National Curriculum and Credit Framework (NCCF)
Syllabus

for

Major Courses and Skill Enhancement Courses in Zoology

w.e.f. Academic Session 2023-24

Kazi Nazrul University

Asansol, Paschim Bardhaman
West Bengal 713340

ASSIGNMENTS OF DIFFERENT SEMESTERS

Semester	COURSE DETAILS	PPT PRESTN.	PROJECT REPORT	DISSECTION	EXCURSION	LAB/FARM VISIT	ALBUM/VIDEO DOCUMENTARY
I	MJC-1	√		√	√		√ (Album)
	SEC-1						
II	MJC-2	√		√			√ (Album), √ (Video)
	SEC-2						

Guidelines for Individual / Team Projects and Field Reports

The aim of the individual/ team project/s is to develop an aptitude for research in Zoology and to inculcate proficiency to identify appropriate research topic and presentation. The topics of biological interest and significance can be selected for the project. Project is to be done by a group not exceeding 5 students. The project report should be submitted on typed A4 paper, 12 Font, 1.5 Space in spirally bound form and duly attested by the supervising teacher and the Head of the Department on the day of practical examination before a board of two Examiners for End Semester. The viva-voce based on the project is conducted individually. Project topic once chosen shall not be repeated by any later batches of students. The project report may have the following sections: 1. Preliminary (Title page, declaration, certificate of the supervising teacher, content etc.) 2. Introduction with relevant literature review and objective 3. Materials and Methods 4. Result 5. Discussion 6. Conclusion / Summary 7. References.

Field Study / Study tour

Students have to visit one research institute and one wild life sanctuary / museum / zoo. Scientifically prepared hand-written study tour report along with photographs of candidate at the places of visit must be submitted by each student for End Semester on the day of the examination of project.

Video presentation

Students have to develop a short film (2-5 min duration) based on relevant animal/topic given solely by themselves along with voice command/floating comments. It will help them to be competent in video documentation of a matter also a career prospect too.

Semester-I

Course name: Diversity of Non-chordates

Course code: BSCZOOMJ101

Course Type: **Major (Theoretical & Practical)**	Course Details: **MJC-1**			L-T-P: **3-0-4**	
Credit: 5	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**15**	**20**	**35**

About the course :

The course is a walk for the Bachelor's entrant through the amazing diversity of living forms from simple to complex one. It enlightens how each group of organisms arose and how did they establish themselves in the environment with their special characteristics. It also deals with the differences and similarities between organisms on the basis of their morphology and anatomy which led to their grouping into taxa and clades.

Learning outcomes :

After successfully completing this course, the students will be able to:

- Develop understanding on the diversity of life with regard to protists and non-chordates.
- Group animals on the basis of their morphological characteristics/structures.
- Develop a critical understanding how animals changed from a primitive cell to a collection of simple cells to form a complex body plan.
- Examine the diversity and evolutionary history of a taxon through the construction of a basic phylogenetic/ cladistics tree.
- Understand how morphological change due to change in environment helps drive evolution over a long period of time.
- The project assignment will also give them a flavour of research to find the process involved in studying biodiversity and taxonomy besides improving their writing skills.
- It will further enable the students to think and interpret individually due to different animal species chosen

THEORY (MJC-1)

Unit I: Principles of Animal Classification (15 Lectures)

1. Definitions: Systematics, taxonomy, Hierarchy, taxonomic levels/types (alpha, beta, gamma, omega, cytotaxonomy, numerical taxonomy, and chemotaxonomy).
2. Principles of codes of Zoological Nomenclature: Binomial nomenclature and utility of scientific names. Principle of priority; Principle of typification (Holotype, Syntype, Allotype, Paratype, Lectotype, Paralectotype, Neotype); Principle of Homonymy and synonymy.
3. Classification: morphological and evolutionary (molecular): Artificial, Natural and phylogenetic concept, Basic idea on Phenetics and Cladistics

Unit II: Multicellularity and Origin of Metazoa (12 Lectures)

1. Species concept: Biological, evolutionary.
2. Origin of Metazoans: diploblastic and triploblastic organization; symmetries; body cavities; protostomes and deuterostomes.
3. Metamerism and its relevance.

