



**Revised in
Year 2017**

M.Sc. Biomedical Science (Ordinance & Syllabus)



**Institute of Biomedical
Sciences Bundelkhand
University, Jhansi**



ORDINANCE

There shall be M.Sc. in Biomedical Science offered by the Department of Biomedical Sciences at Institute of Biomedical Sciences of the University. The courses shall run on regular basis. Subjected to overall control of the Academic Council (AC) of University, M.Sc. Biomedical Science in the Department will be administered by a course committee consisting of Head/Coordinator, and all members of the department.

This committee shall

- (a) Invite, scrutinize applications and make admissions to the M.Sc. courses
- (b) Design courses and prepare syllabi for the same.
- (c) Organize lectures, seminars and supervise the dissertation work.
- (d) Constitute Board of Studies (BoS) for the department.
- (e) Arrange and conduct theory and practical examination, including seminars, tests, viva-voce etc. as per Board of Studies (BoS) recommendations.

1. Duration of the course

The duration of M.Sc. Program in Biomedical Science will be of 02 calendar years and shall run in four (4) semesters.

2. Procedure for admission

- (a) The students shall be admitted to M.Sc. program on the basis of eligibility and all India Entrance test to be conducted by the University for the same.
- (b) A candidate shall be eligible for admission to M.Sc., if he/ she has completed education with 10+2+3 system with Biology flow viz. Biomedical Science/ Biochemistry/ Microbiology/ Biotechnology/ and any other branch of Life Sciences and has secured minimum 45% marks at graduation level.
- (c) The admission test shall be conducted by the University in all cases, provided the number of eligible applicants is less than or equal to the number of seats available in the subject, the requirement of the test may be waived by the admission committee on the recommendation of HOD/Coordinator and Dean Faculty.
- (d) Candidates shall be selected on the basis of merit of the admission test to be prepared by the university admission cell including permissible weightages and reservations under the University/State Govt. rules.

3. Normal Intake

The maximum intake for M.Sc. Biomedical Sciences will be Forty (40). However, University may modify the normal intake as per needs. Statutory reservation shall be applicable as per University/ State Government rules/norms.

4. Medium of Instruction: Medium of instruction and examination shall be English.



5. Methods of teaching

Methods of teaching in the academic program will consist of theory and practical classes taken by regular teachers & Teaching Assistants (TA) of the department, from other departments of the university and visiting/guest faculty from other academic Institutions. Seminars, Group Discussions (GDs) research training, project works shall be essential component of the curriculum. Quality study materials will also be provided besides computer aided instruction and audio-visual teaching methods. Educational tours to various academic and research institutions shall be organized once in an academic year.

6. Attendance

Minimum attendance required being eligible to appear in the internal assessment & semester examination for each paper shall be as following:

- (a) *First Internal Assessment*: 50% of all class lectures (Theory and Practical both).
- (b) *Second Internal Assessment*: 60% of all class lectures (Theory and Practical both).
- (c) *Final Semester Examination*: 75% of all class lectures (Theory and Practical both).

In case a student is short of attendance due to illness, participation in sports, extracurricular activities etc the following rules shall be applied.

- (d) A shortage of attendance up to 10% can be condoned by the HOD/ Coordinator of the Department on the specific recommendation of the subject teacher.
- (e) A shortage of attendance up to 25% can be condoned by the Hon'ble Vice Chancellor on medical grounds on the specific recommendations of the HOD/Coordinator.
- (f) Students shall be allowed to go for training for a specific time period in different institutions of India with the permission of Head/Coordinator of the department. The training period duly certified by HOD/Coordinator of the department shall be considered as normal attendance of the student. The students willing to go for training during summer/winter holidays will have to take permission from the HOD/Coordinator to join the training where they are allowed.
- (g) Students failing to secure minimum attendance even after consideration of all above clauses will have to re-register in that particular paper in which they are short of the minimum required attendance as and when the paper is offered by the department.

7. Examination

M.Sc. programme in Biomedical Science will have following examinations.

7.1 Theory Examinations

Semester/ Year end Examination

The semester shall be conducted by the university as per academic calendar of the department. The question paper will be set by the examiners appointed by Hon'ble Vice-Chancellor from expert panel recommended by the Board of Studies (BoS). The pattern



of the question paper shall be decided by the University. The weightage of this examination will be 70% with 3 hours duration of each theory examination.

Sessionals (Internal assessment)

Sessional examinations shall be conducted by the department on regular intervals during the whole session. The number of sessional examination to be conducted per session and policy for averaging the marks, providing grace marks shall be decided by the Departmental Committee (DC) including all teachers of the department. The weightage of this examination will be 30 % (30 marks out of 100) of each paper. Out of 30 marks, each sessional examination will be conducted for 15 marks only. Remaining 15 marks shall be trifurcated in 5-5 marks each for a) class seminar b) Group Discussion (GD) and c) Punctuality Discipline and Sincerity (PDS) of the student. The question paper pattern of the sessional examination shall be MCQ type/as decided by the DC/university.

7.2 Practical Examinations

The practical examinations shall be conducted in those papers where it is given in the course structure. The examiners will be appointed by Hon'ble Vice-Chancellor from experts' panel recommended by the BoS. Maximum marks of each practical examination will be 100 marks.

7.3 Maximum marks

Maximum marks for each theory and practical paper will be 100. The maximum marks for M.Sc. project/dissertation work will be 200 only.

7.4 Minimum passing marks

40% marks of each theory, practical and dissertation work. It will be required to obtain minimum 40% marks in each theory (annual, sessional and practical paper separately) to promote to the next year.

7.5 Back Paper Examination and Improvement

The student is required to pass minimum 50 % theory and all practical papers of a year to be eligible for promotion in next year. In case a candidate fails to pass 50 % of theory, and all practical papers he/she will be declared as failed and will have to reappear in examination of all papers with junior batch students' examination as ex- student. Student having back paper in less than 50% papers may appear in back paper examination in subsequent semester examination. The candidate may also be allowed to improve his/her marks in maximum 02 papers of previous semester/year, the examinations of which shall be conducted along with subsequent semester examinations.

A student will have to clear all theory and practical papers by the end of the last semester in order to be eligible for the award of the relevant degree by the university.



The maximum time allowed for passing all paper required for the award of degree shall be double time of the duration of the course i.e. 04 years.

In case students are unable to clear all the papers by the end of the last year, they may be allowed to reappear in subsequent examinations, as an ex student, without undergoing a repeat of the regular academic program and practical examination, if passed in previous year.

With the permission of Hon'ble Vice Chancellor on the recommendations of Head/Coordinator of the department, a special back paper examination may also be conducted for such final year students who have backs in few papers of previous years/semesters. The date of examinations shall be decided by the department/university.

7.6 Results and Divisions for theory, practical and project work.

A student shall be declared PASSED if he/she secures minimum 40% passing marks in all theory and practical examinations separately. The aggregate marks obtained will be counted for the award of divisions.

- (a) *Second Division*: 50% or more but less than 60%
- (b) *First Division*: 60% or more but less than 75%
- (c) *Distinction*: 75% or above

7.7 Practical/Summer training

Student may undergo practical/summer training during the months of June and July. After training the student shall be required to submit a project report duly signed by the supervisor to the department. However, summer training being not a part of course curriculum will not be compulsory to do.

7.8 Project work/ dissertation

According to course curriculum, each M.Sc. student will have to undertake a project work under the guidance of project supervisor for a period of 4-6 months. The students will have option of undertaking project work in the department laboratory or in other Institutions with due permission of Coordinator/HOD. If a student undertakes the project in outside institution the Coordinator/HOD may allot one of the faculty members as the supervisor/co-supervisor of the student.

7.9 Submission of Dissertation

The student will be allowed to submit his/her thesis once the supervisor and co-supervisor is satisfied with the progress and completion of the research work. The project work should be an original research work carried out by the student. The student's statement of the same duly certified by supervisor, co-supervisor (if applicable) and Coordinator/HOD should necessarily be enclosed with the dissertation report.



7.10 Oral defense of the Dissertation/Thesis

The student will be required to defend his/her research work in front of a panel consisting internal examiner and an external examiner appointed by the Hon'ble Vice Chancellor.

7.11 Final award of Divisions/Degree

The students will be declared passed in a particular division after considering the average of marks obtained in all theory, practical examinations and project work.

7.12 Discontinuation

A candidate who has discontinued the academic program in any semester may be readmitted in the course with the permission of Hon'ble Vice Chancellor on the recommendation of Coordinator/HoD within not beyond a gap of 02 years. Fee once paid shall not be refund or adjusted during subsequent admission.

8. Fees

The course fees shall be decided and revised by the university time to time which need to be deposited by the candidate at the time of admission in the course/as and when asked to do so.

9. Academic collaboration

The said academic program may be run in collaboration with other institutes where necessary facilities are available.

10. Educational Tour/Field Trips

The department shall organize students' educational tour/field trip once in every academic year for wider exposure of recent trends in R&D sector of Biomedical Sciences. However, it will not be a compulsory part of the curriculum.

11. Amendment of rules

The above rules are subjected to revise time to time by the competent authority/committee duly constituted by the university, as and when deemed necessary.

12. Revision of course structure

The course structure should regularly be updated by the Board of Studies, or a committee appointed by the Hon'ble Vice Chancellor for this purpose.

13. Award of Degree:

On completion of all academic requirements and on the recommendations of the HOD/Coordinator, the university shall award degree to the student.



COURSE CURRICULUM (M.Sc. Biomedical Science) New

M.Sc. Part-I: First Semester

| Paper no. | Paper code | Title | Max. marks |
|------------------|-------------------|--|-------------------|
| Paper-I | BMS-101/6771 | Biochemistry | 100 |
| Paper-II | BMS-102/6772 | Organic Chemistry | 100 |
| Paper-III | BMS-103/6773 | Medical Microbiology | 100 |
| Paper-IV | BMS-104/6774 | Bioinstrumentation & Analytical Techniques | 100 |
| Paper-V | BMS-105/6775 | Practical-I: (Biochemistry and Organic Chemistry) | 100 |
| Paper-VI | BMS-106/6776 | Practical-II: Medical Microbiology and Bioinstrumentation & Analytical Techniques) | 100 |

Total marks = 600

Second Semester

| Paper no. | Paper code | Title | Max. marks |
|------------------|-------------------|---|-------------------|
| Paper-VII | BMS-107/6777 | Bioinformatics & Biostatistics | 100 |
| Paper-VIII | BMS-108/6778 | Clinical Biochemistry | 100 |
| Paper-IX | BMS-109/6779 | Human Physiology | 100 |
| Paper-X | BMS-110/6780 | Immunology | 100 |
| Paper-XI | BMS-111/6781 | Practical -III (Clinical Biochemistry) | 100 |
| Paper-XII | BMS-112/6782 | Practical -IV (Human Physiology and Immunology) | 100 |

Total marks = 600

M.Sc. Part-II: Third Semester

| Teacher's Code | Paper code | Title | Max. marks |
|-----------------------|-------------------|--|-------------------|
| Paper-XIII | BMS-201/7771 | Molecular Biology | 100 |
| Paper-XIV | BMS-202/7772 | Genetics & Biotechnology | 100 |
| Paper-XV | BMS-203/7773 | Medicinal Chemistry | 100 |
| Paper-XVI | BMS-204/7774 | Pharmacology & Toxicology | 100 |
| Paper-XVII | BMS-205/7775 | Practical -IV (Molecular Biology and Genetics & Biotechnology) | 100 |
| Paper-XVIII | BMS-206/7776 | Practical -V (Medicinal Chemistry and Pharmacology & Toxicology) | 100 |

Total marks = 600

Fourth Semester

| Paper no. | Paper code | Title | Max. marks |
|------------------|-------------------|--------------------------------|-------------------|
| Paper-XIX | BMS-209/7777 | Dissertation/ Research Project | 200 |

Total marks = 200

Grand Total for M.Sc. part- I (1200) + Part -II (800) = 2000

**Suggested Norms for Credit Assignment****Teaching:** Semesters – 90 Days**Lectures/Tutorials:** 1 Credit = 15 Hours*(If 45 hours teaching is assigned for a course of study/paper during a semester, the same will stand for 3 credits)***Practical/Lab Work:** 1 Credit = 2 Hours' Practical for 15 days**Field Study/Study Tour (Study Tour Report based on Field Study/Study Tour):** 1 Credit = 3 Hours × 15 days (+1 Credit for Viva Voce/Presentation)**Summer Training/Industrial Training including Training Report:** 1 Credit = 3 Hours × 15 days (+1 Credit for Viva Voce/Presentation)**Dissertation:** 6 Credits (1 Hours × 90 days/ 15) + Viva Voce: 2 Credits = 6+2 = 8 Credits**Proposed Structure for CBCS**

| Courses/Papers | | First Semester Credit | Second Semester Credit | Third Semester Credit | Fourth Semester Credit |
|---------------------------------|--|-----------------------|------------------------|-----------------------|--|
| Core Papers | Theory (4 papers/year) <i>Calculated for 45 Hrs lectures per paper @ 1 Credit = 15Hrs. Lectures/Tutorial</i> | 3x4= 12 | 3x4= 12 | 3x4= 12 | 12 Credits (1 Hours × 180 days/ 15) + 2 Credits of Viva Voce: 12+2 = 14 |
| | Practical (2 papers/ year) <i>Calculated for 15 days, 3 Hrs. practical per paper @ 1 Credit =2 Hr. practical for 15 days</i> | 3x2=06 | 3x2=06 | 3x2=06 | - |
| Elective/Optional Papers | | NA | NA | NA | NA |
| Self-Study Courses | | NA | NA | NA | NA |
| Total Credits | | 18 | 18 | 18 | 14 |



Detailed Syllabus of M.Sc. I Semester

Paper-I

BMS-101/6771

Biochemistry

ENERGY METABOLISM

1. *Molecular logics of life:* Subcellular organelles, Nucleus, Endoplasmic reticulum, Galgi apparatus, Lysosomes, Peroxisomes, Mitochondria.
2. *Elementary chemical Thermodynamics:* Laws of thermodynamics, Enthalpy, Redox potential, Free Energy and Entropy.
3. *Electron transport chain:* Role of cytochrome enzymes viz. NADH-Q reductase, cytochrome reductase and cytochrome oxidase. ATPase proton-motive force, evidences for proton pump and conformational hypothesis.

CARBOHYDRATE: Classification, Structure, Isomerism, Properties and Biological significance.

CARBOHYDRATE METABOLISM

1. Glycolysis, gluconeogenesis, Glucogenolysis reaction mechanisms and regulation.
2. Tricarboxylic acid cycle, role of vitamins in TCA cycle, Regulation of Tricarboxylic acid cycle.
3. Mechanism and significance of Hexose monophosphate shunt.
4. Regulation of blood sugar level and Hormonal control.

LIPID: Classification, Structure, Properties and function of fatty acids.

LIPID METABOLISM

1. Storage Lipids-structure and composition of fatty acids, Triacylglycerols, Phospholipids and its derivatives, sphingolipids, cerebrocides.
2. Lipogenesis, Lipolitic system and hormonal control. Fatty acid synthesis, Oxidation of fatty acids, Generation of ATP by the complete oxidation (β -Oxidation+TCA cycle) of fatty acid.
3. Cholesterol: Biosynthesis and its regulation, Hypochlesterolemic agent/Drugs. Formation of ketone bodies, Synthesis of phospholipid.

STRUCTURE OF AMINO ACIDS and PROTEIN

1. *Aminoacids-* Structure, classification, acid base properties and titration curve, Peptides bonds.
2. *Structure of protein-* Primary, Secondary & Tertiary structure of protein with examples. α helix, β sheets, Ramachandran plot, factors effecting secondary structure and tertiary structure of proteins.
3. *Structure and function of hemoglobin:* Conformational studies, binding of oxygen and its release, oxygen binding of hemoglobin and myoglobin, studies oxygen saturation curves.

PROTEIN METABOLISM

1. Biosynthesis of amino acids (acidic, basic and neutral amino Amino acid oxidation.
2. Nitrogen excretion and urea circle. Creatine and Creatinine.



NUCLEOTIDE METABOLISM

1. Structure and Properties of Purines and Pyrimidines base.
2. *Biosynthesis of Nucleotides*: synthesis of purine, synthesis of pyrimidines.

MEMBRANE AND TRANSPORT

1. *Basic structure of lipid bilayers*: fluid mosaic model of biologic membranes, *In-vitro* reconstitution of membrane and their uses.
2. *Membrane Protein*-Glycophorins, Receptors, Microscopic and X-ray analysis of membrane protein.
3. *Membrane Transport* -Endocytosis, diffusion, active transport, transport of ions, structure of sodium potassium pump and mechanism, ..

ENZYMOLGY

1. *Introduction*: General characteristics of enzymes, definition of coenzyme, holoenzyme, prosthetic groups, classification of Enzymes.
2. *Catalysis*: Homogeneous and heterogeneous catalysis, Biocatalysis, Chemical Kinetics: Rates & orders of reactions, factors effecting reaction rates. Enzyme Kinetics: Substrate, active site, transition state, activation energy, equilibrium constant K_m , V_{max} , specificity, Michaelis-Menten equation. Lineweaver-Burk equation, double reciprocal plot and turnover number.
3. *Regulation of enzyme activity*: Reversible and irreversible Inhibition (non-competitive, competitive) and their effects on K_m and V_{max} , effect of pH, heat and other inhibitors.
4. Allosteric enzymes.

Book(s) Recommended: *Principle of Biochemistry: Lehninger by Nelson & Cox*



Paper-II

BMS-102/6772

Organic Chemistry

(Reaction Mechanisms and Natural Products)

1. Properties of Molecules:

Electrophiles and Nucleophiles, Carbenes, Free Radicals, Carbocations, Carbanions, Inductive and Resonance, Electromeric Effect, Mesomeric Effect.

2. Reaction Mechanisms:

Reduction, Aromatic Substitution Reaction (Nitration, Sulphonation, Chlorination), Elimination Reaction (Dehydration of Alcohol, Dehydro Halogenations of Alkyl Halide), Hydrolysis, Addition Reaction, Substitutions, Esterification, Etherification, Photocyclization

3. Occurrence, Isolation and extraction following natural products]

a) **Terpenoids:** Menthol, Zingiberene and Citral

b) **Alkaloids:** Nicotine, Coniine, Quinine, Adrenaline

c) **Biological function of Vitamin with synthesis:** Vitamin A1, Vitamin C (Ascorbic Acid).

(Heterocyclic and Bioorganic chemistry)

4. Heterocyclic chemistry

Structure and Reactivity of the following ring systems of biological significance: Furan, Pyrrole, Thiophene, Carbazole, Indole, Pyridine, Quinoline and Isoquinoline, Acridine, Purines and Pyrimidines.

5. Carbohydrates (bio-organic chemistry)

Classification, Monosaccharides-Glucose, Fructose and their reactions, cyclic structure of D-Glucose, mutarotation and conformation. Disaccharides-Maltose, Sucrose, Lactose. Polysaccharides-starch, Cellulose, Insulin. Structure of aminosugars-D-ribose, 2-deoxyribose. Glycosides-Classification and method of isolation, alpha & beta D-methylglucose. Structure of arbutin.

6. Important name reaction used in biosynthesis

Fries, Pinacol-Pinacolate rearrangement, Beckmann, Wolff, Perkin, Gattermann Koch reaction, Hunsdiecker, Wittig, Chromethylation. Cannizzaro, Gattermann aldehyde synthesis, Reimer-Tiemann Reaction, Houben-Hosein reaction.

7. Chemotherapeutic use in Biomedical

Antiseptic and disinfectants- Formaldehyde solution, Hexachlorophen. Antiloprotic-Dapsone, Solapson. Antitubercular agent-Isoniazid, PAS. Antibiotic-Benzylpenicillin, Ampicillin, Cloxacillin. Analgesic and antipyretics- Aspirin, Paracetamol.

8. Bio-Organic natural and synthetic colouring matters

Medicinal dyes: Mercurochrome, Fluorocene, TNP. Porphyrins-Chlorophyll and Haemin.

Book(s) Recommended: Text Book of Organic Chemistry by O.P. Agarwal



Paper-III

BMS-103/6773

Medical Microbiology

MICROBIAL BIOLOGY

- Introduction and history background of microbiology
- Microscopic methods for observing microorganisms
- Taxonomy, nomenclature and identification
- Culture and nutrient of microorganism
- Organization and ultra structure of microorganism
- Sterilization and Disinfection
- Antimicrobial chemotherapy ad chemotherapeutic agent
- Laboratory diagnosis of bacterial disease
- Safety in the microbiology laboratory
- Epidemiology of bacterial disease

BACTERIAL PATHONES AND ASSOCIATED DISEASES

- Normal Human flora
- Pathogenesis and virulence Factor of bacteria
- Human disease caused by bacteria
 - a) Respiratory tract infection
 - b) Urinary tract infection
 - c) Genital tract infection
 - d) Gastrointestinal tract infection
 - e) Blood stream & CNS infection

FUNGAL PATHOGEN & PARASTIC INFCTION

- Rash disease, Ring worm, Subcutaneous, Systemic mycosis
- Malaria, toxoplasmosis, Cryptosporidiosis, Amoebic dysentery, Sleeping sickness, Tricomoniasis, Chaga's disease leishmaniasis, Giardiasis and pneumocystis pneumonia.
- Helminth: - Intestinal, Worm infection, Fiarisis, Schistosomiasis, Hydatid disease

VIRAL PATHOGENESIS AND ASSOCIATED DISEASE

- The structure and classification of virus
- History, epidemiology, diagnosis, clinical feature, treatment & prevention of Smallpox, Herpes, Adenovirus, Arbovirus, Picornavirus & Mixovirus

Books referred:

1. Text book of Microbiology by Anant Narayan and Pannikar
2. Text book of Diagnostic Microbiology by Win Mosby



Paper-IV

BMS-104/6774

Bioinstrumentation & Analytical Techniques

Introduction

Definition and scope, role of instrumentation in Biomedical Sciences

Chromatography

An introduction to chromatographic separation, Basic Principles, instrumentation and applications of adsorption, partition, ion exchange, reverse phase, gel filtration. Supercritical Chromatography, Gas Chromatography, HPLC and FPLC

Electrophoresis

Basic principles, instrumentation and applications, moving boundary and zonal electrophoresis including paper and gel (SDS PAGE and Agarose) electrophoresis, isoelectric focusing, isotachopheresis, PFGE and Capillary electrophoresis.

Centrifugation

Basic Principles of sedimentation and centrifugation, different types of centrifuges and their uses analysis of subcellular fractions. Differential and density gradient centrifugation.

Spectroscopy

Basic concepts and application of UV-Visible, fluorescence, IR, NMR, CD, ORD spectroscopy, Mass spectrometry & X-ray diffraction in structure determination of biomolecules.

Radioisotopic techniques

Principles and application of tracer techniques in biology, radioactive isotopes and half life of isotopes, cerenkov radiation, liquid scintillation, GM counter. Effect of radiation on biological system, radioactive labeling of biological macromolecules, autoradiography and radiation dosimetry.

Biosensors

Basic techniques, enzyme electrodes, organic salt electrodes, immuno electrodes, microbial biosensors.

Books referred:

1. *Instrumental Analysis* : D. Skoog
2. *Biophysical Chemistry* : David Sheehan
3. *Principles of Biophysical Chemistry* : David Frifelder
4. *Practical Biochemistry* : Keith Wilson & Walker (New Edition)
5. *Biophysics* : Upadhyay & Upadhyay
6. *Methods of Instrumental Analysis* : Willard



Paper-V

BMS-105/60775

Practical-I: Biochemistry & Organic Chemistry

PRACTICAL BIOCHEMISTRY –

1. To learn Pipping technique.
2. Preparation of solutions of different concentration.
3. Preparation of buffers solutions..
4. Measurement of pH of different buffer solutions..
5. Formal Titration of Glycine.
6. Determination of pKa and pKb values of Glycine.
7. To perform qualitative test for detection of carbohydrate in provided sample.
8. To perform qualitative test for detection of proteins in biological sample.
9. Extraction of Casein proteins from biological sample..
10. Detection of Urea, Starch, Water, Detergent adulteration in milk.
11. Determination of optimum temperature, pH of activity of Enzyme (Salivary amylase).
12. Determination of achromatic point in salivary amylase.
13. To study various glassware, plastic ware and equipment used in Biochemical laboratory.
14. Determination of carbohydrate concentration by phenol, sulphuric acid methods
15. Determination of reducing sugars by 3,5 di-nitro salicylic acid.

PRACTICAL ORGANIC CHEMISTRY

A. Qualitative analysis

Separation, Purification and Identification of compound of binary mixture (one liquid and one solid)

B. Quantitative analysis:

1. Determination of Iodine and sponnification values of water and oil sample.
2. Determination of the percentage or the number of hydroxyl group in and organic compound by acetylation method.

