

**FACTULTY OF LIFE SCIENCES**  
**SYLLABI**  
**FOR**  
**B.Sc. (Hons.) Biotechnology Second Year**  
**(3<sup>rd</sup> and 4<sup>th</sup> Semester)**  
**CBCS SYSTEM**  
**(Session: 2018-2019)**



**MATA GUJRI COLLEGE**  
**FATEHGARH SAHIB-140406, PUNJAB**



**Website: [matagujricollege.org](http://matagujricollege.org)      Email: [info@matagujricollege.org](mailto:info@matagujricollege.org)**

**Phone no. 01763-232247, 01763-233715**

**Note: Copy rights are reserved.**

**Note: Copy for College Library and Examination Branch**

**B. Sc. (Hons.) Biotechnology Second Year  
(3<sup>rd</sup> and 4<sup>th</sup> Semester)  
Subject and Distribution of Marks  
(Academic Session 2018-2019)  
Semester III**

| <b>Paper No and code</b> | <b>Name of paper</b>                            | <b>Credit<br/>per week</b> | <b>Internal<br/>Marks*</b> | <b>External<br/>Marks</b> | <b>Total<br/>Marks</b> |
|--------------------------|---|----------------------------|----------------------------|---------------------------|------------------------|
| Paper-IX (C5-301)        | Genetics  | 4                          | 25                         | 75                        | 100                    |
| Paper-X (C6-302)         | Fermentation Technology                         | 4                          | 25                         | 75                        | 100                    |
| Paper-XI (C7-303)        | Plant Biotechnology                             | 4                          | 25                         | 75                        | 100                    |
| Paper-XII (SEC1-304)     | Industrial Fermentation                         | 2                          | 10                         | 40                        | 50                     |
| Paper-XIII (GE 3-305)    | **General Elective:<br>Chemistry/Botany/Zoology | 4                          | 25                         | 75                        | 100                    |
| LC-8(C5-301)             | Lab Course: Pertaining to theory paper IX       | 2                          | --                         | 50                        | 50                     |
| LC-9(C6-302)             | Lab Course: Pertaining to theory paper X        | 2                          | --                         | 50                        | 50                     |
| LC-10(C7-303)            | Lab Course: Pertaining to theory paper –XI      | 2                          | --                         | 50                        | 50                     |
| LC-11(SEC-1 304)         | and XII   |                            |                            |                           |                        |
| LC-12(GE-3-305)          | Lab Course: Pertaining to theory paper<br>XIII  | 2                          | --                         | 50                        | 50                     |
| BBT- 306 STS1            | Industrial/survey/study/Training seminar        | 1                          | --                         | 25                        | 25                     |
| <b>Total</b>             |   | 27                         | 110                        | 565                       | 675                    |

**Semester - IV**

| <b>Paper No and code</b>              | <b>Name of paper</b>                                    | <b>Credit/<br/>Week</b> | <b>Internal<br/>Marks*</b> | <b>External<br/>Marks</b> | <b>Total<br/>Marks</b> |
|---------------------------------------|---|-------------------------|----------------------------|---------------------------|------------------------|
| Paper-XIV (C8-401)                    | Molecular Biology                                       | 4                       | 25                         | 75                        | 100                    |
| Paper-XV (C9-402)                     | Immunology  | 4                       | 25                         | 75                        | 100                    |
| Paper-XVI (C10-403)                   | Biophysics  | 4                       | 25                         | 75                        | 100                    |
| Paper-XVII(SEC-2-404)                 | Enzymology  | 2                       | 10                         | 40                        | 50                     |
| Paper-XVIII(GE4-405)                  | **General Elective:<br>Chemistry/Botany/Zoology         | 4                       | 25                         | 75                        | 100                    |
| LC-13 (C8-401)                        | Lab Course: Pertaining to theory paper XIV              | 2                       | --                         | 50                        | 50                     |
| LC-14 (C9-402)                        | Lab Course: Pertaining to theory paper XV               | 2                       | --                         | 50                        | 50                     |
| LC-15 (C10-403) &<br>LC-16 (SEC2-404) | Lab Course: Pertaining to theory paper –XVI<br>and XVII | 2                       | --                         | 50                        | 50                     |
| LC-17 (GE4-405)                       | Lab Course: Pertaining to theory paper XVIII            | 2                       | --                         | 50                        | 50                     |
| <b>Total</b>                          |   | 26                      | 110                        | 540                       | 650                    |

\*Internal assessment (25): Seminar (5 Marks) MST (10 Marks), Assignments (5), Attendance for the seminar/symposium/industrial/Educational visit (5 marks)

**Paper - IX(C5-301)-Genetics**

**Course Objectives:**

1. The course exposes the students to genetic material and laws of inheritance.
2. This course also includes various types of chromosomal aberrations and mutations.

**Lectures to be Delivered:**

**60**

**M. Marks : 75**

**Time allowed:**

**3 Hrs**

**Pass Marks : 35%**

**INSTRUCTIONS FOR THE PAPER SETTER/CANDIDATE**

The question paper will consist of three sections. Section A and B (Consist of unit I and II of the syllabus, respectively) will have four questions each from respective units and candidates are required to attempt two questions each from section A and B. Each question in section A and B shall carry 15 marks. Section C will consist of 10 short answer type questions covering entire syllabus and the candidates are required to attempt all questions. Each question in section C will carry 1.5 marks.

**UNIT-I**

**Genetic Material:** Evidence of DNA as Genetic Material. Griffith's Transformation experiment, Hershey and Chase Experiment. Structure of DNA and RNA. Mendel's laws of inheritance. Verification of segregates by test and back crosses, Chromosomal theory of inheritance, Allelic interactions.

**Chromosome I :** Prokaryotic and Eukaryotic chromosome, Chromosome morphology (Chromatid, centromere, telomere, secondary constriction, chromomere), Folded-Fiber model.

**Chromosome II :** Organization of chromatin fibers (Nucleosome-Solenoid Model), Heterochromatin and Euchromatin, Special Chromosomes (Polytene and lampbrush chromosomes).

**UNIT-II**

**Chromosomal Aberrations I:** Structural chromosomal aberrations (deletion, duplication, inversion, translocation).

**Chromosomal Aberrations II:** Numerical chromosomal aberrations (aneuploidy, euploidy, autopolyploidy, allopolyploidy). Down syndrome, turner syndrome.

**Mutations:** Spontaneous and induced Mutation, Physical (Ionizing and Non-Ionizing radiations) and Chemical (Base analogs, Base Modifiers, Intercalating agents) mutagens.

**Books Recommended:**

1. Microbial Genetics; by D. Friefelder, Narosa Publishing House, Second Edition New Delhi.
2. Friefelder Essentials of Molecular Biology: by G.M. Malacinski D., Narosa Publishing House, New Delhi.
3. Molecular Biology of Gene: By J.D. Watson, N.H. Hopkin, J.W. Roberts, J.A. Steing and A.M. Weings, Benjamin Cummings Publication Co., Amsterdam.
4. Genomes 3 by T.A. Brown. Garland Science Publ.
5. Proteome Research: New Frontiers in Functional Genomics. Eds. MR Wilkins, RD Appel and DF Hochshauser, Springer Publ.

6. Molecular Genetics of Bacteria, J.W. Dale, Wiley and Sons Ltd. 3rd Edn.
7. Fundamentals of Genetic Engineering (Vol. 12) by R.H. Rehm and G. Reed Verlag Press, NY.

**Lab Course LC8 (C5-301)- Genetics**

|                                      |                   |                         |
|--------------------------------------|-------------------|-------------------------|
| <b>Practical Time</b>                | <b>4 Hrs/Week</b> | <b>M. Marks : 50</b>    |
| <b>Time allowed for Examination:</b> | <b>4 Hrs.</b>     | <b>Pass Marks : 35%</b> |

**INSTRUCTIONS FOR THE PAPER SETTER/CANDIDATE**

The Final practical paper will consist of three sections A, B and C. Section A will contain write up (12.5 Marks) from the list of practical pertaining to lab course. Section B will contain practical to perform in examination (25 Marks) Section C will contain, practical note Book Evaluation and Viva Voce (12.5 Marks).

**List of Practicals:**

1. Demonstration of Law of segregation and independent assortment (use of colored beads capsules etc.) Numerical for Segregation and independent assortment. Use of  $\chi^2$  for prediction of phenotype genotype frequencies of parents form progeny and vive-versa.
2. Comparison of variance in respect of pod length and no of seeds pod.
3. Pedigree analysis.
4. Determine the Blood groups A, B, O and Rh factors.
5. Identification of unknown person from Dermatographics.
6. Demonstration of sex chromatin from buccal epithelium.
7. To perform Karyotyping

**Paper - X (C6-302)- Fermentation Technology**

**Course Objective:**

1. To make the students conversant with raw materials, types and factors affecting fermentation.
2. To make the students aware about growth kinetics of microbes and production of primary and secondary metabolites.

**Lectures to be Delivered**

**60**

**M. Marks : 75**

**Time allowed:**

**3 Hrs**

**Pass Marks : 35%**

**INSTRUCTIONS FOR THE PAPER SETTER/CANDIDATE**

The question paper will consist of three sections. Section A and B (Consist of unit I and II of the syllabus, respectively) will have four questions each from respective units and candidates are required to attempt two questions each from section A and B. Each question in section A and B shall carry 15 marks. Section C will consist of 10 short answer type questions covering entire syllabus and the candidates are required to attempt all questions. Each question in section C will carry 1.5 marks.

**Unit-I**

**Fermentation Technology:** Introduction, history and applications.

**Media for fermentation:** Medium components: energy source, carbon source, nitrogen source, minerals and growth factors

**Raw Material:** Conventional and non-conventional substrates for microbial fermentation.

**Medium formulation:** Methods of medium optimization for growth and product formation (classical and Statistical).

**Types of Fermentation:** Introduction to Different types of fermentation-submerged, surface and solid state fermentation (SSF).

**Factors affecting fermentations:** Physical and chemicals factors affecting the fermentation process.

**Unit-II**

**Starter cultures:** Inoculums development (bacterial, yeast and fungal) for industrial fermentations, procedures of aseptic inoculation of industrial fermentation.

**Microbial growth kinetics I:** Growth kinetics of Batch, fed-batch fermentation.

**Microbial growth kinetics II:** Growth kinetics of continuous fermentation.

**Production of Primary metabolites:** Production technology and characterization for primary metabolites (Vitamin B12, glutamic acid).

**Production of Secondary metabolites:** Raw materials, culture, fermentation technology for Secondary metabolites production (penicillin).

**Microbial biomass for food and feed:** Production technology and characterization of algal (*Spirulina*) bacterial (*Methylophilus sp.* and *Methylococcus sp.*), fungal (*Rhizopus*) and yeast (*Candida*) biomass as single cell protein.

**Books Recommended:**

1. Prescott and Dunn's Industrial Microbiology by B. Reed Millan Publishers Ltd., Connecticut, 4th Edition.

2. Comprehensive Biotechnology by M. Moo-Young (Second Edition) Pergamon Press, New York.
3. Fundamentals of Biotechnology by P. Praive, B. Faust, W. Sitting and D.A. Sukatesh, WCH Weinheim .
4. Biotechnology, Principles and Applications by J.Higgins, D.J.Best and J.Jons Blackwell Scientific Publications, London
5. Biotechnology by R.H. Rehm and G. Reed (Vol. 4, 5, 6 and 7a), Verlag Press, NY.
6. Yeast Biotechnology by D.R. Berry, I. Russel and G.G. Stewart: Allen and Unwin, Boston .