UNIT III: Diversity in Protists, Acoelomate and Pseudocoelomate Metazoa (15 Lectures)

1. Structure and diversity in Protists (classification up to Phylum).
2. Porifera : Classification up to classes; Canal system; Structural diversity of skeletal organization.
3. Cnidaria : Classification up to classes ; Polymorphism and division of labour;
4. Coral reef: Types, formation & significance.
5. Classification and characteristics of Platyhelminthes up to classes.
6. Classification and characteristics of Nematoda up to classes.
7. Type study: *Paramecium, Taenia, Ascaris*

UNIT IV: Diversity in and Coelomate Non chordates and hemichordates (18 Lectures)

1. Classification and characteristics of Annelids up to classes, Excretory organ in *Pheretima*
2. Classification and characteristics of arthropods up to classes.
3. Affinities of living fossils: *Limulus* and *Peripatus.*
4. Classification and characteristics of Molluscs up to classes.
5. Torsion and Detorsion in Mollusca.
6. Classification and characteristics of Echinoderms up to classes; their affinity with Chordates.
7. Type study: *Periplaneta*

Note: ***Classification to be followed from Ruppert and Barnes Invertebrate Zoology VI edition, except for Protozoa (American Association of Protozoologist ref: Levine 1980) and Porifera (Brusca and Brusca 2002; IV edition. Invertebrate Zoology).***

PRACTICAL (MJC-1)

1. Identification of animals through slides and museum specimens/photographs with their classification and diagnostic features **(record book)**. Animals to be included for the study are as follows:

Non-chordates :
i. **Protista:** *Euglena, Amoeba, Paramecium.*
ii. **Porifera:** *Euspongia, Scypha.*
iii. **Cnidaria:** *Obelia, Physalia, Porpita, Aurelia, Tubipora,* Sea Anemone, *Pennatula, Fungia.*
iv. **Platyhelminthes:** *Fasciola, Taenia solium.*
v. **Nematoda:** *Ascaris.*
vi. **Annelida:** *Aphrodite, Neanthus, Chaetopterus, Pheretima, Hirudinaria*
vii. **Arthropoda:** *Carcinoscorpius, Macrobrachium, Balanus, Julus, Periplaneta, Peripatus.*
viii. **Mollusca:** *Chiton, Pila, Lamellidens, Sepia, Octopus.*
ix. **Echinodermata:** *Astropecten, Cucumaria, Antedon.*
x. **Larval forms:** Ephyra, Trochophore, Nauplius, Zoea, Glochidium, Veliger, Bipinnaria, Brachiolaria.

2. **Excursion:** Study of animals in nature during a survey of a National Park or Forest area or coastal area or any local biodiversity rich area.
3. Dissection of *Periplaneta* to expose- (a) Digestive, (b) Nervous and (c) Reproductive system.
4. Dissection of earthworm to expose the Nervous system.
5. Group discussion or Seminar presentation on following topics:

Pool of Topics for Group Discussion or Seminar presentation :		
1. Tree of Life.	6. Molecular systematics vs Traditional taxonomy.	12. Protostome vs deuterostome
2. Polymorphism.	7. Metamerism and its relevance.	13. Coelom and animal development
3. Freshwater sponges.	8. Principle of Typification	14. Torsion-an evolutionary outbreak
4. Concept of symmetry	9. Basis of classification	15. Molecular system of classification.
5. Species concept	10. Coral reef – A marine rainforest.	16. Significance of living fossils
	11. Type study: Any one animal as per your syllabus.	