C. Testing of organic compound for element test and confirmation test by reagent.

D. Reagent synthesis for testing of organic functional group and identification of the nature of the compound

Tollen's Reagent, Fheling Reagent, Schiff base, Phenophathaleine solution, Methyl orange

E. Isolation of Natural Products:

Caffeine from tea leaves, Oxalic acid from cane sugar, Alkaloids, Terpenoids, Vitamin- C

F. Preparation of organic compounds:

Picric acid, Paranitro acid anlide, Phthalimide, 2,4,6 tribromophenol, Aspirin, Eosin, Cinnamic Acid, Benzoic acid



Paper-VI

BMS-106/60776

Practical-II: Medical Microbiology and
Bioinstrumentation & Analytical Techniques

PRACTICAL MEDICAL MICROBIOLOGY

Bacteriology

1. Preparation and sterilization of different culture media (e.g. Blood agar, chocolate agar, nutrient agar, nutrient broth, Mac Conkey agar).
2. To obtain pure cultures from the given microbial culture by streak plating and spread' plating techniques.
3. To carry out different Gram staining of the given bacterial culture.
4. To demonstrate motility in the given bacterial culture using the Hanging Drop method.
5. To carry out Zeihl-Nelson staining to detect acid fast bacteria in the given sputum sample.
6. To determine the antibiotic sensitivity profile of the given microbial culture using Kirby-Bauer method.
7. To carry out the following biochemical tests:
Catalase test, Urease test, Indole test, Methyl red test, Voges-Prauskauer test, Citrate test, Lysine iron agar, Triple sugar iron, Sugar fermentation tests (glucose, maltose, sucrose).

Mycology

1. To prepare temporary mounts from cultures/clinical specimens and observe permanent slides of the following:
Rhizopus, Mucor, Aspergillus fumigates, Aspergillus flavus, Candida albicans, Blastomyces dermatidis, Penicillium marneffeii, Nocardia, Histoplasma capsulatum
2. To demonstrate the presence of *Candida albicans* in the given clinical specimen using the germ tube test.

Practical Bioinstrumentation and Analytical Techniques

- a) Calibration of pH meter and measurement of pH
- b) Titration curve of amino acids.
- c) Separation of amino acids by paper chromatography/TLC
- d) Separation of proteins using centrifugation and quantitation by UV.
- e) Separation of DNA by electrophoresis
- f) Verify Lambert Beer's law.
- g) Separation of organic compounds by Column chromatography
- h) Demonstration of caffeine separation by HPLC
- i) Demonstration of Analysis of given sample by G



Detailed Syllabus of M.Sc. II Semester

Paper-VII

BMS-107/6777

Bioinformatics & Biostatistics

Bioinformatics

1. **UNIT I**-History, scope and applications of Bioinformatics, database
2. **UNIT II**-DNA Sequence Information Sources, EMBL, GENBANK, DDBJ, Entrez, Unigene, Understanding the structure of each source and using it on the web.
Protein Information Sources, PIR, PDB, SWISSPROT, TREMBL, Understanding the structure of each source and using it on the web.
3. **UNIT III**- Sequence and Phylogeny analysis, Detecting Open Reading Frames, sequence alignments, Introduction to BLAST, using it on the web, Interpreting results, Multiple Sequence Alignment Phylogenetic Analysis. Searching Databases: SRS, Entrez, Sequence Similarity Searches-BLAST, FASTA and DATA Submission Protein Structure: Protein structure classification, Structure Analysis, Secondary structure prediction methods, Ramachandran plot, homology modelling.

BIO-STATISTICS

1. **Introduction** to Mean, mode, median, Geometric mean , Harmonic mean, Quartile duration, mean deviation, Standard deviation, coefficient of variation.
2. **Correlation:** Positive and negative correlation, Karl Passions, Co-efficient of correlation, Rank correlation.
3. **Regression:** Regression analysis, Regression equations.
4. **Probability:** Theoremson probability, Simple Binomial Distribution Normal dist, st. Normal distribution.
5. **Sampling:** 'I' and 'Z' and 'F' tests of significance small samples and large samples χ^2 test.

Books Recommended:

1. *Text Book of Biostatistics* by P.K. Jasra & Gurdeep Raj
2. Bioinformatics. Baxevanis, A.D. and Quelette, B.F.F.
3. Bio informatics. Des Higgins & Willie Taylor
4. Bioinformatics. Methods and protocols. Macsewer, S.
5. Bioinformatics. Sequence and genome analysis. Mount, D.W.



Metabolic disorders and basic concepts of some diseases.

CARBOHYDRATE METABOLISM: Diseases associated with carbohydrate metabolism: Diabetes Mellitus, Galactosuria, Fructosuria, Hunter's Syndrome and Glucose Tolerance Test, Glycogen Storage Diseases.

LIPID METABOLISM: Diseases associated with lipid metabolism: Gaucher's disease and Tay-Sacch's disease.

PROTEIN METABOLISM: Diseases associated with amino acid metabolism: Albinism, Phenylketonuria, Alkaptonuria, Maple-Syrup Urine Disease (MSUD), Cystinuria and Homocystinuria.

NUCLEOTIDE METABOLISM: Diseases associated with nucleotide metabolism: Lesch-Nyhan syndrome and Gout.

Porphyrin diseases and diagnosis: Jaundice (different types), tests for its diagnosis and treatment.

Mineral Metabolism: Anemia, Cushing's syndrome etc.

Neuronal diseases: Parkinson's disease. Alzheimer's disease, drugs for their treatment.

Biochemical changes in body fluids-

- a. Blood- composition, alteration in pathological conditions.
- b. Urine- composition, alteration in pathological conditions.
- c. Cerebro Spinal Fluid- composition, alteration in pathological conditions.

Organ function tests:

- a. Renal Function Tests
- b. Liver Function Tests.
- c. Gastric Function Tests.

Cancer Biochemistry- cancer causing agents, Mechanism of Carcinogenesis, Cancer Markers, Chemotherapy, Radiotherapy and Combination Therapy.

Heart related disorders: Atherosclerosis, myocardial infarction.

Books Referred:

1. *Text Book of Biochemistry with clinical Correlation by: Thomas M Devlin*
2. *Biochemistry by: Campbell & Farrel* 3. *Principle of Biochemistry: Leninger*



Paper-IX

BMS-109/6779

Human Physiology

Membrane Physiology, Nerve and Muscle

Membrane potentials and action potentials & Excitation and Contraction of muscles (Molecular mechanisms of muscle contraction).

Blood Physiology

Hemostasis, Blood cells, Blood Clotting & Regulation of Blood pH. Blood groups, transfusion.

Cardio-vascular Physiology

1. Physiology of cardiac muscle, Rhythmical excitation of heart, Regulation of heart pumping, Cardiac cycle, Cardiac output and Venous Return, Microcirculation, Capillary fluid exchange.
2. **Circulatory regulation:** Nervous, humoral and chemical regulation of circulation.
3. **Cardiac abnormalities:** Normal electrocardiogram, Cardiac Arrhythmias, Heart sounds, Dynamics of valvular and congenital heart defects, Cardiac failure and circulatory shock.

Respiratory Physiology

1. **Pulmonary ventilation:** Mechanisms of pulmonary ventilation, Pulmonary volumes and capacities, Alveolar ventilation, Functions of respiratory passageways.
2. **External & Internal Respiration:** Principle of Gas exchange, Diffusion of gases through respiratory membrane, Transport of O₂ and CO₂ in blood and body fluids. Bohr effect, Chloride Shift, Haldane effect.
3. **Regulation of respiration:** Respiratory Control Center, Peripheral chemoreceptor system, Nervous and chemical regulation of respiration.

Gastrointestinal Physiology

1. **General principles of gastrointestinal function:** Ingestion of food, Motility, Nervous control, Transport and mixing of food in the alimentary tract.
2. **Secretory functions of alimentary tract:** Secretion of saliva, Gastric secretion, Pancreatic Secretion, Bile secretion, Secretions of small and large intestine.
3. **Digestion and absorption in gastrointestinal tract:** Digestion of various foods, Absorption in small intestine.

Excretory Physiology

1. **Urine formation by kidneys**
 - a) Glomerular filtration, Renal blood flow and their control, Determinants of Glomerular Filtration Rate (GFR).
 - b) Reabsorption and secretion along different parts of nephron.
2. **Regulation**
 - a) *Regulation of Extracellular Fluid osmolarity and sodium concentration:* Role of thirst.
 - b) Renal regulation of potassium, calcium, phosphate and magnesium. Acid- base balance.



Nervous Physiology

A. Sensory Physiology

1. *CNS synapses*: special characteristics of synaptic transmission, Sensory receptors.
2. *Somatic sensations*: Tactile and position senses. Sensory pathways, Median Lemniscal System.
3. *Pain*: Referred and Visceral pain, Headache; Pain receptors and their stimulation, Dual transmission of pain, Thermal sensations.
4. *Sense Organs*: Physiology of vision, hearing, taste and smell.

B. Motor and Integrative neurophysiology

1. Spinal cord & Muscle reflexes.
2. *Cerebral Cortex*: Intellectual functions of brain; Thoughts, consciousness, learning and memory. Language input and output. Function of corpus callosum and anterior commissure. Behavioral and motivational mechanisms of brain. Limbic system and hypothalamus: Activating-driving systems of brain.
3. *States of brain activity*: Sleep; Types & its Basic theories, Brain waves (EEG).
4. *Epilepsy*: Roles of specific neurotransmitter systems.

Endocrine Physiology & Hormones

1. General Characteristic and classification of hormone.
2. Synthesis, secretion, transport, metabolism and mechanism of action of Pituitary, Hypothalamus, Thyroid, Parathyroid, Adrenal, Pancreas, Thymus hormones.

Reproductive Physiology

Structure and function of reproductive organs, hormones of testes and ovary, hormonal regulation of ovulation, fertilization, implantation, gestation, parturition and lactation, oogenesis, spermatogenesis.

Book(s) Recommended: Text Book of Medical Physiology by *Guyton & Hall*



Paper-X

BMS-110/6780

Immunology

Immune system: Introduction, Historical review, Innate and acquired Immunity, Active and passive Immunity, natural and artificial Immunity

Lymphoid system: Lymphoid Tissue: Primary or Secondary Organs, Lymphocyte Traffic

Cells Involved In the Immune Response: Lymphocytes, Mononuclear Phagocyte, Antigen-presenting cells, Polymorphs and mast cells Cluster designation (CD): Ag specific receptors.

Antibody Generation, Structure and Function

1. Humoral immunity, Clonal Selection Theory, Immunoglobulin, Antibody Structure and Function
2. Antibody Effector Mechanism, Antibody Receptors, Antibody Diversity
3. Immunoglobulin Gene Recombination: Ab Class switching, Isotype switching
4. Effect of Somatic Mutations on the Antibody Diversity
5. Primary and Secondary immune Responses: Affinity Maturation & Memory cells development

Complement System: Nomenclature, Activation pathways and its biological effects.

Major Histocompatibility Complex: Structure and function of MHC, Genomic Organization of the MHC locus in Mice and Human, Transplantation and Rejection.

Antigen Processing and Presentation

1. Structure and assembly of MHC molecules/Peptide Complexes.
2. Antigen Processing and Presentation through APCs to identify by T-lymphocytes (CD4⁺ and CD8⁺)

Cell Mediated Immune Response: T-Cell independent and dependant defense mechanisms, Cell Mediated Cytotoxicity

Cytokines Network: Molecular basis of t-cell activation, Structure and function of various cytokines, cytokine receptors, Cytokine production from T_H¹ and T_H² CD4⁺ T-cells

Immunopathology: Erythroblastosis fetalis, Genetic and acquired Autoimmune and (AIDS) Immunodeficient disorders

Hypersensitivity Reactions: different types and Role of IgE, Mast cells, Genetic Allergic Response

Antigen Antibody Interaction: Haemagglutination, Direct/ indirect Immunofluorescence, Hybridoma Technology for Mab Production

Cancer Immunology

Vaccines: Principle, method of preparation and their mechanism of action. Types of vaccine

Books referred: Text book of Immunology by **Kuby**, Text book of Immunology by **Roitt**



CLINICAL BIOCHEMISTRY

Blood/Serum/Plasma Analysis

1. Blood Glucose
2. Blood Urea
3. Total Protein from blood
4. Estimation of triglycerides from serum
5. Estimation of cholesterol from serum
6. Estimation of HDL, LDL, VLDL from serum
7. Detection of ketone bodies
8. Lipoprotein in plasma
9. Blood urea nitrogen from plasma
10. SGOT and SGPT in serum

Liver Function test

1. Serum total bilirubin
2. SGOT and SGPT in serum
3. Alkaline Phosphatase
4. Serum Albumin, globulin and albumin globulin ratio

Urine analysis for Normal and Abnormal Constituents:

1. Protein
2. Glucose,
3. Bile salts and its pigments,
4. Ketone bodies.
5. Calcium ions (Ca^{2+})
6. Sulphate ions
7. Urea
8. Uric acid
9. Chloride ion (Cl^-)
10. Urine pH.
11. Determination of Acidic/ alkaline nature of urine.

Kidney Function Test

1. Detection of creatinine in Urine
2. Blood urea nitrogen
3. Urine osmolarity
4. Detection of uric acid in urine.



Practical Human Physiology

Hematology

1. To determine the *Total Leukocyte Count (TLC)/ cubic millimeter* of blood.
2. To prepare a 'Stained blood smear to identify the different leukocytes in the blood smear and to do a *Differential Leukocyte Count (DLC)*
3. To determine the *Total RBC Counts /cubic millimeter* of blood
4. To show the effect of Hypotonic, Isotonic Salt Solutions on Red Blood Cells
5. To determine the *Bleeding Time* by Duke Method.
6. To determine the *Clotting Time* by capillary Tube Method.
7. To determine the *Osmotic Fragility* of a given sample of blood
8. To estimate the *Total Hemoglobin* in human blood
9. To perform the Pulmonary Function Test
10. To perform the Cardiac Efficiency Test
11. To determine the Blood Pressure

IMMUNOLOGY

Handling of Animals

- a) Collection of blood: Retro -orbital bleeding, tail vein puncture
- b) Separation and preservation of serum and plasma

Demonstration of Immunological techniques

- a) Cell Adhesion Assay, Phagocytosis Assay
- b) Indirect Haemagglutination
- c) Dot ELISA technique
- d) RIA (Radio Immunoassay)
- e) Single Immunodiffusion technique
- f) Double Diffusion immuno technique
- g) Immunoprecipitation technique
- h) Lymphocyte Separation
- i) Immunoelectrophoresis
- j) Blood Group Analysis



Detailed Syllabus of M.Sc. III Semester

Paper-XIII BMS-201/7771 Molecular Biology

DNA REPLICATION AND ITS REGULATION

1. Central dogma. Origin of replication, semiconservative hypothesis.
2. Mechanism of DNA Replication: Structure and function of DNA polymerases. Role of Replisome, Primosome, Okazaki fragments, helicase, primase, gyrase, topoisomerase and other proteins in DNA replication in *E.coli* and eukaryotes, initiation of replication, elongation and termination of DNA synthesis.
3. DNA Repair -Mutation, Disease associated with repair mechanisms, DNA replication inhibitors.

RNA SYNTHESIS

1. Structure of RNA -mRNA, tRNA, rRNA, snRNA, Concept of intorn & exon, Structure & function of RNA polymerases.
2. Transcription in prokaryotes using E -coli as an example, transcription inhibition, elongation and termination.
3. *Transcription in eukaryotes*- Structure of TFIID, and other transcription factors, general concept of regulation of transcription.

PROTEIN SYNTHESIS

1. Genetic code and its characteristics, codon and anticodon.
2. Translation in Prokaryotes & Eukaryotes.
3. Inhibition of protein synthesis by antibiotics.
4. Regulation of protein synthesis.
5. Post translation modification
6. Protein targeting, Chaperones, heat shock proteins, inhibitors of protein synthesis.

REGULATION OF GENE EXPRESSION IN PROKARYOTES

1. *Coordinated control of clustered genes*-operon model, with example of inducible Systems like lac-Operon. Arabinose operon and repressible systems like Trp operon.
2. *Role of repressors and activators of transcription in regulation of phage-lytic* and lysogeic pathways, lambda repressor.

REGULATION OF GENE EXPRESSION IN EUKARYOTES:

1. *Organization of genes in eukaryotic DNA*- Repititive DNA sequences, activators, enhancers.
2. Post transcriptional regulation splicing, capping, methylation, acetylation, heat shock protein.
3. Diseases linked with gene expression.

BOOKS RECOMMENDED:

1. *Genome* –by T.A. Brown
2. *The Cell* - by Geoffrey M. Cooper



Paper-XIV

BMS-202/7772

Genetics & Biotechnology

GENETICS

Introduction

1. Definition, Mendelian genetics, its application. Mendel's laws of Inheritance. Deviations from Mendel's laws.
2. Expression and interaction of genes, allelic and non allelic interaction; Multiple alleles, pseudoalleles.
3. Sex linked inheritance; sex determination, extra nuclear genetics- maternal inheritance.

Chromosome Structure

1. Prokaryotic and Eukaryotic Genome and its organization, Eukaryotic chromosomes. DNA Supercoiling: Histones, nonhistone proteins.
2. Linkage, Crossing over and chromosome mapping
3. Mutation, mutagenes, paramutations, molecular basis of gene mutation, chromosomal alterations.
4. Transposable genetic elements in bacteria, yeast, maize and drosophila.

Human Genetics

1. Pedegree analysis, Human chromosomes, Anomalies in autosomes and sex chromosomes, Congenital malformation, Heredity of twins.
2. Structure and life cycle of DNA and RNA viruses, Common viral diseases, Oncogenes: Retroviral, and cellular oncogenes, their function and mechanism of action. AIDS. Interferon.

Population Genetics

1. Definition, aim, scope of population genetics, factors maintaining population boundaries, effective breeding size, gene pool, genetic drift, Genetic equilibrium and Hardy- Weinberg law and its application.
2. Human Polymorphism, relationship between sickle cell polymorphism and malaria, Duffy blood groups, Thalassemia and colorblindness.

RECOMBINANT DNA TECHNOLOGY

1. Restriction enzymes used in genetic engineering
2. Recombinant DNA Technology and Cloning
3. Statement vectors- prokaryotic and eukaryotic
4. Detection and identification of cloned DNA sequences
5. Polymerase chain reaction, utilities in gene cloning and diagnostics, RT –PCR
6. Application of recombinant DNA technology in industry, human genome analysis

BOOKS RECOMMENDED:

1. *Genome –by T.A. Brown*
2. *The Cell - by Geoffrey M. Cooper*
3. *Text book of Genetics by Klug and Cummings*
4. *Text Book of Genetics by Russell*



Paper-XIV BMS-203/7773 Medicinal Chemistry

- 1. Role of medicinal chemistry in discovery of drugs**
- 2. Introduction to Drug Designing:**
Discovery of lead compound, lead modification, conventional drug screening, structural modification, bioisosteres, structure activity relationship, Quantitative structure activity relationships, introduction to molecular modeling and molecular graphics, pharmacophore descriptors
- 3. Enzyme Inhibition:**
Reversible and irreversible, Drugs acting on cell wall, Fungal membrane and Drugs inhibiting protein synthesis.
- 4. Receptors:**
Structure & Chemical nature of receptors, Receptor sites, Drug receptor interactions, Drug receptors theories, Receptor, modulation and mimics, Chirality and receptor binding, classification of receptors. Neurotransmitters and their receptors.
- 5. Drug-DNA interactions**
- 6. SAR studies illustrated with examples from Sulphonamides, β - lactams and Quinolones**
- 7. Drug Metabolism**
Biotransformations and their mechanisms, Phase I and Phase II metabolism, Oxidation, Reduction, Hydrolysis, Deamination and Conjugation (GSH, Sulfate, Glucuronide and Amino acids), Chirality and drug metabolism.

Books Referred:

- 1. The Organic Chemistry of Drug Design & Action by RB Silverman*
- 2. Medicinal Chemistry : Principles & Practice by FD King*
- 3. Principles of Medicinal Chemistry by Foye, Lemke and Williams*
- 4. Introduction to Medicinal Chemistry by A Gringuaz*
- 5. Medicinal Chemistry by G Patrick*



Paper-XV

BMS-204/7774

Pharmacology & Toxicology

PHARMACOLOGY

1. Introduction to pharmacology, scope of pharmacology.
2. Routes of administration of drugs, their advantages and disadvantages.
3. Various processes of absorption of drugs and the factors affecting them; metabolism, distribution and excretion of drugs.
4. General mechanism of drug action and the factors which modify drug action.
5. Pharmacological classification of drugs; the discussion of drugs should emphasize the following aspects:-

a. Drugs acting on the Central Nervous System:

- i. General anesthetics, intravenous anesthetics.
- ii. Analgesic and non-steroidal anti-inflammatory drugs, narcotic analgesics, anti-rheumatic and anti-Gout remedies, sedatives and hypnotics.
- iii. Psychopharmacological agents, anti-convulsants, analeptics.
- iv. Centrally acting muscle relaxants and anti-parkinsonism agents.

b. Local anesthetics

c. Drugs acting on the Autonomic Nervous System

- i. Cholinergic drugs, anticholinergic drugs, anticholinesterase drugs.
- ii. Adrenergic drugs and adrenergic receptor blockers.
- iii. Neuron blockers and ganglion blockers.
- iv. Neuromuscular blockers, drugs used in myasthenia gravis.

d. Drugs acting on the Respiratory System-Bronchodilators, expectorants and antitussive agents.

e. Cardiovascular Drugs- Cardiotonics, antianginal agents, antihypertensive agents, peripheral vasodilators and drugs used in atherosclerosis.

f. Drugs affecting Renal Function- Diuretics and antidiuretics.

g. Drugs acting on the Digestive System- Carminatives, digestants, bitters, antacids and drugs used in peptic ulcer, purgatives and laxatives, antidiarrhoeals, emetics, antiemetics.

h. Hormones and hormone antagonists- Hypoglycemic agents, antithyroid drugs,

TOXICOLOGY

Principles of toxicology-Definition, scope and different branches of toxicology.

A brief review of toxic substances

Synthetic organic compounds: Chemical additives in food, Chemicals in the work place, Solvents, Pesticides, Cosmetics, Drugs of abuse. Naturally occurring poisons: Mycotoxins, Bacterial toxins, Plant toxins and Animal toxins.

Types of toxicity and its measurement:

1. Acute toxicity, Sub-acute and chronic toxicity.
2. Risk and safety analysis: Margin of safety, Therapeutic index, Ideal therapeutic index.
3. Specific toxicity studies: Carcinogenicity, teratogenicity, in-vitro, mutagenicity tests.

Environmental and Pesticide Toxicology

Books Recommended: *Text Book of Pharmacology by K.D. Tripathi*

Text Book of Pharmacology & Toxicology by Goodman & Gillman



Paper-XVII

BMS-205/70775

Practical -IV (Molecular Biology, Genetics & Biotechnology)

PRACTICAL GENETICS

1. Study of linked genes and frequency of crossing over from the given gene frequencies.
2. Study of various body parts of fruitfly (*Drosophila*) by hand lens.
3. To study different developmental stages of fruitfly (*Drosophila*)
4. Study of Polytene chromosome from salivary glands of *drosophila*
5. Bar body staining from buccal smear and sex determination.
6. Study of various phenotypic characters in human population.
7. Pedigree Analysis

PRACTICAL MOLECULAR BIOLOGY & BIOTECHNOLOGY

1. Estimation of DNA by diphenyl amine method.
2. Isolation of genomic DNA from bacteria / blood
3. Isolation of Plasmid DNA
4. Purification of DNA by Gel Electrophoresis
5. Restriction digestion of isolated plasmids
6. Transformation of *E.coli* with isolated plasmids
7. PCR amplification of DNA fragment



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| Paper-XVIII | BMS-206/70776 | Practical –V (Medicinal Chemistry and Pharmacology & Toxicology) |
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MEDICINAL CHEMISTRY

1. To study interaction of intercalating agents like ethidium bromide with DNA using UV-Visible Spectrophotometer
2. Draw the 3 D structural of important pharmaceutical/target molecules using molecular modeling softwares.
3. To study the activity of an enzyme in presence/absence of inhibitor drug molecule.

PHARMACOLOGY

Experiment on Laboratory Animal

1. To study the effects of increasing doses of acetylcholine (Ach) and to plot the dose-response curve.
2. To study the modification of response of Ach on frog's rectus by anticholinesterase (eg. physostigmine).
3. To study the modification by neuromuscular blockers.
4. To identify the nature of the unknown drug by studying the modification to Ach on frog's rectus.

TOXICOLOGY

1. Hemolytic assay for measurement of toxicity
2. Methyltetrazolium test (MTT) for cytotoxicity assessment
3. LD₅₀ determination
4. Assessment of reproductive toxicity of pesticide
5. Hematotoxicity in rat after exposure to pesticide
6. Behavioural study in rat after pesticide exposure
7. Teratogenic effects of pesticides.