St. Xavier's College (Autonomous)
Mumbai

Syllabus
For 1st Semester Courses in
LIFE SCIENCE
(June 2020 onwards)

Contents:
Syllabus (theory and practicals) for Courses:

SLSC0101	Fundamentals of Biochemistry and Analytical Techniques
SLSC0102	Evolution and Genetics
SLSC01PR	Practicals

Template for theory and practical question paper
Evaluation and Assessment Grid

Percent revision:
2015-16: No revision
2016-17: No revision
2017-18: No revision
2018-19: 40-50% revision to practicals
2019-20: No revision
2020-21: No revision

LIFE SCIENCE

F.Y.B.Sc. **Course No.: SLSC0101**

Title: Fundamentals of Biochemistry and Analytical Techniques

Learning Objectives:

The course aims to:

1. Introduce the students to fundamental chemical processes and interactions that prevail in living systems
2. Familiarize the students with biological molecules that are crucial for the maintenance of structure/function in an organism
3. Introduce the students to the tools that may be used in the study of biomolecules and cells

Number of lectures: 45

UNIT I (15 lectures)

1. Types of Bonds: Covalent And Non-Covalent (**1**)
2. Physiological Role of Water: (**4**)
   a. Structure of water
   b. Dissociation and Ionic Product
   c. Ionic interaction with water
   d. Concept of pH and Buffers
   e. Buffering Systems in a living cell
3. Carbohydrates: (**5**)
   a. Classification & structure of Carbohydrates.
   b. Monosaccharides: i. Aldose & Ketose (one example each)
      ii. C3 to C6 (one example each)
   c. Disacharides: Maltose, Cellobiose, Lactose & Sucrose
   d. Polysaccharides: Starch, Glycogen & Cellulose
   e. Properties & Reactions of Glucose & Fructose:
      i. Isomerism
      ii. Oxidation & Reduction
      iii. Esterification
      iv. Glycoside formation.
4. Lipids: (**5**)
   a. Bloor's classification of lipids
   b. Simple lipids (one example each).
   c. Complex lipids (one example each)
   d. Derived lipids (one example each)
   e. Fatty acids: Types, nomenclature & properties (upto C18)

UNIT II (15 lectures)

1. Amino acids and Proteins: (**7**)
   a. Classification and Structure of Amino acids, and concept of iso-electric pH
   b. Chemical reaction with acid/alkali, Ninhydrin, Sanger's reaction
   c. Classification of Proteins based on function & shape
   d. Protein Structure: Primary structure and the concept of 'N' and 'C' terminal, peptide bond formation, characteristics of peptide bond, secondary structures: α helix & β sheets, tertiary & quaternary structure

2. Nucleic Acids: (**8**)
   a. Structure of nucleosides and nucleotides
   b. Structure of a poly nucleotide
   c. Forms of DNA: 'A', 'B' and 'Z'
   d. Types of RNA: mRNA, tRNA, rRNA, snRNAs
   e. Differences between DNA and RNA

UNIT III **(15 lectures)**

1. Separation of organelles: (**2**)
   a. Differential centrifugation
   b. Density gradient centrifugation
2. Separation of Macromolecules: (**6**)
   a. Salting in and Salting out
   b. Paper chromatography
   c. Thin layer chromatography
   d. Electrophoresis
3. Colorimetry: (**2**)
   a. Beer Lambert's law & principle of a colorimeter
4. Microscopy: (**5**)
   a. Principle of Light Microscopy
   b. Introduction to Electron microscopy: SEM, TEM, Fluorescence microscopy and Confocal Microscopy

References:

1. *Biochemistry* (2006) 3rd Revised Edition, Satyanarayana, U. Books and Allied Publishers.
2. *Textbook of Biochemistry* (1961) 3rd Edition, West, E.S. and Todd, W. McMillan.
3. *Harper's Illustrated Biochemistry* (2003) 26th Edition, Murray, R. K. McGraw Hill.
4. *Fundamentals of Biochemistry* (2001) 9th Revised Edition, Deb, A.C. New Central Book Agency Pvt. Ltd.
5. *Outlines of Biochemistry* (2009) 5th Edition, Conn, E.E. and Stumpf, P.K. John Wiley and Sons Publishers.
6. *Principles and Techniques of Biochemistry and Molecular Biology* (2010) 7th Edition, Wilson, K., Walker, J. Cambridge University Press.
7. *Principle of Microbiology* (1997) 2nd Edition, Ronald, M.A., Dubuque, I.A. Wm. C. Brown Publishers.

LIFE SCIENCE

F.Y.B.Sc.: **Course No.: SLSC0102**

Title: Evolution and Genetics

Learning Objectives:

On completion of course the students will be able to:

1. Explain how life might have originated on this planet
2. Describe Darwin's theories and how the principles of natural selection can lead to speciation.
3. Articulate Mendel's "laws" and explain the evidence for it.
4. Define, differentiate, and utilize terminology associated with Mendelian genetics.
5. Utilize Punnett square, forked line, and probabilistic methods of calculating expected ratios of offspring.
6. Construct and analyze pedigrees to determine patterns of inheritance, genotypes, and probabilities.
7. Understand that not all genetic traits are inherited in Mendelian fashion.