Format for conducting CA and ESE practical examination :

CA (30 marks)	ESE (20 marks)
1. Assessment based on practical topics (class test)-**10** **2.** PPT/Poster preparation, presentation and write up submission -3+3+2=**8** **3.** Attendance and Participation in class-**4** **4.** Practical skills, laboratory reports, etc-**3** **5.** Participation in excursion -**5**	**1.** Identification - 2 items (item 1 and 7)- [Sc. Name, systematic position (3 taxa), generic characters, habit & habitat,] 0.5+0.5+1+0.5=2.5 **(2.5x3=5)** **2.** Dissection/mounting- Exposing and display/mounting-3, Drawing-2, Labelling-1. **(6)** **3.** Field Report (Item no 2) -**3** **4.** LNB (Laboratory Note Book) -**3** **5.** Viva -**3**

NOTE :

- *Identification could be done by using a card printed with a photograph/drawing/data /preserved specimen/permanent slide.*
- *CA can be done multiple times even by more than one teacher. An average will be taken for marks capturing.*
- *LNB should be prepared (item 1, 4, 5, 6 & 7) in inter-leaf practical note book with date & Teacher's sign.*
- *Project report (Presentation mandatory), Field report, Write-up, etc to be prepared separately.*
- *A maximum of 4 students can present same topic of GD/seminar presentation, as a group or solo.*

Recommended readings

1. Ruppert and Barnes, R.D. (2006). Invertebrate Zoology, VII Edition. Thompson Brooks Cole (International Edition)
2. Barnes, R.S.K., Callow, P., Olive, P. J. W., Golding, D.W. and Spicer, J.I. (2002). The Invertebrates: A New Synthesis, III Edition, Blackwell Science
3. Barrington, E.J.W. (1979). Invertebrate Structure and Functions. II Edition.
4. Darlington P.J. The Geographical Distribution of Animals, R.E. Krieger Pub Co.
5. Hall B.K. and Hallgrimsson B. (2008), Strickberger's Evolution. 4th Edition. Jones and Bartlett Publishers Inc.
6. Chattopadhyay, S (2014) LIFE: Evolution, adaptation, ethology, 2nd Ed, Books & Allied.
7. Lomolino, M. V. et al (2010) Biogeography, 4th Edition, Sinauer Associates.
8. Simpson, G G (2012) Principles of animal taxonomy, Scientific publishers.
9. Mayr, E and Ashlock P D (2014) Principles of systematic zoology, 2nd, McGraw-Hill Education.
10. Verma, A (2017) Principles of animal taxonomy, 1st Ed, Narosa.
11. Ghosal, S (2020) Taxonomy Principle and Problems, 1st Ed, Techno world.
12. Quicke, Donald L (1993) Principles and Techniques of Contemporary Taxonomy (Tertiary Level Biology), 1st Ed, Springer
13. Sinha, K. S., Adhikari, S., Ganguly, B. B. & Bharati Goswami, B. D. (2001). Biology of Animals. Vol. I. New Central Book Agency (p) Ltd.
14. Kapoor, V C (2019) Theory And Practice Of Animal Taxonomy And Biodiversity 8th Ed, Oxford & IBH Publishing
15. Ruppert, E.E., Fox, R.S., Barnes, R. D. (2003). Invertebrate Zoology: A Functional Evolutionary Approach. VII Edition, Cengage Learning, India
16. Pechenik, J. A. (2015). Biology of the Invertebrates. VII Edition, McGraw-Hill Education

17. Miller S.A. & Harley J.P. (2015) Zoology. 10th Ed., McGraw-Hill Education
18. Hickman C., *et. al.* (2019) Integrated principles of zoology., 18th Ed., McGraw-Hill Education.

Course Name: Public Health and Hygiene

Course Code: BSCZOOSE101

Course Type: **SEC (Theoretical)**	Course Details: **SEC-1**		L-T-P: **3-0-0**
Credit: 3	Full Marks: **50**	CA Marks	ESE Marks
		Theoretical	Theoretical
		15	**35**

About the course :
The course designed for public health and hygiene at graduation level will give understanding for health hygiene, dietary issues, diseases related to malnutrition, communicable and non-communicable diseases.

Learning outcomes :
After successfully completing this course, the students will be able to:

- Identify current national and global public health problems.
- Aware about the issues of food safety, water safety, vaccination, exercise and obesity, exposure to toxins.
- Frame a public health plan during any epidemic or spread of infectious disease etc.
- Analyze case studies of infant mortality and obesity.
- Assess the health inequalities with regard to gender, race, ethnicity, income etc.

THEORY (SEC-1)

Unit-I: Maintenance of personal and community hygiene (13 Lectures)

1. Introduction to public health and hygiene- General concept, determinants and factors.
2. Pollution and health hazards; Causative agent, symptoms, and control/treatment of common water and air borne diseases: Cholera, Typhoid, SARS-CoV.
3. Radiation hazards: Mobile Cell tower and electronic gadgets (recommended levels, effects and precaution).
4. Importance and maintenance of Community Hygiene.

Unit-II: Nutrient deficiency & diseases (13 Lectures)

1. Classification of food into micro and macro nutrients.
2. Balanced diet.
3. Importance of dietary fibers.
4. Significance of breast feeding.
5. Malnutrition anomalies – Anaemia (Iron and B12 deficiency), Kwashiorkar, Marasmus, Rickets, Goiter (cause, symptoms, precaution and cure).

Unit-III: Communicable and contagious diseases (13 Lectures)

1. Communicable viral diseases (causative agent, symptoms, precaution and remedy)- chicken pox, dengue, chickungunya, and hepatitis.

2. Communicable bacterial diseases (causative agent, symptoms, precaution and remedy)-tuberculosis, tetanus, plague, diphtheria.
3. Sexually transmitted diseases (causative agent, symptoms, precaution and remedy)-AIDS, syphilis and gonorrhoea.

Unit-IV: Non-communicable diseases and cure (13 Lectures)

1. Non-communicable diseases such as Atherosclerosis, Asthma, Osteoporosis, osteoarthritis and rheumatoid arthritis-cause, symptom, precautions.
2. Diabetes- types and their effect on human health.
3. Gastrointestinal disorders- acidity, peptic ulcer, piles (cause, symptoms, precaution and remedy). Obesity (Definition and consequences).
4. Mental illness (depression and anxiety).
5. Oral and lung cancer (Cause and preventive measures).

Recommended readings :

1. Mary Jane Schneider (2011) Introduction to Public Health.
2. Muthu, V.K. (2014) A Short Book of Public Health.
3. Detels, R. (2017) Oxford Textbook of Public Health (6th edition).
4. Gibney, M.J. (2013) Public Health Nutrition.
5. Wong, K.V. (2017) Nutrition, Health and Disease.

Semester-II

Course name: Diversity of Chordates

Course code: BSCZOOMJ201

Course Type: **Major (Theoretical & Practical)**	Course Details: **MJC-2**			L-T-P: **3-0-4**	
Credit: 5	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**15**	**20**	**35**

About the course :

The course is a walk for the Bachelor's entrant through the amazing diversity of living forms from simple to complex one. It enlightens how each group of organisms arose and how did they establish themselves in the environment with their special characteristics. It also deals with the differences and similarities between organisms on the basis of their morphology and anatomy which led to their grouping into taxa and clades.

Learning outcomes :

After successfully completing this course, the students will be able to:

- Develop understanding on the diversity of life with regard to chordates.
- Group animals on the basis of their morphological characteristics / structures.
- Develop critical understanding of how aquatic to terrestrial journey happens in chordate animals.
- Examine the diversity and evolutionary history of a taxon through the construction of a basic phylogenetic/ cladistics tree.
- Understand how morphological change due to change in environment helps drive evolution over a long period of time.
- The project assignment will also give them a flavour of research to find the process involved in studying biodiversity and taxonomy besides improving their writing skills.
- It will further enable the students to think and interpret individually due to different animal species chosen.