**Lab Course LC9 (C6-302)-Pertaining to Fermentation Technology**

|                                      |                   |                         |
|--------------------------------------|-------------------|-------------------------|
| <b>Practical Time</b>                | <b>4 Hrs/Week</b> | <b>M. Marks : 50</b>    |
| <b>Time allowed for Examination:</b> | <b>4 Hrs.</b>     | <b>Pass Marks : 35%</b> |

**INSTRUCTIONS FOR THE PAPER SETTER/CANDIDATE**

The Final practical paper will consist of three sections A, B and C. Section A will contain write up (12.5 Marks) from the list of practical pertaining to lab course. Section B will contain practical to perform in examination (25 Marks) Section C will contain, practical note Book Evaluation and Viva Voce (12.5 Marks).

**List of Practicals:**

1. To study the growth kinetics for the *E.Coli*.
2. Inoculum development for bacterial and fungal cultures.
3. Fermentation production of ethanol using free and immobilized cells.
4. Production of alcoholic beverages-wine and vinegar.
5. Determine the optimum temperature, pH required for curd production from *Lactobacillus*.
6. Production and evaluation of single cell-protein-fungal and yeast biomass.
7. Preparation and evaluation of Rhizobia inoculants.
8. Development of inoculum for ethanol production.

**Paper - XI (C7-303) – Plant Biotechnology**

**Course Objective:**

1. This course facilitates students to understand the concept of plant cell and tissue culture techniques.
2. This course enables students to understand methods of gene delivery and transgenic plants.

**Lectures to be Delivered 60**

**M. Marks : 75**

**Time allowed: 3 Hrs**

**Pass Marks : 35%**

**INSTRUCTIONS FOR THE PAPER SETTER/CANDIDATE**

The question paper will consist of three sections. Section A and B (Consist of unit I and II of the syllabus, respectively) will have four questions each from respective units and candidates are required to attempt two questions each from section A and B. Each question in section A and B shall carry 15 marks. Section C will consist of 10 short answer type questions covering entire syllabus and the candidates are required to attempt all questions. Each question in section C will carry 1.5 marks.

**Unit-I**

**Plant tissue culture:** Introduction, History, culture media-composition, cellular totipotency.

**General Techniques of tissue culture:** Lab space, culture rooms, culture vessels and their washing, sterilization (dry, flame, autoclaving, filters sterilization and surface sterilization).

**Callus and suspension cell culture:** Large scale cultures, Isolation of cells, growth of single isolated cells.

**Modes of gene delivery in plants:** Particle bombardment, electroporation, microinjection; Advantages and disadvantages, Agrobacterium mediated and direct gene transfer methods.

**Unit-II**

**Organ culture:** Types of Culture : Meristem culture, embryo culture, anther culture.

**Applications of organ culture:** Introduction to virus free plants, artificial seeds

**Protoplast culture and fusion:** Isolation of protoplasts, culture and regeneration; fusion of protoplasts, selection of fusion products of protoplasts; Cybrids; Introduction to Somaclonal variation.

**Transgenic plants:** Genetic modification of plants for herbicide resistance, insect resistance, virus resistance Bacterial and fungal resistance. improved protein composition, Bt cotton, golden rice.

**Books Recommended:**

1.Plant tissue Culture and Molecular Biology, P.S. Srivastava, N.R. Book Distributors, New Delhi.

2. Genetic Transformation in Plants, R. Walden : Open University Press, Buchingham.
3. Plant Cell Culture, H.A. Collins, NR Book Distributors, New Delhi.
4. Plant Tissue Culture-Theory and Practise, S.S. Bhojwani and M.K. Razdan, Prentice Elservier, , London  
Plant Cell, Tissue and Organ Culture, J. Reinart and Y.P.S. Bajaj Narosa Publication House, New Delhi, .
5. Plant Tissue culture methods - Applications in Agriculture, J. Reinart and Y.P.S. Bajaj Springer - Verlag, Berlin.
6. Plant Cell Culture, A. Stafford and G. Warren Open University Press, Buchingham, 1990.
7. Principles of Plant Biotechnology, H. Maitell, J. Mathew and R.A. Mackee, Blackwell Scientific Publishers, Oxford.
8. Plant Cell Culture Technology, M.M. Yoeman Blackwell Scientific Publication, Oxford.
9. Plant Cell and tissue culture a Laboratory manual, J. Reinart and M.M. Yoeman Narosa Publishing House, New Delhi.
10. Gupta, P.K. (1990). An Introduction to Biotechnology, Rastogi Publications, Meerut



**Paper - XII (SEC 1-304)- Industrial Fermentation**

**Course Objective:**

1. This course facilitates students to understand the concept of fermentation and production of industrial products.
2. This course enables students to understand various products of microbial fermentation.

**Lectures to be Delivered 30**

**M. Marks : 40**

**Time allowed: 3 Hrs.**

**Pass Marks : 35%**

**INSTRUCTIONS FOR THE PAPER SETTER/CANDIDATE**

The question paper will consist of three sections. Section A and B (Consist of unit I and II of the syllabus, respectively) will have four questions each from respective units and candidates are required to attempt two questions each from section A and B. Each question in section A and B shall carry 7.5 marks. Section C will consist of 5 short answer type questions covering entire syllabus and the candidates are required to attempt all questions. Each question in section C will carry 2 marks

**UNIT I**

**Introduction to Industrial fermentation:** Over view and application of Industrial fermentation.

**Microbial Transformations:** Types of transformations and applications to industry.

**Production of industrial Products:** Production of Propionic acid, 2-3 butanediol, Biofuels: Biogas, biodiesel. Starch conversion processes. Antibiotics (penicillin), amino acids (glutamic acid).

**Unit-II**

**Microbial products of pharmacological interest:** Steroid fermentations and transformations. Over production of microbial metabolite, Secondary metabolism – its significance and products.

**Microbial products of agriculture interest:** Production of biopesticides and biofertilizers.

**Industrial environment Bioprocess:** Microbial leaching/Bioleaching, Methods of leaching (direct leaching, indirect leaching), Processes of bioleaching, Applications of bioleaching.

**Books Recommended:**

1. Casida LE. Industrial Microbiology. 1st edition. Wiley Eastern Limited.
2. Crueger W and Crueger A. Biotechnology: A textbook of Industrial Microbiology. 2nd edition. Panima Publishing Co. New Delhi.
3. Patel AH. . Industrial Microbiology. 1st edition, Macmillan India Limited.
4. Stanbury PF, Whitaker A and Hall SJ.. Principles of Fermentation Technology. 2<sup>nd</sup> edition, Elsevier Science Ltd.
5. Salisbury, Whitaker and Hall. Principles of fermentation technology, IndBerg, J. M., Tymoczko, J. L. and Stryer, L.

**Lab Course LC10 and LC-11(C7-303 and SEC-11 304)- Plant Biotechnology and Industrial Fermentation**

**Practical Time 4 Hrs/Week**

**M. Marks : 50**

**Time allowed for Examination: 4 Hrs.**

**Pass Marks : 35%**

**INSTRUCTIONS FOR THE PAPER SETTER/CANDIDATE**

The Final practical paper will consist of three sections A, B and C. Section A will contain write up (12.5 Marks) from the list of practical pertaining to lab course. Section B will contain practical to perform in examination (25 Marks) Section C will contain, practical note Book Evaluation and Viva Voce (12.5 Marks).

**List of Practicals:**

1. Orientation to a plant tissue culture facility.
2. Aseptic culture techniques for establishment and maintenance of cultures.
3. Preparation of stock solutions of MS basal medium and plant growth regulator stocks.
4. Micro propagation of provided plant material.
5. Callus initiation using explants.
6. Callus subculturing from an established callus.

**Lab Course LC11 (SEC-1-304)-Pertaining to Industrial Fermentations**

**List of Practicals:**

1. Demonstration of fermentation by using yeast *Saccharomyces cerevisiae*.
2. Demonstration of acetic acid oxidation (vinegar production) in laboratory.
3. Determination of growth curve of bacteria by spectrophotometric method.
4. Determination of most probable number (MPN) of coliforms in water.
5. Process for Biogas production by anaerobic digestion from waste.
6. Development of rhizobium inoculants.
7. Demonstration of wine production by using grape juice.

**Paper XIII (GE3-305)–Chemistry (Physical Chemistry-I)**

**Lectures to be Delivered: 60**

**M. Marks : 75**

**Time allowed: 3 Hours**

**Pass Marks : 35%**

**INSTRUCTIONS FOR THE PAPER SETTER/CANDIDATE**

The question paper will consist of three sections. Section A and B (Consist of unit I and II of the syllabus, respectively) will have four questions each from respective units and candidates are required to attempt two questions each from section A and B. Each question in section A and B shall carry 15 marks. Section C will consist of 10 short answer type questions covering entire syllabus and the candidates are required to attempt all questions. Each question in section C will carry 1.5 marks.

**Unit-I**

**Mathematical Concepts:** - Logarithmic relation, curve sketching, linear groups and Calculation of slopes, differentiation of functions, like  $k^x$ ,  $e^x$ ,  $x^n$ ,  $\sin x$ ,  $\log x$ , maxima and minima, partial differentiation and reciprocity relation, integration of some useful relevant functions.

**Liquid State:-** Inter molecular forces, differences between the gaseous, liquid and solid states, physical properties of liquid: vapour pressure, surface tension, surface active agents, viscosity, effects of temperature on viscosity, liquid crystal, thermography, LCDs and seven segment cell, classification of thermotropic liquid crystals: smectic and nematic liquid crystals, cholesteric liquid crystals, disc shaped liquid crystals and polymer liquid crystals.

**The Gaseous State:-** The kinetic molecular theory of gases, deviation from ideal behavior, Vander Waal's equation of state, kinetic energy and temperature, Maxwell distribution of molecular velocities and energies, types of molecular velocities, collision parameters (diameter, cross section, number frequency) mean free path, The critical phenomena P-V isotherm of  $\text{CO}_2$ , the Vander Waal's equation of critical state, principle of corresponding states, reduced equation of state, molar masses and density of real gases, liquefaction of gases, viscosity, diffusion.

**Chemical Kinetics:-** Rate of reaction, Rate law and Rate constant, Factors affecting rate of a reaction, order of reaction, units of rate constant, integration of rate expressions, zero order, first, second and third order, pseudo order reactions, Half-life time of a reaction, Methods of determining order of a reaction, Radioactive decay as a first order phenomenon, order and molecularity of reactions. Kinetics of complex reactions: opposing, consecutive, chain. Eyring equation, Lindmann theory of unimolecular gaseous reactions, effect of temperature and pressure on reaction rates.

**Catalysis:-** Introduction, homogenous and heterogeneous catalysis, kinetics of enzyme catalysed reaction, Michaelis-Menten equation.

**Unit-II**

**Thermodynamics:-** Introduction, Intensive and extensive properties, system, surrounding. State and path functions, zeroth law of thermodynamics. First Law: Definition of internal energy U, Heat capacity, Relation between heat capacities, free expansion of gases under isothermal and adiabatic conditions. Concept of entropy, entropy as a state function, entropy as a function of V and T, entropy as a function of P and T, entropy change in Physical process, Clausius inequality, entropy as a criterion of spontaneity and equilibrium entropy change in ideal gases and mixing of gases. Third law of thermodynamics, concept of residual entropy, Gibbs and Helmholtz function, Variation of Entropy, Gibbs free energy, Helmholtz free energy with T, V, P. Maxwell relations, thermodynamic equation of state.