Number of lectures: 45

UNIT I **(15 lectures)**

1. Origin of life
   a. Theories of origin of life: Overview of Creation myths/ Divine creation; Spontaneous generation; Cosmozoic hypothesis; Steady state; Biochemical origin. **(2)**
   b. Biochemical theories: Origin of macromolecules; Miller‟s experiment; RNA world **(2)**
   c. Origin of cells: Protocells; Coacervates; Microspheres; Prokaryotes, Eukaryotes **(3)**
2. Evolution
   a. Pre Darwanian ideas; Darwin‟s theory of natural selection, evidences and objections **(2)**
   b. Evidences for evolution **(2)**
   c. Speciation: Concept of species: Physiological species, Biological species, evolutionary species; Significance of speciation **(2)**
   d. Speciation and macroevolution: Allopatric, sympatric, and parapatric; **(2)**

UNIT II **(15 lectures)**

1. Gene as a unit of heredity: Organisation of genes on chromosomes: **(6)**
   a. Structure of a Prokaryotic genome: eg; *E.coli*
   b. Structure of a Eucaryotic genome: packaging of DNA to chromosome
   c. Evidence of DNA as genetic material: Griffith‟s experiment, Avery & Mcleod‟s experiment
2. Mendelian Inheritance: **(8)**
   a. Concept of alleles, dominance & recessivity, homozygous, heterozygous, phenotype, genotype
   b. Mendel's laws: Law of segregation of alleles, Law of Independent Assortment

c. Monohybrid, dihybrid and trihybrid ratios: test cross and self cross, Punnet square and branch diagram for determining ratios of genotypes and phenotypes, chi square analysis for mono-hybrid and di-hybrid ratios

3. Concept of cytoplasmic inheritance **(1)**

UNIT III **(15 lectures)**

1. Extensions of Mendel's laws: Incomplete dominance; co-dominance **(10)** multiple genes; Multiple alleles; Lethal alleles; Gene interactions: Epistasis- dominant and recessive; Penetrance and expressivity; Extrinsic factors- temperature, nutrition; Intrinsic factors- Sex (sex limited; sex influenced), age; Pleiotropy
2. Study of human pedigrees: Modes of inheritance: sex-linked dominant & recessive autosomal dominant & recessive **(4)**
3. Concept of Karyotype: The Human Karyotype **(1)**

References:

1. *Genetics – A conceptual approach* (2008) 3rd Edition, Pierce, B. W.H. Freeman
2. *Genetics- A molecular approach* (2006) 2nd Edition, Russell, P. Pearson International
3. *Principles of Genetics* (2003) 3rd Edition, Snustad, D.P. and Simmons, M.J. John Wiley and Sons
4. *Genes VI* (1997) New Edition, Lewin, B. Oxford University Press
5. *Concepts of Genetics* (2006) 8th Edition, Klug, W.S., Cummings, M.R. and Spencer, C.A. Pearson Education International
6. *Introduction to Genetic Analysis* (2008) 9th Edition, Griffiths, A.J., Wessler, S.R., Lewontin, R.C. and Caroll, S.B. W.H. Freeman and Co.
7. *Molecular Biology of the Gene* (2004) 5th Edition, Watson, J.D., Baker, T.A., Bell, S.P., Gann, A. and Levine, M. Pearson Education
8. *Genetics: The Continuity of Life* (1999) Fairbanks, D.J. and Andersen, W.R. Brooks/Cole Publication Co.
9. *Strickbergers evolution* (2008) 4th Edition, Hall, B.K. and Hallgrimsson, B. Jones and Bartlett Publishers
10. *The World of Biology* (2008) 8th Edition, Solomon, E.P. and Berg, L.R. Sanders College publishing
11. *Essential Biology* (2008) 8th Edition, Campbell, N.A., Reece, J.B., Umy, L.A., and Cain, M.A. Pearson Benjamin Cummings

Practical: SLSC1PR

1. GLP Lab safety and introduction to common laboratory glassware and instruments
   a. Use of balance
   b. Validation of a glass pipette
2. Concentration and strengths of solutions
   a. Concepts of w/v. v/v, percentage, ppm, ppb, moles/L, molarity, normality, molality
   b. Preparation and verification of solutions of desired strengths
3. Determination of pH of different food samples using pH paper and universal indicator
4. Colorimetric determinations
   a. Verification of Beer's Law using $CoCl_2$
   b. Estimation of proteins using Biuret method
   c. Determination of λ_{max} of a colored solution and preparing a calibration curve for it (Perform in triplicate on a table and collate results)
5. Qualitative analysis
   a. Sugars (mono & disaccharides, ketose & aldose, reducing & non-reducing)
   b. Proteins
6. Extraction of genomic DNA from onion and confirmation with diphenylamine (DPA) reaction
7. Karyotype analysis

Template of Theory Question paper

Courses 101 & 102

CIA I – 20 marks, 45 mins.

Unit I: Objectives/Short questions, not more than 5 marks each

CIA II – 20 marks

Unit II: Test (*45 mins.*)/ Survey /Assignment /Presentation /Poster /Essay /Review

End Semester exam – 60 marks, 2 hours

Question 1: Unit I: maximum marks per sub-question - 6 marks

20 marks to be answered out of 28-30 marks

Question 2: Unit II: maximum marks per sub-question - 6 marks

20 marks to be answered out of 28-30 marks

Question 3: Unit III: maximum marks per sub-question - 6 marks

20 marks to be answered out of 28-30 marks

Mark-distribution pattern for Practical

Course: SLSC1PR

End semester Practical Examination	**Total marks: 100**
Experiments	70 marks
Identification	20 marks
Journal	10 marks

DEPARTMENT OF LIFE SCIENCES AND BIOCHEMISTRY

F.Y.B.Sc. Life Science Exam Grid Semester 1					
Course	**Exam**	**Knowledge and Information**	**Understanding**	**Application/Analysis**	**Total**
0101	CIA I	8	8	4	20
	CIA II	8	8	4	20
	End semester	18	18	24	60
Course	**Exam**	**Knowledge and Information**	**Understanding**	**Application/Analysis**	**Total**
0102	CIA I	10	7	3	20
	CIA I	10	7	3	20
	End semester	25	20	15	60