THEORY (MJC-2)

Unit 1: Protochordata and Agnatha (15 Classes)

1. Characters and affinities of Hemichordates
2. General characteristics of Urochordata and Cephalochordata
3. Study of larval forms in protochordate
4. Retrogressive metamorphosis in *Ascidia*,
5. Theories of origin of Chordata
6. General characteristics and affinities of cyclostomes

Unit 2: Ectotherms: Pisces, Amphibia and Reptilia (18 Classes)

1. General characteristics and Classification of fish up to subclass,
2. Migration of Fishes,
3. Affinities of lung fishes
4. Origin of Tetrapoda (Evolution of terrestrial ectotherms)
1. General characteristics and classification of Amphibia up to living order; Parental care in Amphibia

5. General characteristics and classification of reptiles up to living order
6. Affinities of *Sphenodon*
7. Type study (respiratory system, circulatory system, urinogenital system): *Labeo, Duttaphrynus, Calotes.*

Unit 3: Endotherms: Aves and Mammalia (15 Classes)

1. General characteristics and classification of Aves up to subclass;
2. Archaeopteryx - a connecting link;
3. Principles and aerodynamics of flight and migration in birds
4. Affinities of Prototheria,
5. Origin of Mammals- Special features of Monotremes and Marsupials.
6. Characteristics and classification of mammalian groups (up to orders)
7. Type Study: *Columba, Cavia*

Unit 4: Specialized systems (12 Classes)

2. Accessory respiratory organ, acoustico lateralis system, and swim bladder in fishes
3. Poison apparatus and biting mechanism in snakes
4. Echolocation in chiropterans and cetaceans
5. Ruminant stomach

Note: ***Classification from Young, J. Z. (1981) to be followed except for classification fishes. For Pisces classification scheme to be followed from Nelson, J. S. (2006).***

PRACTICAL (MJC-2)

1. Identification of animals through slides and museum specimens/photographs with their classification and diagnostic features **(record book)**. Animals to be included for the study are as follows:

Chordates :
i. **Protochordata:** *Balanoglossus, Branchiostoma, Ascidia.*
ii. **Fishes:** *Scoliodon, Torpedo, Mystus vitattatus, Catla, Labeo, Exocoetus, Hippocampus*
iii. **Amphibia:** *Ichthyophis, Necturus, Duttaphrynus, Rachophorous*
iv. **Reptiles:** *Chelone, Calotes, Chamaeleon, Draco, Bungarus, Vipera, Naja.*
v. **Birds:** *Psittacula, Pycnonotus.*
vi. **Mammals:** *Sorex, Pteropus, Funambulus.*

2. Dissection: a) Expose and display afferent Branchial system, weberian ossicles and IX-Xth cranial nerve of fish (carp).

b) Expose and display Vth and VIIth cranial nerve of Fowl.

3. Mounting: a) Temporary mount of external scales in fishes (cycloid, placoid, ganoid, ctenoid). **b)** Temporary mount of Pecten of Fowl.

4. Comparison of two species of birds belonging to the same genus (Interspecific difference).

5. Demonstration of Poisonous and non-poisonous snake by chart preparation.

6. Group discussion or Seminar presentation on following topics:

Pool of Topics for Group Discussion or Seminar presentation :		
1. Protochordates-the gateway of chordates	2. Evolution of terrestrial ectotherms	3. Affinities, and biology of cyclostomes
4. Origin of Chordata	5. Migration of Fishes	6. Affinities of lung fishes
7. Affinities of *Sphenodon*	8. Retrogressive metamorphosis	9. Biting mechanism in snakes
10. Aerodynamics of bird flight	11. Archaeopteryx - a connecting link	12. Venomous vs non-venomous snake
13. Affinities of Prototheria	14. Monotremes and Marsupials	15. Zoogeographical realms
16. Type study: anyone in your syllabus	17. Plate tectonic & Continental drift theory	18. Adaptive radiation of mammals

