

**Detailed Course Scheme**  
**Bachelor of Science (B.Sc.)**  
**(Physics, Mathematics, Chemistry, Botany,**  
**Zoology,**  
**Biotechnology and Computer Sciences)**

**Semester- IV**  
**(2016-2019)**

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**RNB**  
GLOBAL UNIVERSITY  
Educating stars for tomorrow

**RNB GLOBAL UNIVERSITY**  
RNB Global City, Ganganagar Road,  
Bikaner, Rajasthan 334601

## **OVERVIEW**

RNB Global University follows Semester System along with Choice Based Credit System as per latest guidelines of University Grants Commission (UGC). Accordingly, each academic year is divided into two semesters, **Odd (July-December) and Even (January-June)**. Also, the university follows a system of continuous evaluation along with regular updating in course curricula and teaching pedagogy.

The curriculum for B.Sc. Program for (January-June) Even Semester, 2018 along with examination pattern is as follows:

### **Course Scheme**

#### **Semester - IV**

S. No	Course Code	Course Name	Credits
1.	-	Discipline Specific Core Course-I Paper-IV	4
2.	-	Discipline Specific Core Course-I Paper-IV Lab	2
3.	-	Discipline Specific Core Course-II Paper-IV	4
4.	-	Discipline Specific Core Course-II Paper-IV Lab	2
5.	-	Discipline Specific Core Course-III Paper-IV	4
6.	-	Discipline Specific Core Course-III Paper-IV Lab	2
7.	99001800	Entrepreneurship	4
8.	13003000	Ability & Skill Enhancement Module - IV	3
9.	99002000	NCC/NSS/Other Similar activities	-
10.	99002100	Club activities	-
<b>Total Credits</b>			<b>25</b>

#### **For Biotechnology Students:**

S. No	Course Code	Course Name	Credits
1.	-	Discipline Specific Core Course-I Paper-IV	4
2.	-	Discipline Specific Core Course-I Paper-IV Lab	2
3.	-	Discipline Specific Core Course-II Paper-IV	4
4.	-	Discipline Specific Core Course-II Paper-IV Lab	2
5.	-	Discipline Specific Core Course-III Paper-IV	4
6.	-	Discipline Specific Core Course-III Paper-IV Lab	2
7.	99001800	Entrepreneurship	4

8.	13011200	Research Methods in Biotechnology	2
9.	13003000	Ability & Skill Enhancement Module - IV	3
10.	99002000	NCC/NSS/Other Similar activities	-
11.	99002100	Club activities	-
<b>Total Credits</b>			<b>27</b>

### **Discipline Specific Core Course Papers**

Subject	Course Code	Course Name
Physics	13001800	Waves and Optics
	13001900	Waves and Optics Lab
Chemistry	13002000	Chemistry-IV
	13002100	Chemistry-IV Lab
Mathematics	13002200	Algebra
Botany	13008700	Plant Physiology and Metabolism
	13008800	Plant Physiology and Metabolism Lab
Zoology	13008900	Genetics and Evolutionary Biology
	13009000	Genetics and Evolutionary Biology Lab
Computer Science	13009300	Analysis and Design of Algorithms
	13009400	Analysis and Design of Algorithms Lab
Biotechnology	13009100	Molecular Biology
	13009200	Molecular Biology Lab

### **EVALUATION SCHEME - THEORY**

The evaluation of the theory paper of B.Sc. program would be based on Internal and External Assessments. Internal Assessment would consist of 50% of the marks (50 marks) and external assessment (in form of End Term Exam) would consist of remaining 50% marks (50 marks). Detailed scheme of Internal and External Assessments as follows:

#### **Internal Assessment**

The distribution of Internal Assessment Marks is as follows:

Area of Assessment	Marking	Maximum Marks
Sessional-I	As per marks obtained	10
Sessional-II	As per marks obtained	10
Marks obtained in various, assignments, presentations, quizzes etc.	Average of marks obtained	15
Overall Conduct and Discipline	To be decided by concerned Faculty Member	5
Attendance	Student with 80% attendance will get 5 marks and 0.25 marks for every 1% attendance above 80%	10
<b>Total</b>	<b>50</b>	

### **External Assessment**

Type	Marks
Theory	50

### **EVALUATION SCHEME - PRACTICAL**

The evaluation of the practical paper of B.Sc. program would be based on Internal and External Assessments. Internal Assessment would consist of 50% of the marks (50 marks) and external assessment (in form of End Term Exam) would consist of remaining 50% marks (50 marks). Detailed scheme of Internal and External Assessment is as follows:

#### **Internal Assessment**

Type	Details	Marks
Marks obtained in various manuals, practical file, participation, any model prepared, output of practical	Average of marks obtained	35

Discipline	To be decided by concerned faculty	5
Attendance	80% - 5 marks and 0.25 percent for every one percent above 80 %	10
<b>TOTAL</b>		<b>50</b>

### **External Assessment**

Type	Marks
Practical	50

### **EVALUATION SCHEME - NSS/NCC AND CLUB ACTIVITIES**

1. NSS/NCC /Similar activities prescribed by University will be completed from Semester I – Semester IV. It will be evaluated internally by the respective institute. The credit for this will be given after IV<sup>th</sup> Semester.
2. The students have to join club/clubs with the active participation in different activities of club. The students would be continuously assessed from Semester I – Semester IV and credits and marks would be given after IV<sup>th</sup> Semester.

### **CURRICULUM**

**Course Name: Waves and Optics**

**Course Code: 13001800**

#### **Course Outline:**

**Unit I:** Superposition of Two Collinear Harmonic oscillations: Linearity and Superposition Principle. (1) Oscillations having equal frequencies and (2) Oscillations having different frequencies (Beats).

Superposition of Two Perpendicular Harmonic Oscillations: Graphical and Analytical Methods. Lissajous Figures with equal and unequal frequency and their uses.

**Unit II:** Waves Motion- General: Transverse waves on a string. Travelling and standing waves on a string. Normal Modes of a string. Group velocity, Phase velocity. Plane waves. Spherical waves, Wave intensity.

**Unit III:** Fluids: Surface Tension: Synclastic and anticlastic surface - Excess of pressure - Application to spherical and cylindrical drops and bubbles - variation of surface tension with temperature - Jaegar's method. Viscosity: Viscosity - Rate flow of liquid in a capillary tube - Poiseuille's formula - Determination of coefficient of viscosity of a liquid - Variations of viscosity of a liquid with temperature lubrication. Physics of low pressure - production and measurement of low pressure - Rotary pump - Diffusion pump - Molecular pump - Knudsen absolute gauge - penning and piraniga pump - Molecular pump - Knudsen absolute gauge - penning and pirani gauge - Detection of leakage.

**Unit IV: Sound:** Simple harmonic motion - forced vibrations and resonance - Fourier's Theorem - Application to saw tooth wave and square wave - Intensity and loudness of sound - Decibels - Intensity levels - musical notes - musical scale. Acoustics of buildings: Reverberation and time of reverberation - Absorption coefficient - Sabine's formula - measurement of reverberation time - Acoustic aspects of halls and auditoria.

**Unit V:** Wave Optics: Electromagnetic nature of light. Definition and Properties of wave front. Huygens Principle.

**Unit VI:** Interference: Division of amplitude and division of wave front. Young's Double Slit experiment. Lloyd's Mirror and Fresnel's Biprism. Phase change on reflection: Stokes' treatment. Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton's Rings: measurement of wavelength and refractive index.

**Unit VII:** Michelson's Interferometer: Idea of form of fringes (no theory needed), Determination of wavelength, Wavelength difference, Refractive index and Visibility of fringes.

**Unit VIII:** Diffraction: Fraunhofer diffraction: Single slit; Double Slit. Multiple slits & Diffraction grating. Fresnel Diffraction: Half-period zones. Zone plate. Fresnel Diffraction pattern of a straight edge, a slit and a wire using half-period zone analysis.

**Unit IX:** Polarization: Transverse nature of light waves. Plane polarized light - production and analysis. Circular and elliptical polarization.

**Suggested Readings:**

1. Fundamentals of Optics, F A Jenkins and H E White, 1976, McGraw-Hill
2. Principles of Optics, B.K. Mathur, 1995, Gopal Printing
3. Fundamentals of Optics, H.R. Gulati and D.R. Khanna, 1991, R. Chand Publication

4. University Physics. FW Sears, MW Zemansky and HD Young 13/e, 1986. Addison-Wesley

**Course name: Waves and Optics Lab**

**Course Code: 13001900**

**Course Outline**

1. To investigate the motion of coupled oscillators.
2. To determine the Frequency of an Electrically Maintained Tuning Fork by Melde's Experiment and to verify  $\lambda^2 - T$  Law.
3. To study Lissajous Figures.
4. Familiarization with Schuster's focussing; determination of angle of prism.
5. To determine the Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).
6. To determine the Refractive Index of the Material of a given Prism using Sodium Light.
7. To determine Dispersive Power of the Material of a given Prism using Mercury Light.
8. To determine the value of Cauchy Constants of a material of a prism.
9. To determine the Resolving Power of a Prism.
10. To determine wavelength of sodium light using Fresnel Biprism.
11. To determine wavelength of sodium light using Newton's Rings.
12. To determine the wavelength of Laser light using Diffraction of Single Slit.
13. To determine wavelength of (1) Sodium & (2) spectrum of Mercury light using plane diffraction Grating.
14. To determine the Resolving Power of a Plane Diffraction Grating.
15. To measure the intensity using photo sensor and laser in diffraction patterns of single and double slits.

**Course Name: Chemistry IV**

**Course Code: 13002000**

**Course Outline:**

**Unit I: 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).

**Unit II: 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.

**Unit III: 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.

**Unit IV: 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).

**Unit V: 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).

**Unit VI: 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.

**Unit VII: 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).

### **Suggested Readings:**

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

## **Course Name: Chemistry-IV Lab**

### **Course Code: 13002100**

#### **Course Outline:**

##### **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>3</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.

**Course Name: Algebra**

**Course Code: 13002200**

### Course Outline:

**Unit I:** Definition and examples of groups, examples of abelian and non-abelian groups, the group  $Z_n$  of integers under addition modulo  $n$  and the group  $U(n)$  of units under multiplication modulo  $n$ . Cyclic groups from number systems, complex roots of unity, circle group, the general linear group  $GL_n(n, R)$ , groups of symmetries of (i) an isosceles triangle, (ii) an equilateral triangle, (iii) a rectangle, and (iv) a square, the permutation group  $Sym(n)$ , Group of quaternions.

**Unit II:** Subgroups, cyclic subgroups, the concept of a subgroup generated by a subset and the commutator subgroup of group, examples of subgroups including the center of a group. Cosets, Index of subgroup, Lagrange's theorem, order of an element, Normal subgroups: their definition, examples, and characterizations, Quotient groups.

**Unit III:** Definition and examples of rings, examples of commutative and non-commutative rings: rings from number systems,  $Z_n$  the ring of integers modulo  $n$ , ring of real quaternions, rings of matrices, polynomial rings, and rings of continuous functions.

**Unit IV:** Subrings and ideals, Integral domains and fields, examples of fields:  $Z_p$ ,  $Q$ ,  $R$ , and  $C$ .  
Field of rational functions.

### **Suggested Readings**

1. John B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson, 2002.
2. M. Artin, Abstract Algebra, 2nd Ed., Pearson, 2011.
3. Joseph A Gallian, Contemporary Abstract Algebra, 4th Ed., Narosa, 1999.
4. George E Andrews, Number Theory, Hindustan Publishing Corporation, 1984.

## **Course Name: Plant Physiology and Metabolism**

**Course Code: 13008700**

### **Course Outline**

**Unit I: Plant-water relations:** Importance of water, water potential and its components; Transpiration and its significance; Factors affecting transpiration; Root pressure and guttation.

**Unit II: 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 III: Translocation in phloem:** Composition of phloem sap, girdling experiment; Pressure flow model; Phloem loading and unloading.

**Unit IV :Photosynthesis:** Photosynthetic Pigments (Chl a, b, xanthophylls, carotene); Photosystem I and II, reaction center, antenna molecules; Electron transport and mechanism of ATP synthesis;  $C_3$ ,  $C_4$  and CAM pathways of carbon fixation; Photorespiration.

**Unit V: Respiration:** Glycolysis, anaerobic respiration, TCA cycle; Oxidative phosphorylation, Glyoxylate, Oxidative Pentose Phosphate Pathway.

**Unit VI: Enzymes:** Structure and properties; Mechanism of enzyme catalysis and enzyme inhibition.

**Unit VII: Nitrogen metabolism:** Biological nitrogen fixation; Nitrate and ammonia assimilation.

**Unit VIII: Plant growth regulators:** Discovery and physiological roles of auxins, gibberellins, cytokinins, ABA, ethylene.

**Unit IX: 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.

**Suggested Readings:**

1. Taiz, L., Zeiger, E., (2010). Plant Physiology. Sinauer Associates Inc., U.S.A. 5<sup>th</sup> 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.

**Course Name: Plant Physiology and Metabolism Lab**

**Course Code: 13008800**

**Course Outline**

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.

**Demonstration experiments (any four)**

1. Bolting.
2. Effect of auxins on rooting.

3. Suction due to transpiration.
4. R.Q.
5. Respiration in roots.

### **Suggested Readings**

1. Taiz, L., Zeiger, E., (2010). Plant Physiology. Sinauer Associates Inc., U.S.A. 5th 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.

## **Course Name: Genetics and Evolutionary Biology**

**Course Code: 13008900**

### **Course Outline**

**Unit I: Introduction to Genetics:** Mendel's work on transmission of traits, Genetic Variation, Molecular basis of Genetic Information.

**Unit II: 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 III: 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 IV: Mutations:** Chromosomal Mutations: Deletion, Duplication, Inversion, Translocation, Aneuploidy and Polyploidy; Gene mutations: Induced versus Spontaneous mutations, Back versus Suppressor mutations.

**Unit V: Sex Determination:** Chromosomal mechanisms, dosage compensation.

**Unit VI: History of Life:** Major Events in History of Life.

**Unit VII: Introduction to Evolutionary Theories:** Lamarckism, Darwinism, Neo-Darwinism.

**Unit VIII: Direct Evidences of Evolution:** Types of fossils, Incompleteness of fossil record, Dating of fossils, Phylogeny of horse.

**Unit IX: Processes of Evolutionary Change:** Organic variations; Isolating Mechanisms; Natural selection (Example: Industrial melanism); Types of natural selection (Directional, Stabilizing, Disruptive), Artificial selection.

**Unit X : Species Concept:** Biological species concept (Advantages and Limitations); Modes of speciation (Allopatric, Sympatric).

**Unit XI: Macro-evolution:** Macro-evolutionary Principles (example: Darwin's Finches).

**Unit XII: Extinction:** Mass extinction (Causes, Names of five major extinctions, K-T extinction in detail), Role of extinction in evolution.

### **Suggested Readings**

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). Principles of Genetics. VIII Edition. Wiley India.
2. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc.
3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). Concepts of Genetics. X Edition. Benjamin Cummings.
4. Russell, P. J. (2009). Genetics- A Molecular Approach. III Edition. Benjamin Cummings.
5. 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.
6. Ridley, M. (2004). Evolution. III Edition. Blackwell Publishing
7. Barton, N. H., Briggs, D. E. G., Eisen, J. A., Goldstein, D. B. and Patel, N. H. (2007). Evolution. Cold Spring, Harbour Laboratory Press.
8. Hall, B. K. and Hallgrimsson, B. (2008). Evolution. IV Edition. Jones and Bartlett Publishers

**Course Name: Genetics and Evolutionary Biology Lab**

**Course Code: 13009000**

### **Course Outline**

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 :**

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). Principles of Genetics. VIII Edition. Wiley India.
2. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc.
3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). Concepts of Genetics. X Edition. Benjamin Cummings.
4. Russell, P. J. (2009). Genetics- A Molecular Approach. III Edition. Benjamin Cummings.
5. 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.
6. Ridley, M. (2004). Evolution. III Edition. Blackwell Publishing.
7. 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.

## **Course Name: Molecular Biology**

**Course Code: 13009100**

### **Course Outline:**

**Unit I: DNA structure and replication:** DNA as genetic material, Structure of DNA, Types of DNA, Replication of DNA in prokaryotes and eukaryotes: Semi conservative nature of DNA replication, Bi-directional replication, DNA polymerases, The replication complex: Pre-priming proteins, primosome, replisome, Rollingcircle replication, Unique aspects of eukaryotic chromosome replication, Fidelity of replication.

**Unit II:DNA damage, repair and homologous recombination:** DNA damage and repair: causes and types of DNA damage, mechanism of DNA repair: Photo reactivation, base excision repair, nucleotide excision repair, mismatch repair, translesion synthesis, recombination repair, non homologous end joining. Homologous recombination: models and mechanism.

**Unit III: Transcription and RNA processing:** RNA structure and types of RNA, Transcription in prokaryotes: Prokaryotic RNA polymerase, role of sigma factor, promoter, Initiation, elongation and termination of RNA chains Transcription in eukaryotes: Eukaryotic RNA polymerases, transcription factors, promoters, enhancers, mechanism of transcription initiation, promoter clearance and elongation RNAsplicing and processing: processing of pre-mRNA: 5' cap formation, polyadenylation, splicing, rRNA and tRNA splicing.

**Unit IV: Regulation of gene expression and translation:** Regulation of gene expression in prokaryotes: Operon concept (inducible and repressible system), Genetic code and its characteristics, Prokaryotic and eukaryotic translation: ribosome structure and assembly, Charging of tRNA, aminoacyl tRNA synthetases, Mechanism of initiation, elongation and termination of polypeptides, Fidelity of translation, Inhibitors of translation., Posttranslational modifications of proteins.

#### **Suggested Readings:**

1. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
3. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
4. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., (2008) Molecular.
5. Biology of the Gene (VI Edition.). Cold Spring Harbour Lab. Press, Pearson Pub.

**Course Name: Molecular Biology Lab**

**Course Code: 13009200**

#### **Course Outline**

1. Preparation of solutions for Molecular Biology experiments.



2. Isolation of chromosomal DNA from bacterial cells.
3. Isolation of Plasmid DNA by alkaline lysis method.
4. Agarose gel electrophoresis of genomic DNA & plasmid DNA.
5. Preparation of restriction enzyme digests of DNA samples.
6. Demonstration of AMES test or reverse mutation for carcinogenicity.

### **Suggested Readings :**

1. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
3. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009): The World of the Cell. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
4. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., (2008) Molecular Biology of the Gene (VI Edition.). Cold Spring Harbour Lab. Press, Pearson Pub.

## **Course Name: Analysis and Design of Algorithms**

**Course Code: 13009300**

### **Course Outline**

**Unit I Basics of Algorithm Analysis & Design:**. Algorithm Definition, Analyzing algorithms, order arithmetic, time and space complexity. stacks, queues, trees, heaps, sets and graphs.

**Algorithm Design Techniques:** Divide and Conquer: general method, merge sort, Recurrences, Solving Recurrences by Substitution method, Recursive Tree Method.

**Unit-II Greedy method:** Job Sequencing with Deadlines, Knapsack problem, Optimal merge patterns, Optimal Storage on tapes, Minimum spanning trees & other applications of Greedy method.

**Unit-III Dynamic Programming:** Use of table instead of recursion, all pair shortest Path, 0/1 knapsack, Matrix Chain Multiplication, optimal binary search tree, Longest Common Subsequence, Traveling salesperson problem.

**Unit-IV Search and Traversal:** Search techniques: breadth first search, depth first search, code optimization, Internal and External sorting, searching and merging techniques  
**Backtracking:** 8 queens problem, sum of subsets, graph coloring.

**Unit-V Problem clauses:** P, NP, NP- Hard and NP-complete, deterministic and non-deterministic polynomial time algorithm approximation and algorithm for some NP complete problems.

**Course Name: Analysis and Design of Algorithms Lab**

**Course Code: 13009400**

**Laboratory work:**

1. Implementation of all the algorithmic techniques studied.
2. Implement Insertion Sort (The program should report the number of comparisons).
3. Implement Merge Sort(The program should report the number of comparisons).
4. Implement Heap Sort(The program should report the number of comparisons).
5. Implement Randomized Quick sort (The program should report the number of comparisons).
6. Implement Radix Sort.
7. Create a Red-Black Tree and perform following operations on it: i. Insert a node ii. Delete a node iii. Search for a number & also report the color of the node containing this number.
8. Write a program to determine the LCS of two given sequences.
9. Implement Breadth-First Search in a graph.
10. Implement Depth-First Search in a graph.
11. Write a program to determine the minimum spanning tree of a graph.

**Suggested Readings:**

1. E. Horowitz & S. Sahani, Fundamentals of Computer Algorithms. Galgotia Publications.
2. Goodrich, Tamassia, Algorithm Analysis & Design, Wiley.
3. Corman, Leiserson & Rivest, Introduction to Algorithms, MIT Press.
4. Sara Basse, A.V. Geider, Computer Algorithms, Introduction to Design and Analysis.
5. Robert Lafore,, Data Structures & Algorithms in Java, Pearson Education Asia.

**Course Name: Entrepreneurship**

**Course Code: 99001800**

## **Course Outline:**

**Unit I:** Introduction Meaning, elements, determinants and importance of entrepreneurship and creative behavior; Entrepreneurship and creative response to the society' problems and at work; Dimensions of entrepreneurship: intrapreneurship, technopreneurship, cultural entrepreneurship, international entrepreneurship, netpreneurship, ecopreneurship, and social entrepreneurship

**Unit II:** Entrepreneurship and Micro, Small and Medium Enterprises Concept of business groups and role of business houses and family business in India; The contemporary role models in Indian business: their values, business philosophy and behavioral orientations; Conflict in family business and its resolution.

**Unit III:** Public and private system of stimulation, support and sustainability of entrepreneurship. Requirement, availability and access to finance, marketing assistance, technology, and Industrial accommodation, Role of industries/entrepreneur's associations and self-help groups, The concept, role and functions of business incubators, angel investors, venture capital and private equity fund.

**Unit IV :** Sources of business ideas and tests of feasibility. Significance of writing the business plan/ project proposal; Contents of business plan/ project proposal; Designing business processes, location, layout, operation, planning & control; preparation of project report (various aspects of the project report such as size of investment, nature of product, market potential may be covered); Project submission/ presentation and appraisal thereof by external agencies, such as financial/non-financial institutions.

**Unit V:** Mobilising Resources Mobilising resources for start-up. Accommodation and utilities; Preliminary contracts with the vendors, suppliers, bankers, principal customers; Contract management: Basic start-up problems.

## **Suggested Readings:**

1. Kuratko and Rao, Entrepreneurship: A South Asian Perspective, Cengage Learning.
2. Robert Hisrich, Michael Peters, Dean Shepherd, Entrepreneurship, McGraw-Hill Education.
3. Desai, Vasant. Dynamics of Entrepreneurial Development and Management. Mumbai, Himalaya Publishing House.
4. Dollinger, Mare J. Entrepreneurship: Strategies and Resources. Illinois, Irwin.
5. Holt, David H. Entrepreneurship: New Venture Creation. Prentice-Hall of India, New Delhi.
6. Plsek, Paul E. Creativity, Innovation and Quality. (Eastern Economic Edition), New Delhi: Prentice-Hall of India. ISBN-81-203-1690-8.

7. Singh, Nagendra P. Emerging Trends in Entrepreneurship Development. New Delhi: ASEED.
8. SS Khanka, Entrepreneurial Development, S. Chand & Co, Delhi.
9. K Ramachandran, Entrepreneurship Development, McGraw-Hill Education
10. SIDBI Reports on Small Scale Industries Sector.

**Course Name: Research Methods in Biotechnology**

**Course Code: 13011200**

**Course Outline**

**Unit I** Introduction: Concept of Research and Its Application, Types of Research, Process of Research: Steps Involved in Research Process. Research Design: Various Methods of Research Design. Hypothesis as a framework for scientific projects, Null Hypothesis, Collection of Data, Experimental Design, Control Samples.

**Unit II** Analysis of Data: Organize data, describe data Tabulation of Data, Various Kinds of Charts and Diagrams, Tables, Bar Graphs, Pie charts or circle graphs and Line graphs.

Statistical Tests, t-test, G-test, Chi-square test, Confidence levels, Standard Deviation, mean, variance, Basic Software's for Statistical Analysis

\*\*Biotechnology Students will have to do Project work Mandatory during Summer Vacation and will have One Paper of it.

**Course Name: Ability & Skill Enhancement Module- IV**

**Course Code: 13003000**

**Course Outline - Final Assessment – Mock Interviews & PI Kit Submission**

**Unit I - Tele – Etiquettes** Receiving Calls, Placing a call, Ending Calls, Transferring calls, Taking Message/ Voice Mails, Placing call on hold, Handling Complaints.

**Unit II – Confidence Building & Brain Storming** How to build confidence by positive thinking, identifying negative thoughts, how to control negative thoughts entering our mind, identifying personal talents, and its ways to improve, how to develop good habits and having principles and follow them at all times.

Need to learn new things, ideas and skills, what is brain storming, why do we need it, what are the different ways of brain storming through logics and reasoning, Brain Storming Session.

**Unit III - PI Kit** What is resume, Format of Resume, Formatting, Resume Preparation, Covering Letter, PI Kit.

**Unit IV - Interview Skills** Mastering the art of giving interviews in - selection or placement interviews, web /video conferencing, Mock Interview, HR Expert Mock Interview, Telephonic Interviews.

**Unit V - Internship Preparation: Company Specific Research and Presentation** Identifying domain specific industries, researching the industry, Industry analysis, Presentation on specific industry/company.

**Note:** The review of Syllabus happens on periodic basis for the benefit of the students. In case there are changes in curriculum due to review, students would be intimated in writing.

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