients; linear second order ordinary differential equations with variable coefficients; method of Laplace transforms for solving ordinary differential equations, series solutions (power series, Frobenius method); Legendre and Bessel functions and their orthogonal properties.

Section 5: Algebra

Groups, subgroups, normal subgroups, quotient groups and homomorphism theorems, automorphisms; cyclic groups and permutation groups, Sylows theorems and their applications; Rings, ideals, prime and maximal ideals, quotient rings, unique factorization

domains, Principle ideal domains, Euclidean domains, polynomial rings and irreducibility criteria; Fields, finite fields, field extensions.

II)Department of Chemistry

Syllabus for Ph. D Entrance Test in Chemistry

PART B

Section 1: In-organic Chemistry

1. Chemical Periodicity
2. Structure and bonding in homo and hetero nuclear molecules, including shapes of molecules (VSEPR Theory).
3. Concepts of acids and bases, Hard-Soft acid base concept, Non-aqueous solvents.
4. Main group elements and their compounds: Allotropy, synthesis, structure and bonding, industrial importance of the compounds.
5. Transition elements and coordination compounds: structure, bonding theories, spectral and magnetic properties, reaction mechanisms.
6. Inner transition elements: spectral and magnetic properties, redox chemistry, analytical applications.
7. Organometallic compounds: synthesis, bonding and structure, and reactivity. Organometallics in homogeneous catalysis.
8. Cages and metal clusters.
9. Analytical chemistry-separation, spectroscopic, electro-and thermos analytical methods.
10. Bioin-organic chemistry: photo systems, porphyrins, metalloenzymes, oxygen transport, electron-transfer reactions; nitrogen fixation, metal complexes in medicine.
11. Characterization of in-organic compounds by IR, Raman, NMR, EPR, Mossbauer, UV- vis, NQR, MS, electron spectroscopy and microscopic techniques.
12. Nuclear chemistry: nuclear reactions, fission and fusion, radio-analytical techniques and activation analysis.

Section 2: Physical Chemistry

1. Basic principles of quantum mechanics: Postulates; operator algebra; exactly-solvable systems: particle-in-a-box, harmonic oscillator and the hydrogen atom, including shapes of atomic orbitals; orbital and spin angular momenta; tunneling.
2. Approximate methods of Quantum mechanics: Variational principle; perturbation theory up to second order in energy; applications.
3. Atomic structure and spectroscopy; term symbols; many-electron systems and antisymmetric principle.
4. Chemical bonding in diatomic; elementary concepts of MO and VB theories; Huckel theory for conjugated –electron systems.
5. Chemical applications of group theory; symmetry elements; point groups; character tables; selection rules.

6. Molecular spectroscopy: Rotational and vibrational spectra of diatomic molecules; electronic spectra; IR and Raman activities– selection rules; basic principles of magnetic resonance.
7. Chemical thermos dynamics: Laws, state and path functions and their applications; thermodynamic description of various types of processes; Maxwell's relations; spontaneityandequilibria; temperature and pressure dependence of thermodynamic quantities; Le-Chatelier principle; elementary description of phase transitions; phase equilibria and phase rule; thermodynamics of idealandnon -idealgases, and solutions.
8. Statistical thermodynamics: Boltzmann distribution; kinetic theory of gases; partition functions and their relation to thermodynamic quantities– calculations for model systems.
9. Electrochemistry: Nernst equation, redox systems, electrochemical cells; Debye-Huckel theory; electrolytic conductance– Kohlrausch's law and its applications; ionic equilibria; conductometric and potentiometric titrations.
10. Chemical kinetics: Empirical rate laws and temperature dependence; complex reactions; steady state approximation; determination of reaction mechanisms; collision and transition state theories of rate constants; uni-molecular reactions; enzymekinetics; salt effects; homogeneous catalysis; photo chemical reactions.
11. Colloids and surfaces: Stability and properties of colloids; isotherms and surface area; heterogeneous catalysis.
12. Solid state Crystal structures; Bragg's law and applications; band structure of solids.
13. Polymer chemistry: Molar masses; kinetics of polymerization.
14. Data analysis: Mean and standard deviation; absolute and relative errors; linear regression; covariance and correlation coefficient.