Format for conducting CA and ESE practical examination :

CA (30 marks)	**ESE (20 marks)**
1. Assessment based on practical topics (class test)-**10** **2.** PPT/Poster preparation, presentation and write up submission-3+4+3=**10** **3.** Attendance and Participation in class-**5** **4.** Practical skills, laboratory reports, etc-**5**	**1.** Identification (Sl no 1)- Sc. Name-0.5, Characters-1, Habit & habitat-0.5, (2x2=**4**) **2.** Dissection/mounting- Exposing and display/mounting-5, Drawing-2, Labelling-1. (**8**) **3.** Bird album-**2** **4.** LNB 2 **5.** Viva voce-**4**

NOTE :

- *Study of specimen should include-Scientific name, Habit and Habitat, Diagnostics feature, importance/values if any.*
- *Identification could be done by using card printed with photograph/drawing/data/preserved specimen/permanent slide.*
- *CA can be done multiple times even by more than one teacher. An average will be taken for marks capturing.*
- *LNB should be prepared in inter-leaf practical note book with date & Teacher's sign.*
- *Video should made on one or more animals on behavioral pattern/life cycle/feeding habit with sound commended by voice.*
- *A maximum of 4 students can present same topic of GD/seminar presentation, as a group or solo.*

Recommended readings

1. Young, J. Z. (1981). The Life of Vertebrates. 3rd Ed. Oxford university press.
2. Pough H. Vertebrate life, VIII Edition, Pearson International.
3. Darlington P.J. The Geographical Distribution of Animals, R.E. Krieger Pub Co.
4. Hall B.K. and Hallgrimsson B. (2008), Strickberger's Evolution. 4th Edition. Jones and Bartlett Publishers Inc.
5. Chattopadhyay, S (2014) LIFE: Evolution, adaptation, ethology, 2nd Ed, Books & Allied.
6. Lomolino, M. V. et al (2010) Biogeography, 4th Edition, Sinauer Associates.

7. Simpson, G G (2012) Principles of animal taxonomy, Scientific publishers.
8. Mayr, E and Ashlock P D (2014) Principles of systematic zoology, 2nd, McGraw-Hill Education.
9. Verma, A (2017) Principles of animal taxonomy, 1st Ed, Narosa.
10. Ghosal, S (2020) Taxonomy Principle and Problems, 1st Ed, Techno world.
11. Quicke, Donald L (1993) Principles and Techniques of Contemporary Taxonomy (Tertiary Level Biology), 1st Ed, Springer
12. Sinha, K. S., Adhikari, S., Ganguly, B. B. & Bharati Goswami, B. D. (2001). Biology of Animals. Vol. II. New Central Book Agency (p) Ltd.
13. Kapoor, V C (2019) Theory And Practice Of Animal Taxonomy And Biodiversity 8th Ed, Oxford & IBH Publishing
14. Miller S.A. & Harley J.P. (2015) Zoology. 10th Ed., McGraw-Hill Education
15. Hickman C., *et. al.* (2019) Integrated principles of zoology., 18th Ed., McGraw-Hill Education.

Course Name: Instrumentation and Clinical Diagnosis

Course Code: BSCZOOSE201

Course Type: **SEC** **(Theoretical)**	Course Details: **SEC-2**		L-T-P: 3-**0-0**
Credit: 3	Full Marks: **50**	CA Marks	ESE Marks
		Theoretical	Theoretical
		15	**35**

About the course :

This is the only laboratory course taught independently of lecture courses. It has full hands on approach to expose the students to modern techniques and methodologies. The diverse techniques from microscopy to spectroscopy, calorimetry, chromatography ELISA, tissue culture to cloning, medical diagonosis etc. are included to make the student well versed with these protocols and methods.

Learning outcomes

Upon successful completion of this course, students should be able to:

- Understand the purpose of the technique, its proper use and possible modifications/improvement.
- Learn the theoretical basis of technique, its principle of working and its correct application.
- Learn the construction repair and adjustment of any equipment required for a technique.
- Learn the accuracy of technique.
- Understand the application of medical diagonosis.
- Learn the maintenance laboratory equipments / tools, safety hazards and precautions.
- Understand the technique of cell and tissue culture. Learn the preparation of solution of given percentage and molarity.
- Understand the process of preparation of buffer. Learn the techniques of separation of amino acids, proteins and nucleic acids.

UNIT I : Principles of Microscopy (13 Lectures)

1. Microscopy: Introduction to Microscopy (Discovery, General structure).
2. Definitions-Resolving Power, Limit of Resolution and Magnification, Numerical Aperture.
3. Types of Light microscopes; bright field, dark-field, phase contrast.
4. Basic principles and applications of Light, Electron (SEM, TEM), Fluorescence.

UNIT II : Tools and techniques in Biochemistry and Physiology (15 Lectures)

1. Biochemistry and Physiology: Physiological Salines, Concept of Normality and Molarity. Buffers and the use of pH meter.
2. Principles and types of Centrifugation, Differential centrifugation.
3. Basic Principle and Application of Colorimetry and Spectrophotometry, Beer-Lambert's Law.

4. Principle and applications of Agarose gel Electrophoresis and PAGE.
5. Principle and Applications of Paper chromatography, Thin layer chromatography

UNIT III : Tools and Techniques in Endocrinology and immunology (12 Lectures)

1. Principle and applications of Western Blotting, ELISA, RIA.
2. Application of Immunological techniques (EIA, Coombs test and Widal test) in disease diagnosis.
3. Tracer techniques: Principle and Applications, Unit of radioactivity, half-life and measurement of radioactivity. Adverse effect of radioisotopes.

UNIT IV: Cell culture and clinical diagonosis (18 Lectures)

1. Introduction to Cell Culture**:** Cell culture (in vitro, in vivo, ex vivo) and its basic requirements (laboratory facility), application and limitation of animal cell culture.
2. Cell counting (haemocytometer, Flow cytometer) and cell viability testing (Trypan blue exclusion).
3. **C**ryopreservation (principle, cryopreservant, methodologies, cryoprotectant, revival/thawing, factors for good survivality, banking of cell lines, advantages, applications).
4. Medical applications of CT, MRI, EEG, ECG.
5. Haematology techniques: Glucometer, haemometer
6. Good laboratory practice (GLP) & Bioethics (General concept).

Recommended readings:

1. Pearse, A.G.E. (1980-1993) Histochemistry - Theoretical and applied, Volume I-III, Churchill-Livingstones.
2. Plummer, D. (2017) An Introduction to Practical Biochemistry (3rd edition) McGraw Hill.
3. Wilson, K. and Walker, J. (2010) Experimental Biochemistry, Cambridge.
4. Boyer, R. (2000). Modern Experimental Biology. Pearson Education. English Universities Cambridge Low-price Ed.
5. Cantor, C.R. & Schimmel, P.R. (2003). Biophysical chemistry (3 vol. set). W. H. Freeman & Co.
6. Bajpai, P.K. (2006). Biological Instrumentation and Methodology. 1st Ed. S. Chand & Company Ltd.
7. Ghoshal & Shrivastava (2009). Fundamentals of Bioanalytical Techniques and Instrumentation. PHI
8. Sharma, V. K. (1991). Techniques in Microscopy and Cell Biology. Tata-McGraw Hill.
9. Arya A & Kumar A, (2018) Methods in biology, 2nd Ed, Drawing Pin Publishing
10. Kumar, P.; (2016) Fundamentals and Techniques of Biophysics and Molecular Biology, 1st Ed, Pathfinder Publication
11. Roy, R.N. (2005). A Text Book of Biophysics. New Central Book Agency (P) Ltd. Kolkata..