**Thermochemistry:-** Heats of reaction: standard states, enthalpy of formation of molecules and ions, enthalpy of combustion and its applications, Flame and Explosion temperatures, Bond energies and its application.

**Chemical Equilibrium:-** Reversible and irreversible reactions, chemical equilibrium, Law of mass action, Thermodynamic treatment of the law of mass action, Van't Hoff reaction isotherm, Relation between  $K_p$ ,  $K_c$  and  $K_x$ , Homogeneous and heterogeneous equilibria, Le Chatelier's principle, Clausius-Clapeyron equation.

**Books Recommended:**

1. Physical Chemistry by Gurdeep Raj; Krishna Prakashan Media (P) Ltd.
2. Physical Chemistry by Puri Sharma Pathania; Vishal Publishing Co.
3. Physical Chemistry by Atkins; W.H. Freeman and Company, New York.
4. Advanced Physical Chemistry by Gurthu; Praghati Prakashan.
5. Physical Chemistry by K L Kapoor; Rajiv Beri for Macmillan India Ltd.
6. Physical Chemistry by Gurdeep Raj; Krishna Prakashan Media (P) Ltd.
7. Physical Chemistry by Puri Sharma Pathania; Vishal Publishing Co.
8. Physical Chemistry by Atkins; W.H. Freeman and Company, New York.
9. Advanced Physical Chemistry by Gurthu; Praghati Prakashan.
10. Physical Chemistry by K L Kapoor; Rajiv Beri for Macmillan India Ltd.

**Lab Course LC12 (GE 3-305)-Pertaining to Chemistry Paper**

**Practical Time 3 Hrs/Week**

**M. Marks : 50**

**Time allowed for Examination: 4 Hrs**

**Pass Marks : 35%**

**INSTRUCTIONS FOR THE PAPER SETTER/CANDIDATE**

The Final practical paper will consist of three sections A, B and C. Section A will contain write up (12.5 Marks) from the list of practical pertaining to lab course. Section B will contain practical to perform in examination (25 Marks) Section C will contain, practical note Book Evaluation and Viva Voce (12.5 Marks).

**List of Practicals:**

1. Determine the surface tension of glycerin and ethanol at room temperature using stalagmometer by drop number method.
2. Determine the coefficient of viscosity of glycerin and ethanol using Ostwald viscometer
3. To determine the heat capacity of calorimeter and enthalpy of neutralization of HCl and NaOH.
4. To determine the basicity of a polybasic acid by heat of neutralization method.
5. To study adsorption of acetic acid from aqueous solution by charcoal.
6. To study adsorption of iodine on charcoal from alcoholic solutions.
7. To study the effect of acid strength on rate of hydrolysis of ethyl acetate.
8. To determine the solubility of benzoic acid at different temperature and to determine the  $\Delta H$  of the dissolution process.

**B.Sc.( Hons.) Biotechnology Second Year (4<sup>th</sup> Semester)**

**Paper - XIV ( C8-401)– Molecular Biology**

**Course Objectives:**

1. The course is to expose the students to the structure of Nucleic acids & gene expression in both prokaryotes and eukaryotes.
2. At the end of the course the student is expected to gain an understanding of nucleic acids their role in gene expression & technologies for control of gene expression.

**Lectures to be Delivered**

**60**

**M. Marks : 75**

**Time allowed:**

**3 Hrs**

**Pass Marks : 35%**

**INSTRUCTIONS FOR THE PAPER SETTER/CANDIDATE**

The question paper will consist of three sections. Section A and B (Consist of unit I and II of the syllabus, respectively) will have four questions each from respective units and candidates are required to attempt two questions each from section A and B. Each question in section A and B shall carry 15 marks. Section C will consist of 10 short answer type questions covering entire syllabus and the candidates are required to attempt all questions. Each question in section C will carry 1.5 marks.

**Unit-I**

**DNA structure and replication:** DNA as genetic material, Structure of DNA, Types of DNA, Replication of DNA in prokaryotes and eukaryotes: Semiconservative nature of DNA replication, Bi-directional replication, DNA polymerases, Unique aspects of eukaryotic chromosome replication, Fidelity of replication.

**DNA damage, repair and homologous recombination:** DNA damage and repair: causes and types ,recombinational repair, nonhomologous end joining. Homologous recombination: models and mechanism.

**Unit-II**

**Transcription and RNA processing**

RNA structure and types of RNA, Transcription in prokaryotes: Prokaryotic RNA polymerase, Initiation, elongation and termination of RNA chains .Transcription in eukaryotes: Eukaryotic RNA polymerases, transcription factors, promoters, enhancers, mechanism of transcription initiation and elongation. Post transcriptional modifications and transcription inhibitors.

**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, Charging of tRNA, Mechanism of initiation, elongation and termination of polypeptides, Inhibitors of translation, Posttranslational modifications of proteins.

**Books Recommended:**

1. Genes VII, by Lewin, John Wiley and sons, New York.
2. Genes IX by Benjamin Lewin, Jones Bartlett Publ.
3. Friefelder Essentials of Molecular Biology: by G.M.Malaciniski D., Narosa

Publishing House, New Delhi.

4. Molecular Biology: by D. Friefelder, Narosa Publishing House, New Delhi.
5. Molecular Biology and Human Diseases; by A Macleod and S. Sijkora, Blackwell Scientific Publications Ltd., London.
6. Molecular Microbial Ecology Manual: Ed, ADLSK Kerman, J.D. Van Elsas, F.J. de Bruigin, Kluwer Academic Publ.

**Lab Course LC13 (C8-401)- Molecular Biology**

**Practical Time                      4 Hrs/Week**

**M. Marks : 50**

**Time allowed for Examination: 4 Hrs.**

**Pass Marks : 35%**

**INSTRUCTIONS FOR THE PAPER SETTER/CANDIDATE**

The Final practical paper will consist of three sections A, B and C. Section A will contain write up (12.5 Marks) from the list of practical pertaining to lab course. Section B will contain practical to perform in examination (25 Marks) Section C will contain, practical note Book Evaluation and Viva Voce (12.5 Marks).

**List of Practicals:**

- 1) Isolation of genomic DNA from E.coli cells.
- 2) Isolation of genomic DNA from blood cells.
- 3) Determine the molecular weight of DNA with Agarose gel electrophoresis.
- 4) Qualitative and quantitative analysis of DNA by spectrophotometric method.
- 5) Isolation of genomic DNA from plants.

**Paper - XV (C 9-402)- Immunology**

**Course Objectives:**

1. This course aims to familiarize the students to mechanisms associated with immune system, any abnormalities which could lead to disease development.
2. Students will be able to distinguish between innate & acquired immunity, they should also be able to demonstrate and identify immune cells specific functions. They can correlate between immune/disease development

**Lectures to be Delivered 60**

**M. Marks : 75**

**Time allowed:**

**3 Hrs**

**Pass Marks : 35%**

**INSTRUCTIONS FOR THE PAPER SETTER/CANDIDATE**

The question paper will consist of three sections. Section A and B (Consist of unit I and II of the syllabus, respectively) will have four questions each from respective units and candidates are required to attempt two questions each from section A and B. Each question in section A and B shall carry 15 marks. Section C will consist of 10 short answer type questions covering entire syllabus and the candidates are required to attempt all questions. Each question in section C will carry 1.5 marks.

**Unit-I**

**Introduction:** Introduction and history of immunology.

**Cells and organs involved in immune response:** Myeloid cell and Lymphoid cell, Primary and Secondary lymphoid organs

**Types of immunity:** Innate and acquired immunity, Humoral and cell mediated immune response.

**Immunoglobulins:** Types, Structure, distribution and functions.

**Antibody Diversity:** Immunoglobulin Gene, Mechanisms of Antibody Diversity.

**Cytokines:** Introduction, properties, functions.

**Unit-II**

**Hypersensitivity:** Type I, II, III and IV hypersensitivity.

**Autoimmunity:** Autoimmune diseases: Organ specific: (Hashimoto's thyroiditis, Grave's disease) systemic specific: (Rheumatoid arthritis).

**Transplantation:** Introduction: Types of rejection, prevention of rejection.

**Immunoresponse Techniques:** Methods to assay humoral immune response : agglutination, immunodiffusion, immunoelectrophoresis, RIA, ELISA.

**Monoclonal antibodies :** Production of monoclonal antibodies by Hybridoma Technology, applications of monoclonal antibodies.

**Introduction to vaccines:** Types of vaccines: conventional vaccines (Attenuated, Inactivated, subunit vaccines) modern vaccines (conjugate, DNA vaccine).

**Books Recommended:**

Cellular and Molecular Immunology by Abbas, A.K. Lichtman, A.H. Pober, J.S. W.B. Saunders Co., Philadelphia.



Immunology by A.I. Prentice Hall International London.

Essential Immunology: 12th Edn., Roitt I.M. Blackwell Scientific Pub.

Immunology: Sixth Edn., Kuby Janis, W.H. Greenman and Co., New York.

Immunology, Tizard, I.R. Fourth Edition. Saunders College Publishing, Philadelphia.

The experimental Foundation of Modern Immunology, Clark, W.R. Fourth Ed. John Wiley and Sons. New Y 1991.

Benjamin E. Immunology: A short course 3<sup>rd</sup> Edition, John Wiley, New York.

Kuby's Immunology by Kindt, Osborn, Goldsby 6<sup>th</sup> Edition.

**Lab Course LC14 (C9-402)-Pertaining to Immunology**

**Practical Time**

**4 Hrs/Week**

**M. Marks : 50**

**Time allowed for Examination: 4 Hrs.**

**Pass Marks : 35%**

**INSTRUCTIONS FOR THE PAPER SETTER/CANDIDATE**

The Final practical paper will consist of three sections A, B and C. Section A will contain write up (12.5 Marks) from the list of practical pertaining to lab course. Section B will contain practical to perform in examination (25 Marks) Section C will contain, practical note Book Evaluation and Viva Voce (12.5 Marks).

**List of Practicals:**

1. Preparation of blood serum.
2. Determination of Differential Leucocyte Count (DLC).
3. Determination of Total Leucocyte Count (TLC).
4. Radial immuno-diffusion test for detection of antigen.
5. Determination of antigen and antibody reaction by rocket immuno-electrophoresis.
6. Ouchterlony Double diffusion assay for detection of antigen.

**Paper -XVI (C10-403)- Biophysics**

**Course Objectives:**

1. To aware the students about methods of physics to study biological systems like thermodynamics, bioenergetics, chemical kinetics, electrode potential and quantum mechanics.
2. Exposure of instrumental techniques like spectroscopy, diffraction, optical and various hydrodynamic techniques in the field of biotechnology.

**Lectures to be Delivered**

**60**

**M. Marks : 75**

**Time allowed:**

**3 Hrs**

**Pass Marks : 35%**

**INSTRUCTIONS FOR THE PAPER SETTER/CANDIDATE**

The question paper will consist of three sections. Section A and B (Consist of unit I and II of the syllabus, respectively) will have four questions each from respective units and candidates are required to attempt two questions each from section A and B. Each question in section A and B shall carry 15 marks. Section C will consist of 10 short answer type questions covering entire syllabus and the candidates are required to attempt all questions. Each question in section C will carry 1.5 marks.

**Unit-I**

**Thermodynamics:** Review of principles of thermodynamics, free energy, enthalpy and entropy, energy yielding and energy requiring reactions, coupled reactions.

**Redox Potentials:** Oxidation & Reduction, Electro chemical cell, Galvanic cell, Redox potentials & its calculations by Nernst equation.

**Bioenergetics:** High energy phosphate bond, oxidative phosphorylation, components of ETC (cytochromes, Ferredoxin, oxidases and dehydrogenases), Electron transport chain, Chemiosmotic model, membrane potential.

**Chemical kinetics:** Rate of reaction, order, molecularity, half life of a reaction

**Spectroscopy:** Introduction, Beers Lamberts law, molar and extinction coefficient, Principle, instrumentation and applications of UV-VIS spectrophotometry and spectrofluorimetry.

**Unit-II**

**Diffraction techniques:** Principle, instrumentation and applications of X-ray diffraction.

**Optical Techniques:** Principle, instrumentation and applications of Flow cytometry.

**Hydrodynamic Techniques:** Introduction to diffusion, viscosity and osmosis.

**Quantum mechanics:** Wave theory of light, photoelectric effect, Debroglie concept, Hesienberg uncertainty principle.

**Isotopes in biology:** Effects of IR spectra. Hydrophobic interactions, definitions and illustrations, ionic interactions (salt bridges etc.) Radioactive decay, production of isotopes, use of isotopes as tracers in biological sciences.

**Books Recommended:**

1. Biophysical Chemistry - Principles and Techniques. Upadhyay, Upadhyay and Nath, 2<sup>nd</sup> Edition. Himalaya Publishing House.
2. Physical Chemistry with application to Biological systems: Raymond Chang, 2<sup>nd</sup> Edition, MacMillan Publishing Co. 2 No. New York.
3. Biophysical Chemistry (2011) by Alan Cooper RSC Publisher
4. Biophysical Chemistry (2008) by James P. Alen Wiley-Blackwell
5. Physical Biochemistry by Van Holde, K.E., (2006) Prentice Hall, Englewood, Cliffs, New York.
6. Physical Chemistry with Applications to Life Sciences (1979) by Eisenberg, D and Brothers, D., Benjamin-Cumming, California, USA
7. Physical Chemistry: Principles and Applications to Biological Sciences (2007) by Tinco, Pearson Education.

**Paper - XVII (SEC-2-404)- Enzymology**

**Course Objective:**

1. To make the students conversant with structure and mechanism of enzymes
2. To make the student acquire sound knowledge of kinetics and enzyme inhibitions
3. To acquaint the student with concepts of enzyme production purification and applications.

**Lectures to be Delivered**

**30**

**M. Marks : 40**

**Time allowed:**

**3 Hrs.**

**Pass Marks : 35%**

**INSTRUCTIONS FOR THE PAPER SETTER/CANDIDATE**

The question paper will consist of three sections. Section A and B (Consist of unit I and II of the syllabus, respectively) will have four questions each from respective units and candidates are required to attempt two questions each from section A and B. Each question in section A and B shall carry 7.5 marks. Section C will consist of 5 short answer type questions covering entire syllabus and the candidates are required to attempt all questions. Each question in section C will carry 2 marks

**Unit-1**

**Introduction to enzymes:** Introduction and properties of enzyme, classification of enzymes. **Enzyme activity, units of enzyme activity, cofactors, coenzymes and prosthetic group (brief introduction).**

**Enzymes specificity-** Types of specificity, lock and key hypothesis, induced fit hypothesis.

**Enzyme catalysis:** Factors responsible for catalytic efficiency of enzymes (pH, temperature).

**Kinetics of enzyme catalyzed reactions:** Michaelis-Menten equations, modification of Michaelis-Menten equations (Line weaver-Burk plot).

**Allosteric enzyme:** Characteristics of allosteric enzymes.

**Unit-II**

**Enzyme production:** Microbial sources of enzymes, criteria for the selection of microbes for the enzyme production, Microbial production of amylase.

**Enzyme purification:** Introduction to primary and secondary purification methods. purification fold,% recovery.

**Enzyme Inhibition:** Concept of enzyme inhibition, types of enzyme inhibition.

**Immobilized enzymes:** Enzyme immobilization Methods of enzyme immobilization (adsorption, covalent bonding, and gel entrapment), Co immobilization.

**Application of enzymes-:** Application of enzyme in diagnosis and treatment of disease (enzyme therapy).

**Books Recommended:**

1. Shultz, A.R. (1994). Enzyme Kinetics, Cambridge Press.
2. Trevor, P. (1995). Understanding Enzymes, 4th ed. Prentice Hall/Ellis Horwood, England.
3. Microbial Genetics; by D. Friefelder, Narosa Publishing House, New Delhi, 1989.
4. Price, N.C. and Strevens, L. (1999). Fundamentals of Enzymology, 3rd ed., Oxford University Press.
5. Palmer, T. (2001). Enzymes. Horwood Publishing, Chichester.

**Lab Course LC15 and LC16 (C10-403 and SEC-2-404) pertaining to Biophysics and Enzymology**

**Practical Time**

**4 Hrs/Week**

**M. Marks : 50**

**Time allowed for Examination: 4 Hrs.**

**Pass Marks : 35%**

**INSTRUCTIONS FOR THE PAPER SETTER/CANDIDATE**

The Final practical paper will consist of three sections A, B and C. Section A will contain write up (12.5 Marks) from the list of practical pertaining to lab course. Section B will contain practical to perform in examination (25 Marks) Section C will contain, practical note Book Evaluation and Viva Voce (12.5 Marks).

**List of Practicals:**

1. Quantitative analysis of protein by different methods.
2. Determine the viscosity of given sample.
3. Determination of  $\lambda_{\text{max}}$  of protein and nucleic acid from UV-VIS spectrum
4. Verification of Beers Lamberts law with UV-VIS spectrophotometer.
5. Determine the effect of salt concentration on the osmosis
6. Effect of pH, salt type, and ionic strength on aqueous bovine serum albumin solutions.
7. Characteristics of UV absorption spectra of Aromatic Amino Acids.
8. Chemical estimation of sugars by DNS method

**List of Practical's: LC-16 SEC-2 404**

9. Production of amylase enzyme.
10. Estimation of enzyme activity and specific activity.
11. Determination of enzyme activity in presence of activators/ inhibitors.
12. Determination of optimum pH for the activity of enzyme.
13. Determination of optimum temperature for the activity of enzyme.
14. Determination of  $K_m$  &  $V_{\text{max}}$  for the enzyme.
15. Enzyme Immobilization and saccharification of polysaccharides

**Paper-XVIII(GE-4 405) Chemistry (Inorganic-II)**

**Lectures to be Delivered 60**

**M. Marks : 75**

**Time allowed: 3 Hours**

**Pass Marks : 35%**

**INSTRUCTIONS FOR THE PAPER SETTER/CANDIDATE**

The question paper will consist of three sections. Section A and B (Consist of unit I and II of the syllabus, respectively) will have four questions each from respective units and candidates are required to attempt two questions each from section A and B. Each question in section A and B shall carry 15 marks. Section C will consist of 10 short answer type questions covering entire syllabus and the candidates are required to attempt all questions. Each question in section C will carry 1.5 marks.

**Unit-I**

**Chemistry of s-Block Elements:-** Comparative study, diagonal relationships, salient features of hydrides, solvation and complexation tendencies including their functions in biosystems. Basic beryllium acetate, oxalate.

**Chemistry of Noble Gases:-** Occurrence and uses, rationalization of inertness of the noble gases and its failings, chemical properties of the noble gases. Nature of bonding in Noble gas compounds (VBT) and Molecular Orbital treatment for XeF<sub>2</sub>. Preparation and properties of XeF<sub>2</sub>, XeF<sub>4</sub>, XeF<sub>6</sub>, XeOF<sub>4</sub>, XeO<sub>2</sub>F<sub>2</sub>, XeO<sub>3</sub>. Molecular shapes of noble gas compounds (VSEPR theory).

**Chemistry of p-Block Elements:-** Comparative study ; diagonal relationships of groups 13-17 elements compounds like hydrides, oxides, oxyacids, halides of groups 13-16. Hydrides of boron: diborane, higher boranes, borohydrides. Fullerenes, carbides, fluoro-carbons, tetrasulphur tetra nitride. Basic properties of halogens, Interhalogens and polyhalides. Allotropy catenation.

**Inorganic Polymers:-** Types of inorganic polymers; comparison with organic polymers, synthesis, structural aspects; applications of silicones, siloxane Phosphonitrilic halides, condensed phosphates, Borazines, phosphazenes, silicates, polysulphates.

**Unit-II**

**Transition Elements:-** General group trends with special reference to electronic configuration, colour, variable valency, magnetic and catalytic properties, ability to form complexes, co-ordination no. and geometry, stability of various oxidation states, spectral properties, stereochemistry. Difference between first, second and third transition series. Chemistry of T, V, Cr, Mn, Fe and Co in various oxidations

states (excluding their metallurgy).

**Co-ordination Compounds:-** Werner's theory and its experimental verification; effective atomic number concept, chelates and their stability ; Chelation ; Nomenclature of co-ordination compounds , valence Bond theory of transition metal complexes.

**Magnetic properties of transition Metal Complexes:-** Types of Magnetic behavior, method of determining magnetic susceptibility, spin- only formula, L-S coupling, correlation of  $\mu_s$  and  $\mu_{eff}$  values, orbital contribution to magnetic moments, application of magnetic moment data for 3d- metal complexes, Temperature Independent Paramagnetism (T.I.P).

**Lanthanides and Actinides:-** Electronic configuration, oxidation states, colour, spectral, magnetic properties, Lanthanide contraction, Actinide contraction, complex formation, occurrence and isolation of lanthanide compounds. Chemistry of separation of Np, Pu and Am from U. Similarities between later actinides and the later lanthanides.

**Books Recommended:**

1. Lee, J.D. Concise Inorganic chemistry, ELBS.
2. Cotton, F.A. and Wilkinson, G, Advanced Inorganic Chemistry, Wiley, VCH, 1999
3. Principle of Inorganic chemistry by Puri, Sharma, Kalia, Milestone Publishers, Delhi.

**Lab Course LC-17 (GE-4 -405)-Pertaining to Chemistry Paper**

**Practical Time            3 Hrs/Week**

**M. Marks : 50**

**Time allowed for Examination: 4 Hrs**

**Pass Marks : 35%**

**INSTRUCTIONS FOR THE PAPER SETTER/CANDIDATE**

The Final practical paper will consist of three sections A, B and C. Section A will contain write up (12.5 Marks) from the list of practical pertaining to lab course. Section B will contain practical to perform in examination (25 Marks) Section C will contain, practical note Book Evaluation and Viva Voce (12.5 Marks).

**List of Practicals:**

1. Estimation of copper in sample of copper sulphate crystals using standardized sodium thiosulphate solution iodometrically.
2. Estimation of available chlorine in bleaching powder iodometrically.
3. Estimation of  $\text{KMnO}_4$  solution iodometrically.
4. Estimation of Magnesium, Nickel, Copper with EDTA.
5. Estimation of Chloride by Mohr's method, Volhard's method and Fajan's method
6. Estimation of carbonate and bicarbonate present together in the mixture.
7. Estimation of ferrous and ferric ions in the given mixture using standard  $\text{KMnO}_4$ .