Starex University, Gurugram

Choice Based Credit System (CBCS)

M.Sc. Zoology

(2019-21)

Ordinance, Scheme & Syllabus
M.Sc.Zoology
(W.E.F. 2019-21)

Ordinance, Scheme of Examination and Syllabi

M.Sc. Zoology

Saved as provided in the First Ordinance of the University, this Ordinance shall contain the following:

1. **Title and Commencement**

   This Ordinance shall be called the Ordinance of Starex University and shall be effective from the Academic Session 2019-21.

2. **Duration of the Course**

The duration of Biotechnology course shall be of two academic years. Each year shall be divided in two semesters i.e. semester-1, semester-2. Accordingly, the two years shall consist of four semesters. However, a student is required to pass out the said course within a maximum period of 4 years from the date of admission to 1st semester where after he/she shall stand unfit for the course.

3. **Eligibility**

B.Sc.(Hons.)/B.Sc. with Biology with 45% marks or any other equivalent degree from any recognized University.

4. **Admission Schedule, Submission of Examination Forms and Fee**

Theadmission schedule along with the last date for submission of admission form and fee shall be fixed by the Vice-Chancellor from time to time and displayed by the University.

Date of examinations and fee shall be fixed by the Vice-Chancellor from time to time and notified by the Controller of Examinations.

5. **Change of Branch/ Discipline**

A student will be entitled to change/switch over Branch/Discipline within 15 days after the commencement of academic session where after no change will be allowed. Such a student must be eligible for admission to the Branch/Discipline intended to be admitted to.

6. **Promotion to Higher Semester(s)**

The student shall be promoted to 2nd and 4th semester automatically without any condition of

passing minimum number of papers. For promotion from 2nd to 3rd semester, the student shall have to clear at least 50% paper of 1st and 2nd semester taken together.

7. Reappear Examinations

Re-appear examinations for odd semesters will be held along with the regular semester examinations of these semesters in December and those of even semesters along with the regular examinations of these semesters in May. However, the re-appear examination of 4th semester may be held in December along with the odd semester examinations.

8. Medium of Instruction and Examination

The medium of instructions and writing question papers shall be English only.

9. Type of Examinations

Wherever not otherwise provided in any course Ordinance there will be two types of examinations.

(a) **End term:** End term examination shall be held at the end of each semester and will cover the entire syllabus for that semester. 1st and 3rd semester examinations shall ordinarily be held in the month of December and 2nd and 4th semester examinations in the month of May.

(b) **Internal Test:** Theremay be one/two Internal Assessment test(s) in each semester. Each Internal Assessment test will cover the syllabus taught up to the date of test.

10. Scheme of Examinations

Twenty five percent marks of the total marks of the concerned subject shall be earmarked for Internal Assessment.

a) **Distribution of Marks**

i) Theory	75
ii) Internal Assessment	25

b) **Pass Percentage**

Theory:

i) 40% marks in written paper.
ii) 40% marks in written paper and Internal Assessment taken together

Practical: (Wherever provided)

i) 40 % marks in Practical.

ii) 40 % marks in Practical and Internal Assessment taken together.

Viva-Voce: (Wherever provided)

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i) 40% marks in Viva-Voce separately.

Note:

i) In case, a student fails to secure 25% marks in Internal Assessment in Theory of a particular subject, he/she shall be detained from appearing in the Theory paper examination of that subject and so for practical exams (wherever provided).

ii) A list of detained students and the students detained due to shortage of attendance shall be forwarded to the Examination Branch by the School/Faculty before a week from the date of commencement of examination.

c) **Components of Internal Assessment**

The Internal Assessment marks shall comprise of the following;

i) Attendance	10 Marks
ii) Internal Test	10 Marks
iii) Assignment/Seminar/Presentation etc.	05 Marks

Note

i) In case, a student is detained from appearing in the examination of Theory or Practical having failed to secure 25% marks in Internal Assessment, he/she may improve the same for appearing in the relevant subsequent examination. In all other cases, the marks of Internal Assessment shall be carried forward for the subsequent examination.

ii) The concerned teacher shall preserve the records of the Internal Assessment and shall make the same available as and when required.

iii) The concerned School/Faculty shall display the marks of Internal Assessment on the Notice Board for information of the students.

11. Eligibility to appear in the Examination

The Student should fulfill the following criteria to be eligible for appearing in the end term examination;

i) He/she should bear a good moral character.

ii) He/she should be on the rolls of the University during the semester.

iii) He/she should have not less than 75% of the attendance during the respective semester. In case, a student fails to secure the prescribed percentage of lectures

either in Theory or Practical, he/she shall be detained from appearing in the said part of examination (Theory or practical or both, as the case may be).

iv) He/she should not be a defaulter of payment of tuition fee or any other dues of the University and no disciplinary action should be pending against him/her.

Note: In case, a student fails to secure 75% attendance in Theory or Practical or both, he/she will be detained from appearing in Theory or Practical or both examinations, as the case may be.

12. Exemption from Attendance/Condonation of Shortage of Attendance

The shortage of attendance can be condoned/ relaxed as under;

S.No	Category for Exemption/Condonation of lectures/attendance	Ground for Exemption/Condonation	ompetent Authority
*1	ll periods of the day of Blood donation	Voluntarily blood donation to the blood bank	Dean of the School/Faculty
*2	All periods of the day of Examination	or appearing in the supplementary Examinations (Th./Pr./Vive-Voce)	-do-
*3	10 Days attendance during a Semester	For participation in University or Inter University/College Sports Tournaments / Youth Festivals, NCC/NSS camps/ University Educational Excursions	-do-

*Provided that:

1. He/she has obtained prior approval of the Dean of School/faculty.
2. Credit may be given only for the days on which lectures were

delivered or tutorials or practical work done during the period of participation in the aforesaid events.

S.No.	Category for Exemption/Condonation of lectures/attendance	Ground for Exemption/Condonation	Competent Authority
	Condonation/Relaxation up to 5% during a Semester	Genuine reason such as illness, transfer of parents, sudden death in blood relation, on production of proof.	1. The concerned Dean of his own or on the recommendation of HOD 2. Vice-Chancellor of his own or on the recommendation of Concerned Dean

13. Setting of Question Papers and Re-Checking, Evaluation/Re-evaluation of Answer book(s)

As per provisions in the First Ordinance and rules and regulations of the University.

14. Grace Marks

As per provisions in the First Ordinance of the University.

15. Improvement of Examination Result

A student may be permitted to improve his/her result subject to the followings:

i) The student will be permitted to appear in improvement examination as an ex-student with regular batches for the purpose of improvement of CGPA/Division.

ii) Only one chance for improvement for a Semester will be given. The chance must be availed within a period of 1 year from passing the final examination.

iii) In case the nature of result does not improve i.e. up to CGPA 5, 6, 7, 8 and 9, his/her improvement result shall be declared as **"PRS"** (Previous Result Stands).

iv) There will be no separate examination for improvement i.e. the student intending to improve his/her result shall appear along with the regular batches in accordance with the syllabus prescribed for the regular batches.

16. Issuance of DGS, Award of Degree

A student shall be issued Detailed Grade Statement for each examination and shall be awarded Degree on successful completion of the course. The division and performance shall be indicated in the Degree as depicted in **Grading Method** against **Clause No. 19.**

17. Inter University Migration

a) A student of this University may seek Migration as per provision in the First Ordinance of the University.

b) Any student intending to seek Migration to this University may do so subject to the following;

i) The Migration cannot be claimed as a matter of right and shall subject to the availability of seat.

ii) The Migration shall be allowed only in 2^{nd} year (3^{rd} semester).

iii) Thestudent must have pursued the previous Exam(s) under semester system.

iv) At least 50% papers, of the papers passed by him/her in the previous Institute/University must have matched with the papers prescribed by this University.

v) Rest of the unmatched Subjects/Papers will be required to be passed by him/her from this University as deficient Subjects/Papers.

18. Choice Based Credit System

Definitions of Key Words

1. **Academic Year:** Two consecutive (one odd + one even) Semesters constitute one academic year.

2. **Choice Based Credit System (CBCS):** The CBCS provides choice for students to select from the prescribed courses (core, elective or minor or soft skill courses).

3. **Course**: Usually referred to, as 'papers' is a component of a programme. All courses need not carry the same weight. The courses should define learning objectives and learning outcomes. A course may be designed to comprise lectures/ tutorials/laboratory work/ field work/ outreach activities/ project work/ vocational training/viva/ seminars/ term papers/assignments/ presentations/ self-study etc. or a combination of some of these.

4. **Credit Based Semester System (CBSS):** Under the CBSS, the requirement for awarding a degree or diploma or certificate is prescribed in terms of number of credits to be completed by the students.

5. **Credit Point:** It is the product of grade point and number of credits for a course.

6. **Credit:** A unit by which the course work is measured. It determines the number of hours of instructions required per week. One credit is equivalent to one hour of teaching (lecture or tutorial) or two hours of practical work/field work per week.

7. **Cumulative Grade Point Average (CGPA):** It is a measure of overall cumulative performance of a student over all semesters. The CGPA is the ratio of total credit points secured by a student in various courses in all semesters and the sum of the total credits of all courses in all the semesters. It is expressed up to two decimal places.

8. **Grade Point:** It is a numerical weight allotted to each letter grade on a 10-point scale.

9. **Letter Grade:** It is an index of the performance of students in a said course. Grades are denoted by letters O, A+, A, B+, B, C, P and F.

10. **Programme:** An educational programme leading to award of a Degree, Diploma or Certificate.

11. **Semester Grade Point Average (SGPA):** It is a measure of performance of work done in a semester. It is ratio of total credit points secured by a student in various courses registered in a semester and the total course credits taken during that semester. It shall be expressed up to two decimal places.

Range of Percentage of Marks	**Letter Grade**	**Grade Points**	**Range of Grade Points**	**Classification**
90 and above	O (Outstanding)	10	9-10	Outstanding
80 & above but less than 90	A+ (Excellent)	9	8 < 9	Excellent
70 & above but less than 80	A (Very Good)	8	7 < 8	1st Div. with Distinction
60 & above but less than 70	B+ (Good)	7	6 < 7	1st Division
50 & above but less than 60	B (Above Average)	6	5 < 6	2nd Division
Above 40 but less than 50	C (Pass-Average)	5	Above 4 < 5	3rd Division
35 To 40	P (Pass)	4	3.5 To 4	Pass

Below minimum pass marks	F (Fail)	0	-	-

12. **Semester:** Each semester will consist of 15-18 weeks of academic work equivalent to 90 actual teaching days. The odd semester may be scheduled from July to December and even semester from January to May/June.

13. **Transcript and Detailed Grade Certificate/Statement (DGS):** Based on the earned credit points, a detailed grade Certificate/Statement (DGS) shall be issued to all the registered students after every semester. The grade Certificate/Statement will display the course details (Course Code, its nomenclature, total credit points and letter grade) along with SGPA of that semester and CGPA in the final semester.

19. Grading Method

Thegrading method for evaluating students' performance involves award, of grade according to the range of total marks in the course. The grade will be awarded based on marks out of 100, as depicted below:

Formula for Computationof SGPA & CGPA

i. The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e

$$SGPA\ (Si) = \sum (Ci \times Gi) / \sum Ci$$

Where Ci is the number of credits of the ith course and Gi is the grade point scored by the student in the ith course.

ii. The CGPA is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a programme, i.e.

$$CGPA = \sum (Si \times Si) / \sum Ci$$

Where Si is the SGPA of the ith semester and Ci is the total number of credits in that semester.

iii. The SGPA and CGPA shall be worked up to 2 decimal points and mentioned in the DGS and transcripts.

iv). Formula for calculation of aggregate pass percentage CGPA x 10

Example

Course	**Credit**	**Grade Letter**	**Grade Point Block**	**Range of Grade Points(Actual Grade Value as per marks obtd.**	**Earned Credit Points (Credit ×Actual Grade Value)**
Course 1	3	O	10	9.2	3×9.2=27.6
Course 2	3	A+	9	8.2	3×8.2=24.6
Course 3	4	A	8	7	4×7=28
Course 4	3	B+	7	6.7	3×6.7=20.1
Course 5	3	B	6	5.6	3×5.6=16.8
Course 6	4	C	5	4.7	4×4.7=18.8
	20				135.9

Thus, **SGPA** = 135.9/20 = 6.79

Similarly, suppose SGPA for 2nd, 3rd, and 4th semester are 7.85, 5.6 and 6.0 with credits 22, 24 and 22 respectively than for a two year programme, the CGPA will be computed as follows

CGPA= 20 × 6.79 + 22× 7.85 + 24 × 5.6 + 22 × 6.0/88 = 6.53

Formula for calculating percentage of marks

CGPA × 10 e.g. 6.53 × 10 = 65.3

20. Other Provisions

i) Nothing in this Ordinance shall debar the University from amending the Ordinance and the same shall be applicable to all the students whether old or new.

ii) Any other provision not contained in the Ordinance shall be governed by the rule and regulations framed by the University from time to time.

iii) All disputes shall Subject to Gurugram Court Jurisdiction.

PREAMBLE

The University Grants Commission (UGC) has initiated several measures to bring equity, efficiency and excellence in the Higher Education System of country. The important measures taken to enhance academic standards and quality in higher education include innovation and improvements in curriculum, teaching-learning process, examination and evaluation systems, besides governance and other matters. The UGC has formulated various regulations and guidelines from time to time to improve the higher education system and maintain minimum standards and quality across the Higher Educational Institutions (HEIs) in India. The academic reforms recommended by the UGC in the recent past have led to overall improvement in the higher education system. However, due to lot of diversity in the system of higher education, there are multiple approaches followed by universities towards examination, evaluation and grading system. While the HEIs must have the flexibility and freedom in designing the examination and evaluation methods that best fits the curriculum, syllabi and teaching–learning methods, there is a need to devise a sensible system for awarding the grades based on the performance of students.

Presently the performance of the students is reported using the conventional system of marks secured in the examinations or grades or both. The conversion from marks to letter grades and the letter grades used vary widely across the HEIs in the country. This creates difficulty for the academia and the employers to understand and infer the performance of the students graduating

from different universities and colleges based on grades. The grading system is considered to be better than the conventional marks system and hence it has been followed in the top institutions in India and abroad. So it is desirable to introduce uniform grading system. This will facilitate student mobility across institutions within and across countries and also enable potential employers to assess the performance of students. To bring in the desired uniformity, in grading system and method for computing the cumulative grade point average (CGPA) based on the performance of students in the examinations, the UGC has formulated these guidelines.

CHOICE BASED CREDIT SYSTEM (CBCS)

The CBCS provides an opportunity for the students to choose courses from the prescribed courses comprising core, elective/minor or skill-based courses. The courses can be evaluated following the grading system, which is considered to be better than the conventional marks system. Therefore, it is necessary to introduce uniform grading system in the entire higher education in India. This will benefit the students to move across institutions within India to begin with and across countries. The uniform grading system will also enable potential employers in assessing the performance of the candidates. In order to bring uniformity in evaluation system and computation of the Cumulative Grade Point Average (CGPA) based on student's performance in examinations, the UGC has formulated the guidelines to be followed.

Outline of Choice Based Credit System:

1. **Core Course**: A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.

2. **Elective Course**: Generally, a course which can be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline/ subject of study or which provides an extended scope or which enables an exposure to some other discipline/subject/domain or nurtures the candidate's proficiency/skill is called an Elective Course.

Discipline Centric Elective (DCE) Course: Elective courses may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective. The University/Institute may also offer discipline related Elective courses of interdisciplinary nature (to be offered by main discipline/subject of study).

Dissertation/Project: An elective course designed to acquire special/advanced knowledge, such as supplement study/support study to a project work, and a candidate

studies such a course on his own with an advisory support by a teacher/faculty member is called dissertation/project.

Generic Elective (GE) Course: An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure is called a Generic Elective. P.S.: A core course offered in a discipline/subject may be treated as an elective by other discipline/subject and vice versa and such electives may also be referred to as Generic Elective.

3. **Skill Enhancement Elective(SEE) Course:-**SEEC courses are value-based and/or skill-based and are aimed at providing hands-on-training, competencies, skills, etc.

Project work/Dissertation is considered as a special course involving application of knowledge in solving / analyzing /exploring a real-life situation / difficult problem. A Project/Dissertation work would be of 24 and 16 credits for Major and Minor Project, respectively. A Project/Dissertation work may be given in lieu of a discipline centric elective paper.

SEMESTER 1

Paper/ Course Code	Nomenclature of Paper/Course	Courses Type	Theory	Internal	Total	Credits
1	ANIMAL DIVERSITY I	CC	75	25	100	4
2	ANIMAL CELL BIOLOGY	CC	75	25	100	4
3	ANIMAL PHYSIOLOGY	CC	75	25	100	4
4	FUNDAMENTALS OF BIOCHEMISTRY	CC	75	25	100	4
5	PRINCIPLES OF MICROBIOLOGY/INTRODUCTION BOTECHNOLOGY	GEC	75	25	100	4
	Practical	CC	75	25	100	4

SEMESTER 2

Paper/ Course Code	Nomenclature of Paper/Course	Courses Type	Theory	Internal	Total	Credits
7	ANIMAL DIVERSITY II	CC	75	25	100	4
8	MOLECULAR BIOLOGY	CC	75	25	100	4
9	ANIMAL BEHAVIOUR	CC	75	25	100	4
10	DEVELOPMENTAL BIOLOGY	DCEC *	75	25	100	4
10	APPLIED ZOOLOGY	DCEC *	75	25	100	4
11	TOOLS & TECHNIQUES	GEC	75	25	100	4
12	Practical- II	CC	75	25	100	4
13	SEMINAR				50	2
	TOTAL					26

SEMESTER 3

14	GENETICS	CC	75	25	100	4
15	IMMUNOLOGY& ENDOCRINOLOGY	CC	75	25	100	4
16	EVOLUTIONARY BIOLOGY	CC	75	25	100	4
17	WILD LIFE CONSERVATION	DCEC*	75	25	100	4
17	HUMAN INFECTIONS DISEASES	DCEC*	75	25	100	4
18	BIOINFORMATICS & BIOSTATSTICS	GEC	75	25	100	4
19	Practical- III	CC	75	25	100	4
20	NTCC					2
	TOTAL					26

SEMESTER 4

Paper/ Course Code	Nomenclature of Paper/Course	Courses Type	Theory	Internal	Total	Credits
21	DISSERTATION	SEEC*			600	24

OR

Paper/ Course Code	Nomenclature of Paper/Course	Courses Type	Theory	Internal	Total	Credits
21	FISH BIOLOGY	DCEC*	75	25	100	4
22	AQUACULTURE	DCEC*	75	25	100	4
23	**PROJECT**				400	16
	TOTAL				600	24

OR

Paper/ Course Code	Nomenclature of Paper/Course	Courses Type	Theory	Internal	Total	Credits
21	FUNDAMENTALS OF ENTOMOLOGY	DCEC*	75	25	100	4
22	PEST MANAGEMENGT	DCEC*	75	25	100	4
23	**PROJECT**				400	16
	TOTAL				600	24

CC	Core Course
DCEC	Discipline Centric Elective Course
GEC	Generic Elective Course
SEEC	Skill Enhancement Elective Course
*****	CHOOSE ANY ONE

Semester	**Credits**			**Total Credits**	**Total marks**
	Core Courses	**Elective Courses**			
		DCEC	**GEC**		
I	20		4	24	600
II	16	4+2	4	26	650
III	16	4+2	4	26	650
IV	16(SEEC)	8		24	600
Total	68	20	12	100	2500

SEMESTER-I

CORE COURSE I

ANIMAL DIVERSITY I

(The Invertebrates)

Paper Code: Time Allowed: 3 Hours
Max. Marks:75 Credits: 4

Note for Examiners and Students:
1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 15 marks each and may contain more than one part. Question 1 will be of 15 marks and consists of short answer type questions of 2 to 3 marks each covering the entire syllabus.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.

Section-A

Salient Features and classification up to classes with reference to diversity in animal form and function ofProtozoa, Porifera,General account: Aquiferousand skeleton system in Porifera. In detail study of one specimen from each class.

Section-B

Salient Features and classification up to classes with reference to diversity in animal form and function ofCoelenterate, Helminthes, Nematodes,General account: Polymorphism in cnidarians; parasitic adaptations in helminthes; larval form and theirsignificance.In detail study of one specimen from each class.

Section-C

Salient Features and classification up to classes with reference to diversity in animal form and function ofAnnelid, Arthropoda,General account: Larval form and their significance in Arthropoda. In detail study of one specimen from each class.

Section-D

Salient Features and classification up to classes with reference to diversity in animal form and function ofMollusca, EchinodermetaGeneral account: Larval form and their significance in Echinodermata; Coelom; Torsion and detorsionin Mollusca; Ambulacral system. In detail study of one specimen from each class.

SUGGESTED READINGS
1. Kettle, D.S: Medical Veterinary Entomology (CAB International).

2. Boolotian and Stiles: College Zoology (Macmillan)

3. Campbell: Biology (Benjamin)

4. Marshall and Williams: Text Book of Zoology

5. Wolfe: Biology the Foundations (Wadsworth)'

6. Parker &Haswell: Text Book of Zoology Vol.II (Macmillan)

7. Prescott: Cell (Jones & Bartlett).

8. M.Kato. The Biology of Biodiversity, Springer.

9. J.C. Avise. Molecular Markers, Natural History and Evolution, Chapman & Hall, New York.

10. E.O. Wilson. Biodiversity, Academic Press, Washington.

SEMESTER-I

CORE COURSE II

ANIMAL CELL BIOLOGY

Paper Code: Time Allowed: 3 Hours
Max. Marks:75 Credits: 4

Note for Examiners and Students:

1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 15 marks each and may contain more than one part. Question 1 will be of 15 marks and consists of short answer type questions of 2 to 3 marks each covering the entire syllabus.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.

Section-A

Structure of pro-and eukaryotic cells; Structure and function of cells and intracellular organelles of both prokaryotesand eukaryotes); Significance of intracellular compartments;Structure of nucleus; Genetic analysis in Cell Biology: Nucleus; Mitochondria and chloroplasts and their geneticorganization; Evolution of aerobic respiration.

Section-B

Biomembranes: Molecular composition and arrangement functional consequences; Model membranes; Liposomes.Transport across cell membrane-Diffusion, active transport and pumps, uniports, symports and antiports; Membranepotential; Co-transport by symporters or antiporters; Transport across epithelia.

Cytoskeleton: Microfilaments and microtubules-structure and dynamics; Microtubules and mitosis; Cellmovements-intracellular transport, role and kinesin and dynein; Cilia and Flagella

Section-C

Cell-Cell signaling:Signal transduction mechanisms;Cell surface receptors;Second messenger system;MAP kinase pathways;Cell-cell interaction.Cell-Cell matrix, adhesion and communicationCa++ dependent & independent homophilic cell-cell adhesion; Gap junctions and connexinsCell matrix adhesion: Integrins, Collagen, Non-collagen components & Cellulose fibril synthesis and orientation

Section-D

Cell cycle: Mechanism of cell division including (mitosis and meiosis) and cell differentiation Cyclines and cyclinedependent kinases and Regulation of CDK-cycline activity; Biology of cancer, Biology of aging and Apoptosis-definition, mechanism and significance

SUGGESTED READINGS

1. Molecular Cell Biology, J. Darnell, H. Lodish and D. Baltimore Scientific American Book, Inc., USA.

2. Molecular Biology of the Cell, B.Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts, and J.D. Watson. Garland

Publishing Inc., New York.

3. Cell and molecular biology Phillip Sheeler, Donald E. Bianchi Wiley, 1987

SEMESTER-I

CORE COURSE III

ANIMAL PHYSIOLOGY

Paper Code: Time Allowed: 3 Hours
Max. Marks:75 Credits: 4

Note for Examiners and Students:

1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 15 marks each and may contain more than one part. Question 1 will be of 15 marks and consists of short answer type questions of 2 to 3 marks each covering the entire syllabus.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.

Section-A

Digestive system:Feeding mechanisms and regulationPhysiology of mammalian ingestion, digestion, absorption, assimilation and egestion;Dentition in mammals

Section-B

Respiratory system:Respiratory organs and respiratory pigments;Control of respiration;Structure of heart and blood vessel;Circulation and composition of body fluids and their regulation;Blood coagulation.

Section-C

Excretion and osmoregulation:Patterns of nitrogen excretion among different animal groups;Physiology of excretion;Osmoregulation in different mammalian groups;

Section-D

Muscle and Receptor physiology:

Receptor physiology -MechanoreceptionPhotoreceptionChemoreceptionEquilibrium receptionMuscles: structure and function;Neuromuscular transmission and nerve conduction.

SUGGESTED READINGS

1. Hoar, W.S. General and Comparative Animal Physiology, Prentice Hall of India.

2. Strand, F.L. Physiology: A regulatory Systems Approach. Macmillan Publishing Co., New York.

3. Pummer, L. Practical Biochemistry, Tata McGraw-Hill.

4. Prosser, C.L. Environmental and Metabolic Animal Physiology. Wiley-Liss Inc., New York.

5. Willmer, P.G. Stone, and I. Johnston. Environmental Physiology. Blackwell Sci. Oxford, UK, 644pp.

6. Newell, R.C. (ed.) 1976. Adaptation to environment. Essays on the physiology of marine animals. Butterworths, London, UK, 539pp.

7. Townsend, C.R. and P. Calow. Physiological Ecology: An evolutionary approach to resource use. Blackwell Sci. Publ., Oxford, UK.

8. Alexander, R.M.N. Optima for animals. Princeton Univ. Press, Princeton, NJ.

9. Louw, G.N. Physiological animal ecology. Longman Harloss, UK.

10. Sastry KV and Shukla V. Text Book of Physiology and Biochemistry, Rastogi Publication, Meerut

SEMESTER-I

CORE COURSE III

Fundamentals of Biochemistry

Paper Code: Time Allowed: 3 Hours

Max. Marks: 75 Credits: 4

Note for Examiners and Students:

1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 15 marks each and may contain more than one part. Question 1 will be of 15 marks and consists of short answer type questions of 2 to 3 marks each covering the entire syllabus.
2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.

Section-A

Chemical basis of life; Composition of living matter; Water – properties, pH, ionization and hydrophobicity; Emergent properties of biomolecules in water; Biomolecular hierarchy; Macromolecules; Molecular assemblies; Structure-function relationships Amino acids – structure and functional group properties; Peptides and covalent structure of proteins; Elucidation of primary and higher order structures; Evolution of

protein structure; Structure-function relationships in model proteins like ribonuclease A, myoglobin, hemoglobin, chymotrypsin etc.; Tools to characterize expressed proteins. 17 HOURS

Section-B

Enzyme catalysis – general principles of catalysis; Quantitation of enzyme activity and efficiency; Enzyme characterization and Michaelis-Menten kinetics; Relevance of enzymes in metabolic regulation, activation, inhibition and covalent modification; Single substrate enzymes, Sugars - mono, di, and polysaccharides; Suitability in the context of their different functions- cellular structure, energy storage, signaling; Glycosylation of other biomolecules - glycoproteins and glycolipids; Lipids - structure and properties of important members of storage and membrane lipids; lipoproteins.

12 hours

Section-C

Biomembrane organization - sidedness and function; Membrane bound proteins - structure, properties and function; Transport phenomena Nucleosides, nucleotides, nucleic acids - structure, diversity and function; sequencing; Brief overview of central dogma. 12 hours

Section-D

Bioenergetics-basic principles; Equilibria and concept of free energy; Coupled processes; Glycolytic pathway; Kreb's cycle; Oxidative phosphorylation; Photosynthesis; Elucidation of metabolic pathways; Logic and integration of central metabolism; entry/ exit of various biomolecules from central pathways; Principles of metabolic regulation; Regulatory steps; Signals and second messengers. 19 hOURS

Suggested Readings

1. V. Voet and J. G. Voet, Biochemistry, 3rd edition, John Wiley, New York, 2004.

2. A.L. Lehninger, Principles of Biochemistry, 4th edition, W.H Freeman and Company, 2004.

3. L. Stryer, Biochemistry, 5th edition, W.H. Freeman and Company, 2002.

4. A. C. Deb, Fundamentals of Biochemistry

SEMESTER-I

CORE COURSE IV

PRACTICAL

Paper Code: Time Allowed: 3 Hours
Max. Marks: 50 Credits: 2

From the following list of practical as many as canbe performed as per the duration of the course (Minimum 20).

- To plot the calibration curve for protein estimation by Lowry method
- To separate and identify sugar by Thin Layer Chromatography
- To adjust the pH of given buffer by pH meter
- To prepare casein from milk
- To plot standard curve for estimation of carbohydrate by anthrone method.
- Estimation of creatinine in blood.
- To test the urine for urea, proteins, ketones and sugar.
- To determine the protein concentration in the given albumin by Biuret method
- Qualitative estimation of given enzyme by colorimetric method.
- To investigate the effect of temperature on enzyme catalysed reaction
- To investigate the effect of varying pH on enzyme catalysed reaction
- To study the Beer Lambert's law for spectrophotometry.
- To prepare the absorbance curve.
- To isolate chloroplast pigments from leaf by paper chromatography.
- To isolate amino acids by paper chromatography/TLC.
- To perform agarose gel electrophoresis.
- To perform SDS-PAGE.
- To perform affinity column chromatography
- To perform ion exchange column chromatography
- To perform PCR for a given sample
- To perform ELISA
- To study the principle and working of Light Microscope.
- To measure the size of prepared protozoan slides such as *Euglena*, *Paramaecium*by Micrometry.
- To prepare a temporary mount of Buccal epithelial cells.
- To observe Barr body in the Buccal Epithelial cells of human females.
- To prepare polytene chromosomes from salivary glands of *Drosophila* larva.
- To demonstrate the movement of water by haemolysis and crenation in blood cells.
- To study squash technique for the study of Mitosis/Meiosis.
- To study the principle of cell fractionation for isolation of sub-cellular organelles.
- Identification of mitotic and meiotic stages from permanent slides.

- To perform extraction of nucleic acids
- Competent cell preparation
- Microscopy applications
- Solutions and Buffers preparation
- To estimate DNA in the given material/sample
- Assessment of proliferation in cultured cells by MTT assay
- To find the blood group and Rh factor of own blood
- To estimate the amount of Hb present in human blood
- To estimate the RBC count present in 1mm3 volume of blood.
- To estimate the WBC count present in 1mm3 volume of blood.
- Determination of MCV, MCH, and MCHC.
- Determination of colour Index of blood.
- Demonstration of the blood clotting time.
- Demonstration of the erythrocyte

SEMESTER-II

CORE COURSE VI

ANIMAL DIVERSITY II
(The Vertebrates)

Paper Code: Time Allowed: 3 Hours
Max. Marks:75 Credits: 4

Note for Examiners and Students:

1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 15 marks each and may contain more than one part. Question 1 will be of 15 marks and consists of short answer type questions of 2 to 3 marks each covering the entire syllabus.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.

Section-A

Introduction to chordates with their general characters:Origin of chordatesClassifications of vertebrate's upto order.

Section-B

Salient Features and classification up to classes with reference to diversity in animal form and function ofProtochordata, Urochordata, Hemichordata. In detail study of one specimen from each class.

Section-C

Salient Features and classification up to classes with reference to diversity in animal form and function of Pisces, Amphibia, General account: Dipnoi; Migration of fishes; Parental care in fishes and amphibians. In detail study of one specimen from each class.

Section-D

Salient Features and classification up to classes with reference to diversity in animal form and function, like:Reptilia, Aves, MammalsGeneral account: Flight adaptation in birds; Migration of birds. Evolution of Horse and man.In detail study of one specimen from each class.

SUGGESTED READINGS

1. Boolotian and Stiles: College Zoology (Macmillan)
2. Campbell: Biology (Benjamin)
3. Marshall and Williams: Text Book of Zoology
4. Wolfe: Biology the Foundations (Wadsworth)'
5. Parker &Haswell: Text Book of Zoology Vol.II (Macmillan)

6. Prescott: Cell (Jones & Bartlett).
7. M.Kato. The Biology of Biodiversity, Springer.
8. J.C. Avise. Molecular Markers, Natural History and Evolution, Chapman & Hall, New York.
9. E.O. Wilson. Biodiversity, Academic Press, Washington.
10. G.G. Simpson. Principle of animal taxonomy, Oxford IBH Publishing Company.
11. E. Mayer. Elements of Taxonomy.
12. E.O. Wilson. The Diversity of Life (The College Edition), W.W. Northern & Co.
13. B.K. Tikadar. Threatened Animals of India, ZSI Publication, Calcutta.

SEMESTER-II

CORE COURSE VII

MOLECULAR BIOLOGY

Paper Code: Time Allowed: 3 Hours
Max. Marks:75 Credits: 4

Note for Examiners and Students:

1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 15 marks each and may contain more than one part. Question 1 will be of 15 marks and consists of short answer type questions of 2 to 3 marks each covering the entire syllabus.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.

Section-A

History and Scope of Molecular Zoology,DNA replication: Prokaryotic and eukaryotic DNA replication, Mechanics of DNA replication, Enzymes andaccessory proteins involved in DNA replication

Section-B

Transcription: Prokaryotic and Eukaryotic transcription; RNA polymerases; General and specific transcriptionfactors; Regulatory elements and mechanisms of transcription regulationPost-transcriptional modifications in RNA: 5'-Cap formation; Transcription termination; 3'-end processing andpolyadenylation; Splicing, Editing; mRNA stability and Transcriptional and post-transcriptional gene silencing.

Section-C

Translation: Prokaryotic and eukaryotic translation; The translational machinery; echanisms of initiation,elongation and termination; Regulation of translation; Genetic code and Co- and post-translational modifications ofproteins ; the signal hypothesis.

Section-D

Recombination and repair: Holiday junction, excision repair; RecA and other recombinasesand DNA repairmechanisms. Biomaterials and their significance.

SUGGESTED READINGS

1. Molecular Biology of the Gene, J.D. Watson, N.H. Hopkins, J.W. Roberts, J.A. Steitz and A.M. Weiner.
The Benjamin/Cummings Pub. Co., Inc., California.
2. Molecular Cell Biology, J. Darnell, H. Lodish and D. Baltimore Scientific American Books, Inc., USA.
3. Molecular Biology of the Cell, B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson. Garland
Publishing Inc., New York.
4. Gene VI, Benjamin Lewin, Oxford University Press, U.K.
5. Molecular Biology and Biotechnology. A comprehensive desk reference, R.A. Meyers (Ed.), VCH
Publishers, Inc., New York.
6. Molecular Cloning: a Laboratory Manual, J. Sambrook, E.F. Fritsch and T. Maniatis, Cold Spring Harbor
Laboratory Press, New York.
7. Introduction to Practical Molecular Biology, P.D. Dabre, John Wiley & Sons Ltd., New York.
8. Molecular Biology LabFax, T.A. Brown (Ed.), Bios Scientific Publishers Ltd., Oxford

SEMESTER-II

CORE COURSE VIII

ANIMAL BEHAVIOUR

Paper Code: Time Allowed: 3 Hours
Max. Marks:75 Credits: 4

Note for Examiners and Students:

1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 15 marks each and may contain more than one part. Question 1 will be of 15 marks and consists of short answer type questions of 2 to 3 marks each covering the entire syllabus.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.

Section-A

Introduction - Approaches and Methods in Study of Behavior; definition, historical out line, patterns of behaviour, objectives of behaviour, mechanism of behaviour, asking questions.

Reflexes- reflex action, types of reflexes, reflex arch, characteristics of reflexes and complex behaviour

Section-B

Altruism – reciprocal altruism, group selection, kin selection and inclusive fitness, cooperation, alarm call. Parental care, parental manipulation, evolutionarily stable strategy, cost benefit analysis of parental care with suitable case studies. Sexual selection: intra sexual selection (male rivalry), inter-sexual selection (female choice), infanticide, sperm competition, mate guarding, sexual selection in human, consequences of mate choice for female fitness, monogamous verses polygamous sexual conflict.

Section-C

Concept of Learning, Memory, Cognition, Sleep And Arousal;Biological Clock.IRM Innate Releasing Mechanism. . Orientation primary and secondary orientation; kinesis – orthokinesis, klinokinesis; taxis – different kinds of taxis; sun-compass orientation, dorsal- light reaction. Hormones and pheromones influencing behaviour of animals.

Section-D

Development of Behavior, Social Communication, Social Dominance; Territoriality; Mating Systems, Parental Care,Aggressive Behavior, Migration, Orientation And Navigation; Domestication and Behavioral Changes

SUGGESTED READINGS

1. G.G. Simpson. Principle of animal taxonomy, Oxford IBH Publishing Company
2. E. Mayer. Elements of Taxonomy.
3. E.O. Wilson. The Diversity of Life (The College Edition), W.W. Northern & Co.
4. B.K. Tikadar. Threatened Animals of India, ZSI Publication, Calcutta.
5. Mechanism of Animal Behaviour, Peter Marler and J. Hamilton; John Wiley & Sons, USA
6. Animal Behaviour, David McFarland, Pitman Publishing Limited, London, UK
7. Animal Behaviour, John Alcock, Sinauer Associate Inc., USA
8. Perspective on Animal Behaviour, Goodenough, McGuire and Wallace, John Wiley & Sons, USA
9. Exploring Animal Behaviour, Paul W. Sherman & John Alcock, Sinauer Associate Inc. ,Massachusetts, USA
10. An Introduction to Animal Behaviour, A. Manning and M.S Dawkins, Cambridge University Press, UK

SEMESTER-II

Discipline Centric Elective Course I
(DCEC)
Tools and Techniques

Paper Code: Time Allowed: 3 Hours
Max. Marks: 75 Credits: 4

Note for Examiners and Students:
1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 15 marks each and may contain more than one part. Question 1 will be of 15 marks and consists of short answer type questions of 2 to 3 marks each covering the entire syllabus.
2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.

SECTION A

Microscopy: Principles and applications of light, phase contrast, fluorescence microscopes, scanning and transmission electron microscopes. Fixation and staining; cytophotometry and flow cytometry.

SECTION B

Chromatography: Principles and applications of gel filtration, ion-exchange, affinity, thin layer, gas chromatography and high pressure liquid chromatography (HPLC). Electrophoresis and centrifugation: Principles and applications of agarose and polyacrylamide gel electrophoresis; ultracentrifugation (velocity and buoyant density).

SECTION C

Molecular biology techniques: southern, northern and western blotting techniques, polymerase chain reaction (PCR), ELISA. Methods for measuring nucleic acid and protein interactions; DNA fingerprinting; Molecular markers (RFLP, AFLP, RAPD).

SECTION D

Spectroscopy: Fluorescence, UV, visible, NMR and ESR spectroscopy; X-ray diffraction. Tracer Biology: Principles and applications of tracer techniques in biology; radioactive isotopes and half-life of isotopes; autoradiography.

Suggested Readings

1. Freifelder D. (1982), Physical Biochemistry- Application to Biochemistry and Molecular Biology, 2nd Edition, W.H. Freemen and Company, San Fransisco.
2. Rietdorf, J. (2010) Microscopy Techniques, Springer, Berlin
3. Walker J. and Wilson K (2010), Principles and Techniques-Practical Biochemistry, 7 th Edition, Cambridge University Press, London.

APPLIED ZOOLOGY

Paper Code: Time Allowed: 3 Hours
Max. Marks:75 Credits: 4

Note for Examiners and Students:
1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 15 marks each and may contain more than one part. Question 1 will be of 15 marks and consists of short answer type questions of 2 to 3 marks each covering the entire syllabus.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.

Section-A

Host – Definitive and intermediate, Parasitism, Symbiosis, Commensalism, Reservoir. Transmission, prevention and control of diseases: Tuberculosis and Swine fluPrinciples and applications of ECG, MRI, PET, and CAT.

Section-B

Life history and pathogenesis of *Plasmodium* sp.Life history, Medical importance and control of *Aedes*sp.Life history, pathogenesis and control of *Taenia*sp.Principles and applications of brain activity recording, and pharmacological testing.

Section-C

Preservation of gametes in animal and artificial insemination.Principles and management of Poultry.

Section-D

Introduction and management of pisciculture. Genetic improvement in animals; Induced breeding in aquaculture.

SUGGESTED READINGS

1. Dent, D. Insect Pest ManagementSS
2. Hill, D.S., Timber Press. Agricultural Entomology
3. David, B. V. &Ananthakrishnan. General and Applied Entom
5. Asa C. Chandler, Clark P. Read, Introduction to Parasitology, John wiley and Sons., Inc., New York.
6. Thomas W.M. Cameron, Parasites and Parasitism, Billing and Sons ltd. London,
7. Elmer R. Noble, Glenn A. Noble; Parasitology: The Biology of Animal Parasites, Lea andFebiger, Washington.
8. R.P. Hall, