

**BACHELOR OF SCIENCE BACHELOR OF EDUCATION (ZBC) – FOURTH SEMESTER**

Fourth Semester			
S. No.	Name of Subject	Credits	Total Marks
1	Transition Metal & Coordination Chemistry, States of Matter & Chemical Kinetics	4	100
2	Transition Metal & Coordination Chemistry, States of Matter & Chemical Kinetics Lab	3	100
3	Plant Physiology and Metabolism	4	100
4	Plant Physiology and Metabolism Lab	3	100
5	Genetics and Evolutionary Biology	4	100
6	Genetics and Evolutionary Biology Lab	3	100
7	Biofertilizers	3	100
8	Understanding Disciplines and Subjects	4	100
9	Learning and Teaching	4	100
<b>Total</b>		<b>32</b>	

**Subject Name:** TRANSITION METAL & COORDINATION CHEMISTRY, STATES OF MATTER & CHEMICAL KINETICS

**Section A: Inorganic Chemistry**

**Transition Elements (3d series)**

General group trends with special reference to electronic configuration, variable valency, colour, magnetic and catalytic properties, ability to form complexes and stability of various oxidation states (Latimer diagrams) for Mn, Fe and Cu.

Lanthanoids and actinoids: Electronic configurations, oxidation states, colour, magnetic properties, lanthanide contraction, separation of lanthanides (ion exchange method only).

**Coordination Chemistry**

Valence Bond Theory (VBT): Inner and outer orbital complexes of Cr, Fe, Co, Ni and Cu (coordination numbers 4 and 6). Structural and stereoisomerism in complexes with coordination numbers 4 and 6.

Drawbacks of VBT. IUPAC system of nomenclature.

**Crystal Field Theory**

Crystal field effect, octahedral symmetry. Crystal field stabilization energy (CFSE), Crystal field effects for weak and strong fields. Tetrahedral symmetry. Factors affecting the magnitude of D. Spectrochemical series. Comparison of CFSE for Oh and Td complexes, Tetragonal distortion of octahedral geometry.

Jahn-Teller distortion, Square planar coordination.

## ***Section B: Physical Chemistry***

### **Kinetic Theory of Gases**

Postulates of Kinetic Theory of Gases and derivation of the kinetic gas equation.

Deviation of real gases from ideal behaviour, compressibility factor, causes of deviation. van der Waals equation of state for real gases. Boyle temperature (derivation not required). Critical phenomena, critical constants and their calculation from van der Waals equation. Andrews isotherms of CO<sub>2</sub>.

Maxwell Boltzmann distribution laws of molecular velocities and molecular energies (graphic representation – derivation not required) and their importance.

Temperature dependence of these distributions. Most probable, average and root mean square velocities (no derivation). Collision cross section, collision number, collision frequency, collision diameter and mean free path of molecules. Viscosity of gases and effect of temperature and pressure on coefficient of viscosity (qualitative treatment only).

### **Liquids**

Surface tension and its determination using stalagmometer. Viscosity of a liquid and determination of coefficient of viscosity using Ostwald viscometer. Effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment only).

### **Solids**

Forms of solids. Symmetry elements, unit cells, crystal systems, Bravais lattice types and identification of lattice planes. Laws of Crystallography - Law of constancy of interfacial angles, Law of rational indices. Miller indices. X-Ray diffraction by crystals, Bragg's law. Structures of NaCl, KCl and CsCl (qualitative treatment only). Defects in crystals. Glasses and liquid crystals.

### **Chemical Kinetics**

The concept of reaction rates. Effect of temperature, pressure, catalyst and other factors on reaction rates. Order and molecularity of a reaction. Derivation of integrated rate equations for zero, first and second order reactions (both for equal and unequal concentrations of reactants). Half-life of a reaction. General methods for determination of order of a reaction. Concept of activation energy and its calculation from Arrhenius equation.

Theories of Reaction Rates: Collision theory and Activated Complex theory of bimolecular reactions. Comparison of the two theories (qualitative treatment only).

### **Reference Books:**

- Barrow, G.M. Physical Chemistry Tata McGraw-Hill (2007).
- Castellan, G.W. Physical Chemistry 4th Ed. Narosa (2004).
- Kotz, J.C., Treichel, P.M. & Townsend, J.R. General Chemistry Cengage Learning India Pvt. Ltd., New Delhi (2009).
- Mahan, B.H. University Chemistry 3rd Ed. Narosa (1998).
- Petrucci, R.H. General Chemistry 5th Ed. Macmillan Publishing Co.: New York (1985).
- Cotton, F.A. & Wilkinson, G. Basic Inorganic Chemistry, Wiley.
- Shriver, D.F. & Atkins, P.W. Inorganic Chemistry, Oxford University Press.
- Wulfsberg, G. Inorganic Chemistry, Viva Books Pvt. Ltd.
- Rodgers, G.E. Inorganic & Solid State Chemistry, Cengage Learning India Ltd., 2008.

**Subject Name:** TRANSITION METAL & COORDINATION CHEMISTRY, STATES OF MATTER & CHEMICAL KINETICS-LAB

**Section A: Inorganic Chemistry**

Semi-micro qualitative analysis (using H<sub>2</sub>S or other methods) of mixtures - not more than four ionic species (two anions and two cations, excluding insoluble salts) out of the following:

Cations : NH<sub>4</sub><sup>+</sup>, Pb<sup>2+</sup>, Bi<sup>3+</sup>, Cu<sup>2+</sup>, Cd<sup>2+</sup>, Fe<sup>3+</sup>, Al<sup>3+</sup>, Co<sup>2+</sup>, Ni<sup>2+</sup>, Mn<sup>2+</sup>, Zn<sup>2+</sup>, Ba<sup>2+</sup>, Sr<sup>2+</sup>, Ca<sup>2+</sup>, K<sup>+</sup>

Anions : CO<sub>3</sub><sup>2-</sup>, S<sup>2-</sup>, SO<sub>3</sub><sup>2-</sup>, S<sub>2</sub>O<sub>3</sub><sup>2-</sup>, NO<sub>3</sub><sup>-</sup>, CH<sub>3</sub>COO<sup>-</sup>, Cl<sup>-</sup>, Br<sup>-</sup>, I<sup>-</sup>, NO<sub>2</sub><sup>-</sup>, SO<sub>4</sub><sup>2-</sup>, PO<sub>4</sub><sup>3-</sup>, BO<sub>3</sub><sup>3-</sup>, C<sub>2</sub>O<sub>4</sub><sup>2-</sup>, F<sup>-</sup>

(Spot tests should be carried out wherever feasible)

1. Estimate the amount of nickel present in a given solution as bis(dimethylglyoximate) nickel(II) or aluminium as oximate in a given solution gravimetrically.
2. Estimation of (i) Mg<sup>2+</sup> or (ii) Zn<sup>2+</sup> by complexometric titrations using EDTA.
3. Estimation of total hardness of a given sample of water by complexometric titration.

**Section B: Physical Chemistry**

(I) Surface tension measurement (use of organic solvents excluded).

- a) Determination of the surface tension of a liquid or a dilute solution using a stalagmometer.
- b) Study of the variation of surface tension of a detergent solution with concentration.

(II) Viscosity measurement (use of organic solvents excluded).

- a) Determination of the relative and absolute viscosity of a liquid or dilute solution using an Ostwald's viscometer.
- b) Study of the variation of viscosity of an aqueous solution with concentration of solute.

(III) Chemical Kinetics

Study the kinetics of the following reactions.

1. Initial rate method: Iodide-persulphate reaction
2. Integrated rate method:
  - a. Acid hydrolysis of methyl acetate with hydrochloric acid.
  - b. Saponification of ethyl acetate.
  - c. Compare the strengths of HCl and H<sub>2</sub>SO<sub>4</sub> by studying kinetics of hydrolysis of methyl acetate

**Reference Books:**

- Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education, 2012.
- Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009.
- Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).

**Subject Name:** PLANT PHYSIOLOGY AND METABOLISM

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**Subject Name:** PLANT PHYSIOLOGY AND METABOLISM LAB

### **Unit 1: Plant-water relations**

Importance of water, water potential and its components; Transpiration and its significance; Factors affecting transpiration; Root pressure and guttation.

### **Unit 2: Mineral nutrition**

Essential elements, macro and micronutrients; Criteria of essentiality of elements; Role of essential elements; Transport of ions across cell membrane, active and passive transport, carriers, channels and pumps.

### **Unit 3: Translocation in phloem**

Composition of phloem sap, girdling experiment; Pressure flow model; Phloem loading and unloading

### **Unit 4: Photosynthesis**

Photosynthetic Pigments (Chl a, b, xanthophylls, carotene); Photosystem I and II, reaction center, antenna molecules; Electron transport and mechanism of ATP synthesis; C3, C4 and CAM pathways of carbon fixation; Photorespiration.

### **Unit 5: Respiration**

Glycolysis, anaerobic respiration, TCA cycle; Oxidative phosphorylation, Glyoxylate, Oxidative Pentose Phosphate Pathway.

### **Unit 6: Enzymes**

Structure and properties; Mechanism of enzyme catalysis and enzyme inhibition.

### **Unit 7: Nitrogen metabolism**

Biological nitrogen fixation; Nitrate and ammonia assimilation.

### **Unit 8: Plant growth regulators**

Discovery and physiological roles of auxins, gibberellins, cytokinins, ABA, ethylene.

### **Unit 9: Plant response to light and temperature**

Photoperiodism (SDP, LDP, Day neutral plants); Phytochrome (discovery and structure), red and far red light responses on photomorphogenesis; Vernalization.

### **Practical**

1. Determination of osmotic potential of plant cell sap by plasmolytic method.
2. To study the effect of two environmental factors (light and wind) on transpiration by excised twig.
3. Calculation of stomatal index and stomatal frequency of a mesophyte and a xerophyte.
4. Demonstration of Hill reaction.
5. Demonstrate the activity of catalase and study the effect of pH and enzyme concentration.
6. To study the effect of light intensity and bicarbonate concentration on O<sub>2</sub> evolution in photosynthesis.
7. Comparison of the rate of respiration in any two parts of a plant.
8. Separation of amino acids by paper chromatography.

### **Suggested Readings**

1. Taiz, L., Zeiger, E., Møller, I.M. and Murphy, A (2015). Plant Physiology and Development. Sinauer Associates Inc. USA. 6th edition.
2. Hopkins, W.G., Huner, N.P., (2009). Introduction to Plant Physiology. John Wiley & Sons, U.S.A. 4th Edition.
3. Bajracharya, D., (1999). Experiments in Plant Physiology- A Laboratory Manual. Narosa Publishing House, New Delhi.

**Subject Name:** GENETICS AND EVOLUTIONARY BIOLOGY

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**Subject Name:** GENETICS AND EVOLUTIONARY BIOLOGY LAB

**Unit 1: Introduction to Genetics**

Mendel's work on transmission of traits, Genetic Variation, Molecular basis of Genetic Information

**Unit 2: Mendelian Genetics and its Extension**

Principles of Inheritance, Chromosome theory of inheritance, Incomplete dominance and codominance, Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, sex linked inheritance, extra-chromosomal inheritance

**Unit 3: Linkage, Crossing Over and Chromosomal Mapping**

Linkage and crossing over, Recombination frequency as a measure of linkage intensity, two factor and three factor crosses, Interference and coincidence, Somatic cell genetics - an alternative approach to gene mapping

**Unit 4: Mutations**

Chromosomal Mutations: Deletion, Duplication, Inversion, Translocation, Aneuploidy and Polyploidy; Gene mutations: Induced versus Spontaneous mutations, Back versus Suppressor mutations,

**Unit 5: Sex Determination**

Chromosomal mechanisms, dosage compensation

**Unit 6: History of Life**

Major Events in History of Life

**Unit 7: Introduction to Evolutionary Theories**

Lamarckism, Darwinism, Neo-Darwinism

**Unit 8: Direct Evidences of Evolution**

Types of fossils, Incompleteness of fossil record, Dating of fossils, Phylogeny of horse

**Unit 9: Processes of Evolutionary Change**

Organic variations; Isolating Mechanisms; Natural selection (Example: Industrial melanism); Types of natural selection (Directional, Stabilizing, Disruptive), Artificial selection

**Unit 10: Species Concept**

Biological species concept (Advantages and Limitations); Modes of speciation (Allopatric, Sympatric) CBCS Undergraduate Program in Zoology 2015

### **Unit 11: Macro-evolution**

Macro-evolutionary Principles (example: Darwin's Finches)

### **Unit 12: Extinction**

Mass extinction (Causes, Names of five major extinctions, K-T extinction in detail), Role of extinction in evolution

### **PRACTICAL**

1. Study of Mendelian Inheritance and gene interactions (Non Mendelian Inheritance) using suitable examples. Verify the results using Chi-square test.
2. Study of Linkage, recombination, gene mapping using the data.
3. Study of Human Karyotypes (normal and abnormal).
4. Study of fossil evidences from plaster cast models and pictures
5. Study of homology and analogy from suitable specimens/ pictures
6. Charts: a) Phylogeny of horse with diagrams/ cut outs of limbs and teeth of horse ancestors b) Darwin's Finches with diagrams/ cut outs of beaks of different species
7. Visit to Natural History Museum and submission of report

### **SUGGESTED READINGS**

- Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). Principles of Genetics. VIII Edition. Wiley India.
- Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc.
- Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). Concepts of Genetics. X Edition. Benjamin Cummings.
- Russell, P. J. (2009). Genetics- A Molecular Approach. III Edition. Benjamin Cummings.
- Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. Introduction to Genetic Analysis. IX Edition. W. H. Freeman and Co.
- Ridley, M. (2004). Evolution. III Edition. Blackwell Publishing
- Barton, N. H., Briggs, D. E. G., Eisen, J. A., Goldstein, D. B. and Patel, N. H. (2007). Evolution. Cold Spring, Harbour Laboratory Press.
- Hall, B. K. and Hallgrimsson, B. (2008). Evolution. IV Edition. Jones and Bartlett Publishers
- Campbell, N. A. and Reece J. B. (2011). Biology. IX Edition, Pearson, Benjamin, Cummings.
- Douglas, J. Futuyma (1997). Evolutionary Biology. Sinauer Associates.

### **Subject Name: BIOFERTILIZERS**

**Unit 1:** General account about the microbes used as biofertilizer – Rhizobium – isolation, identification, mass multiplication, carrier based inoculants, Actinorrhizal symbiosis.

**Unit 2: Azospirillum:** isolation and mass multiplication – carrier based inoculant, associative effect of different microorganisms. Azotobacter: classification, characteristics – crop response to Azotobacter inoculum, maintenance and mass multiplication.

**Unit 3:** Cyanobacteria (blue green algae), Azolla and Anabaena azollae association, nitrogen fixation, factors affecting growth, blue green algae and Azolla in rice cultivation.

**Unit 4:** Mycorrhizal association, types of mycorrhizal association, taxonomy, occurrence and distribution, phosphorus nutrition, growth and yield – colonization of VAM – isolation and inoculum production of VAM, and its influence on growth and yield of crop plants.

**Unit 5:** Organic farming – Green manuring and organic fertilizers, Recycling of biodegradable municipal, agricultural and Industrial wastes – biocompost making methods, types and method of vermicomposting – field Application.

### **Suggested Readings**

1. Dubey, R.C., 2005 A Text book of Biotechnology S.Chand & Co, New Delhi.
2. Kumaresan, V. 2005, Biotechnology, Saras Publications, New Delhi.
3. John Jothi Prakash, E. 2004. Outlines of Plant Biotechnology. Emkay -Publication, New Delhi.
4. Sathe, T.V. 2004 Vermiculture and Organic Farming. Daya publishers.
5. Subha Rao, N.S. 2000, Soil Microbiology, Oxford & IBH Publishers, New \_Delhi.
6. Vayas,S.C, Vayas, S. and Modi, H.A. 1998 Bio-fertilizers and organic \_Farming Akta Prakashan, Nadiad

**Subject Name:** UNDERSTANDING DISCIPLINES AND SUBJECTS

### **Unit I: Knowledge and Methods of Enquiry**

- Disciplinary Knowledge :Nature and Scope,
- Interdisciplinary Knowledge: Nature ,Scope and Need
- Knowledge as Construction of Experience; Case examples from School Subjects
- Knowledge as distinct from Information;Case examples from School Subjects
- Methods of Inquiry, Scientific Thinking, Social Scientific Thinking, Mathematical Thinking, Critical Thinking
- Language, Social Relations, Power, Identity and Thinking(Relationship and Interface with Knowledge).

### **Unit II: Learner and their Contexts**

- Interface between Knowledge, Subjects ,Curriculum, Textbooks, Linguistic background of learners
- Alternative Frameworks of Children.s Thinking
- Child and Adult Misconceptions :Meaning,Scope in a Classroom,Processes to be used to Dispel Misconceptions.
- Everyday Concepts and Situated Cognition
- Pedagogical Perspective and Concerns of Inclusive Education in Schools

### **Unit III: Pedagogic Practice and the Process of Learning**

- Critical Examination of Terminology and Notions associated with Child-centered Education
- Critical understanding of standardised pedagogic methods: concept-formation; enquirybased learning; project-based learning etc
- Interrogating disciplinary practices and Creating non-threatening learning environments: Relevance, Scope and Process

### **Unit IV: Critical Study of ICTs and Developing Capacities**

- Critical examination of the role of ICT in Effective Curriculum Transaction and Evaluation
- Capacity development of teachers and Students in the use of ICTs
- ICT - based teaching-learning approaches in schools

- Role of Open and Distance Learning in Catering to Diversity in Learners and Learning Styles.

### **Suggested Readings:**

- Batra, P. (Ed.) (2010). *Social Science Learning in Schools: Perspective and Challenges*. New Delhi: Sage.
- Bruner, J. (1996). In *The Culture of Education*. Cambridge: Harvard University Press, 2: Folk Pedagogy, 44-65.
- Dewey, J. (1897). *My Pedagogic Creed*. School Journal, Vol. 54.
- Driver, R. (1981). Pupils' Alternative Frameworks in Science. *European Journal of Science Education*. 3(1), 93-101.
- Holt, J. (1990). *Learning All the Time*. New York: Addison-Wesley Publishing Co.

## **Subject Name: LEARNING AND TEACHING**

### **Unit I: Understanding the Learner**

- Dimensions of differences in psychological attributes-cognitive abilities, interest, aptitude, creativity, personality, values & Self Esteem.
- Understanding learners from the perspective of multiple intelligences with a focus on Gardner's theory of multiple intelligences. Implications for teaching- learning in the light of changing concept of intelligence, including emotional intelligence.
- Differences in learners based on predominant 'learning styles'.
- Differences in learners based on socio-cultural contexts: Impact of home language of learners' and language of instruction, impact of differential 'cultural capital' of learners.
- Understanding differences based on range of cognitive abilities--learning difficulties, slow learners and dyslexics, intellectual deficiency, intellectual giftedness. Implications for catering to individual variations in view of 'difference' rather than 'deficit' perspective.

### **Unit II: Understanding Learning**

- Implicit knowledge and beliefs about learning (demystifying misconceptions).
- Perspectives on human learning: Behaviourist (conditioning paradigm in brief), cognitivist, information-processing view, humanist, social- constructivist (drawing selectively on the ideas of Skinner, Piaget, Rogers, Vygotsky).
  - I. Concepts and principles of each perspective and their applicability in different learning situations.
  - II. Relevance and applicability of various theories of learning for different kinds of learning situations.
  - III. Role of learner in various learning situations, as seen in different theoretical perspectives.
  - IV. Role of teacher in teaching-learning situations: a) transmitter of knowledge, b) facilitator, c) negotiator, d) co-learner.

### **Unit III: Learning in 'Constructivist' Perspective**

- Distinctions between learning as 'construction of knowledge' and learning as 'transmission and reception of knowledge'.
- Social-constructivist perspective (also Bruner and Ausubel's perspective) and applications of Vygotsky's ideas in teaching.
- Understanding processes that facilitate 'construction of knowledge':
  - (i) Experiential learning and reflection
  - (ii) Social mediation
  - (iii) Cognitive negotiability
  - (iv) Situated learning and cognitive apprenticeship
  - (v) Meta-cognition.



- Creating facilitative learning environments, teachers' attitudes, expectations – enhancing motivation, positive emotions, self-efficacy, collaborative and self regulated learning.
- Utilizing learners experiences (in and outside school) in classroom process.

#### **Unit IV: Understanding Teaching**

- What is meant by teaching (teaching as a practice, activity and performance).
- Teaching as a complex activity,
  - how not to conceive teaching as a skill
  - teaching, personality and character
  - Reflective Teaching
  - teaching in a diverse classroom (addressing the diversity of student in classroom.

Diversity in cognitive abilities learning styles diversity due to socio-cultural context language diversity, differences resulting from disabilities, gender difference, diversity of student at risk.

  - teacher as a critical pedagogue.

#### **Unit V: Teaching as a Profession**

- Is teaching a profession (Basic characteristics of teaching qualifying it as a profession.
- Professional development of teachers.
  - Need (link between professional development of teacher and substantial school improvement and student learning).
  - Phases of Professional Development (Pre-service and In-service).
  - Strategies
    - (i) Conventional face to face (through various institutions).
    - (ii) School based INSET.
    - (iii) Action Research
    - (iv) Collaborative problem solving.
    - (v) Self initiated learning.
    - (vi) Facilitating professional development
- Teacher Autonomy and Accountability.

#### **Suggested Readings**

1. Bhutt, H. The dairy of a school teacher: An Azim Prenji university publications, [www.arvindguptatoys.com/arvindgupta/diary - school teacher- eng.pdf](http://www.arvindguptatoys.com/arvindgupta/diary - school teacher- eng.pdf)
2. Burden, Paul R; Byrd, David. M. (1999). Methods for Effective Teaching (Sec Edition), Allyn and Bacon.
3. Carr, D (2005), Making sense of education: An introduction to the philosophy and theory of education and teaching, Rontledge.
4. Delpit, L (2006). Other people's children, cultural conflict in the classroom. The New press.
5. Dhar,T.N. (Ed). 1996.Professional status of Teachers, NCTE, New Delhi.
6. Kauchak, D. P and Eggen, P. D (1998). Learning and Teaching,,: Research based methods, Boston: Allyn and Bocan

7. Ladsen – Billings, G (1995). Toward a theory of culturally relevant pedagogy. *American Educational Research Journal*, 32 (3), 465-491.
8. Lampert, M. (2001). *Teaching problems and the problems of teaching*. Yale University press.
9. NCERT (2005). *National Curriculum Framework*, New Delhi
10. Olson, D.R. & Bruner, J.S. (1996). "Folk Psychology and Folk Pedagogy". In D.R. Olson & N. Torrance (Eds.). *The Handbook of Education and Human Development* (PP.9-27).Blackwell.
11. Piaget, J. (1997). "Development and Learning", In M. Gauvain & M. Cole (Eds.), *Reading on the Development of Children*. New York: WH Freeman & Company.
12. Rogeff, B; Baker-Sennatt, T., Lacasa, P. and Goldsmith, D. (1995). Development through participation in socio-cultural activity, *New Directions for child and adolescent development*, 1995 (67), 45-65.
13. Shulman,L.S. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher*, 4-14.
14. Vygotsky, L. (1997). "Interaction between Learning and Development", In M. Gauvain & M. Cole (Eds.) *Reading on the Development of Children*, New York: WH Freeman & Company.