Section 3: Organic Chemistry

1. IUPACnomenclatureoforganicmoleculesincludingregio-andstereoisomers.
2. Principles of stereochemistry: Configurational and conformational isomerism in acyclic and cyclic compounds; stereogenicity, stereoselectivity, enantio selectivity, diastereo selectivity and asymmetric induction.
3. Aromaticity: Benzenoid and non-benzenoid compounds–generation and reactions.
4. Organic reactive intermediates: Generation, stability and reactivity of carbocations, carbanions, free radicals, carbenes, benzynes and nitrenes.
5. Organic reaction mechanisms involving addition, elimination and substitution reactions with electrophilic, nucleophilic or radical species. Determination of reaction pathways.
6. Common named reactions and rearrangements – applications in organic synthesis.
7. Organic transformations and reagents: Functional group inter-conversion including oxidations and reductions; common catalysts and reagents (organic, inorganic, organometallic and enzymatic). Chemo, regio and stereo selective transformations.
8. Concepts in organic synthesis: Retrosynthesis, disconnection, synthons, linear and convergent synthesis, umpolung of reactivity and protecting groups.

9. Asymmetric synthesis: Chiral auxiliaries, methods of asymmetric induction – substrate, reagent and catalyst-controlled reactions; determination of enantiomeri and diastereomeric excess; enantio-discrimination. resolution–optical and kinetic.
10. Pericyclic reactions – electrocyclization, cyclo addition, sigmatropic rearrangements and other related concerted reactions. Principles and applications of photochemical reactions in organic chemistry.
11. Synthesis and reactivity of common heterocyclic compounds containing one or two heteroatoms (O, N, S).
12. Chemistry of natural products: Carbohydrates, proteins and peptides, fatty acids, nucleic acids, terpenes, steroids and alkaloids. Biogenesis of terpenoids and alkaloids.
13. Structure determination of organic compounds by IR, UV-Vis, 1H &^{13}C NMR and Mass spectroscopic techniques.

III) Department of Physics

Syllabus for Ph. D Entrance Test 2025

PART B

I. **Section 1: Mathematical Physics**

Linear vector space: basis, orthogonality and completeness; matrices; vector calculus;linear differential equations; elements of complex analysis: Cauchy Riemann conditions, Cauchy's theorems, singularities, residue theorem and applications; Laplace transforms, Fourier analysis; elementary ideas about tensors: covariant and contravariant tensor, Levi-Civita and Christoffel symbols.

II. **Section 2: Classical Mechanics**

D'Alembert's principle, cyclic coordinates, variational principle, Lagrange's equation of motion, central force and scattering problems, rigid body motion; small oscillations, Hamilton's formalisms; Poisson bracket; special theory of relativity: Lorentz transformations, relativistic kinematics, mass-energy equivalence.

III. **Section 3: Electromagnetic Theory**

Solutions of electrostatic and magnetostatic problems including boundary value problems; dielectrics and conductors; Maxwell's equations; scalar and vector potentials; Coulomb and Lorentz gauges; Electromagnetic waves and their reflection, refraction, interference, diffraction and polarization; Poynting vector, Poynting theorem, energy and momentum of electromagnetic waves; radiation from a moving charge.

IV. **Section 4: Quantum Mechanics**

Postulates of quantum mechanics; uncertainty principle; Schrodinger equation; one-, two- and three-dimensional potential problems; particle in a box, transmission throughone dimensional potential barrier, harmonic oscillator, hydrogen atom; linear vectors and operators in Hilbert space; angular momentum and spin; addition of angular momenta; time independent perturbation theory; elementary scattering theory.

V. **Section 5: Thermodynamics and Statistical Physics**

Laws of thermodynamics; macrostates and microstates; phase space; ensembles; partition function, free energy, calculation of thermodynamic quantities; classical and quantum statistics; degenerate Fermi gas; black body radiation and Planck's distribution law; Bose-Einstein condensation; first and second order phase transitions, phase equilibria, critical point.

VI. **Section 6: Atomic and Molecular Physics**

Spectra of one- and many-electron atoms; LS and jj coupling; hyperfine structure; Zeeman and Stark effects; electric dipole transitions and selection rules; rotational andvibrational spectra of diatomic molecules; electronic transition in diatomic molecules, Franck-Condon principle; Raman effect; NMR, ESR, X-ray spectra; lasers: Einstein

coefficients, population inversion, two and three level systems.

VII. Section 7: Solid State Physics & Electronics

Elements of crystallography; diffraction methods for structure determination; bonding in solids; lattice vibrations and thermal properties of solids; free electron theory; band theory of solids: nearly free electron and tight binding models; metals, semiconductorsand insulators; conductivity, mobility and effective mass; optical, dielectric and magnetic properties of solids; elements of superconductivity: Type-I and Type II superconductors, Meissner effect, London equation. Semiconductor devices: diodes, Bipolar Junction Transistors, Field Effect Transistors; operational amplifiers: negative feedback circuits, active filters and oscillators; regulated power supplies; basic digital logic circuits, sequential circuits, flip-flops, counters, registers, A/D and D/A conversion.

VIII. Section 8: Nuclear and Particle Physics

Nuclear radii and charge distributions, nuclear binding energy, Electric and magnetic moments; nuclear models, liquid drop model: semi-empirical mass formula, Fermi gas model of nucleus, nuclear shell model; nuclear force and two nucleon problem; alpha decay, beta-decay, electromagnetic transitions in nuclei; Rutherford scattering, nuclearreactions, conservation laws; fission and fusion; particle accelerators and detectors; elementary particles, photons, baryons, mesons and leptons; quark model.

Dayananda Sagar University

IV) Department of Literature

Syllabus for Ph. D Entrance Test 2025

PART B

Objectives:

1. To test the knowledge of the research scholar in the discipline of literature
2. To test the research scholar's ability to analyse and respond to a literary narrative
3. To test the research scholar's ability to critique and write an analysis

Unit 1: Histories

1. Al Beruni—Indica
2. Emile Eegous and Louis Cazamian -A history of English Literature
3. Radha Kumar – The History of Doing-An Illustrated History
4. Literary Critical Theory— Aristotle-Poetics; Rasa-Dhvani Theory;
   English Critical Tradition—John Dryden; Samuel Johnson; William Wordsworth& Samuel Coleridge; Mathew Arnold; F R Leavis; Cleanth Brooks; William Empson; T S Eliot
5. Popular Culture: Mathew Arnold-Culture and Anarchy; Raymond Williams-Popular Culture; Theodore Adono- Culture Industry; Walter Benjamin Art in the age of Mechanical Reproduction;

Unit 2: Literary Movements and Schools:

i. Renaissance
ii. Metaphysical Poetry- Ed by Helen Gardner
iii. Vachana and Bhakti Movements-Ed By A K Ramanujan
iv. Romantic Movement
v. Transcendentalism
vi. Modern and Post Modern

Unit 3: Gender Studies:

i. Concepts: Patriarchy; Androcentricism; Masculinities; Femininities; Matriarchy; Body; Queer Theory; Three Waves of Feminisms
ii. Literary Texts: Charlotte Perkins Gilman-the Yellow Wallpaper; Kate Chopin-The Story of an Hour; Vaidehi-Akku; Sadat Hassan Manto- Khol do; Vasudhendra- Mohanswamy;
A. Revathi-The Truth About Me; Visual Text: Naanu Avanalla, Avalu
iii. Theories of Gender: Body Studies: Betty Friedan -The Feminine Mystique; Michelle Foucault-History of Sexuality; R. W. Connell Hegemonic Masculinity -Rethinking the concept;

Unit 4: Post-colonial Studies:

i. Concepts: Nation; Contrapuntal Reading; Aboriginal/indigenous people; agency; decolonization; exotic; hegemony; marginality; orality; Orient and Occident
ii. Edward Said *Orientalism*; Frantz Fanon *Black Skin, White Masks* and Gayathri Spivak: *Can the Subaltern Speak?*

iii. Meenakshi Muherjee: The Perishable Empire Ngugi Wa thiong'O- On the Abolition of the English Department; Something Torn & New African Renaissance
iv. Literary Texts: Chinua Achebe- Things Fall Apart; Arvind Adiga-The White Tiger; George Orwell-Shooting an Elephant; Chimamnda Adichi- We Should all be Feminists;
Visual Text: Invictus

Unit 5: English language

Basic concepts in Linguistics

- Core Linguistics - Phonetics and Phonology, Morphology, syntax, Semantics & Pragmatics
- Historical Linguistics - Synchronic and diachronic approaches to language; language classification-Notion of language family, Criteria for identifying family relationships among languages-Language Families-Language Contact and Dialect Geography : Linguistic borrowing—lexical and structural; motivations— Prestige and need-filling (including culture-based) Loan words- translation, loan blend, assimilated and unassimilated loans (tadbhava and tatsama); Bilingualism as the source for borrowing; dialect, idiolect; register- Isogloss
- Sociolinguistics - Language, culture and society-Speech community- linguistic and communicative competence- Ethnography of speaking- socio-linguistic variables; patterns of variation; regional, social and stylistic. Languages in Contact: Bilingualism and Multilingualism - language maintenance and shift. Sociology of Language: Language standardization and modernization- language and Status, Intimacy, Gender and power - Literacy -
- Applied Linguistics- Discourse Analysis; First and second language learning; language acquisition in multilingual settings; Theories of language learning; social and psychological aspects of second language acquisition; methods, materials and teaching-aids in language teaching; Computer Assisted Language Teaching (CALT) Translation: Paraphrase, translation and transcreation; translation of literary text and technical text; translation loss; problems of translation

Unit 6

Basic Concepts in English language Teaching

- Foundations of Language and Linguistics in ELT

Key- linguistic concepts relevant to ELT- Language variations and dialects in India. Language Acquisition and Language learning- Behaviourist, , Cognitive, and socio-cultural perspectives- Implications for language teaching methodologies

- Pedagogical Approaches and Methodologies in ELT

Communicative Language Teaching (CLT)- Task-based Language Teaching (TBLT)- Technology in Language Teaching, Computer-Assisted Language Learning (CALL)

- Language Assessment and Evaluation in ELT

Reliability and validity in language assessment- Addressing cultural and linguistic biases in testing

- Feedback and Remediation

Providing effective feedback to learners-Designing remedial interventions for learner, Digital literacy and ethical considerations

References:

1. Wimsatt W.K. and Cleanth Brooks- Literary criticism: A Short History.
2. Jonathan Culler- Literary Theory: A Very Short Introduction
3. Terry Eagleton-Literary Theory.
4. Cleanth Brookes: “The Language of Paradox”
5. Peter Barry-The Beginning Theory
6. 50 Key Concepts in Gender Studies-Sage Publication
7. Key concepts in Postcolonial Studies- Bill Ashcroft. Gareth Griffiths and Helen Tiffin
8. Uma chakravarthy—whatever happened to the vedic dasi?
9. Kumkum Roy—The Power of Gender and The Gender of Power
10. Lance Eaton-What is popular Culture https://www.youtube.com/watch?v=DZtcv6XedgQ
11. Chandra Mukerji & Michael Schudson-Rethinking Popular Culture Contemporary perspectives in Cultural Studies
12. Barbara D Metcalf-A Concise history of India. Cambridge University Press.
13. The Routledge History Literature in English Britain and Ireland. Ed by Ronald Carter and John Mc Rae.
https://literaturecurry.com/uploads/pdfnotes/7b6285c3-71be-46d0-ba44-2076b869409a_The%20Routledge%20History%20of%20English%20Literature.pdf
14. Boris Ford (Ed)- Pelican Guide to English Literature
15. Hiryanna: Art Experience: Indian Aesthetics
16. George Yule: The Study of Language
17. Peter Trudgill: Sociolinguistics: An Introduction to Language and Society
18. S. K. Verma and N. Krishnaswamy: Modern Linguistics
19. Adrian Akmajain, et al. Linguistics: An Introduction to Language and Communication
Graham Hough: Style and Stylistics
20. Chomsky, N. (2002). Syntactic structures. Walter de Gruyter.
21. Fromkin, V., Rodman, R., & Hyams, N. (2013). An introduction to language (10th ed.)..
22. Levinson, S. C. (1983). Pragmatics. Cambridge University Press.
23. O'Grady, W., Archibald, J., Aron off, M., & Rees-Miller, J. (2011). Contemporary linguistics: An introduction (6th ed.). Bedford/St. Martin's.
24. Wardhaugh, R. (2010). An introduction to sociolinguistics. Wiley-Blackwell.
25. Brown, H. D. (2007). Principles of language learning and teaching (5th ed.). Pearson Education.
26. Kumaravadivelu, B. (2006). Understanding language teaching: From method to post method. Routledge.
27. Larsen-Freeman, D., & Anderson, M. (2011). Techniques and principles in language teaching (3rd ed.). Oxford University Press.
28. Nunan, D. (2004). Task-based language teaching. Cambridge University Press.
29. Richards, J. C., & Rodgers, T. S. (2001). Approaches and methods in language teaching (2nd ed.). Cambridge University Press.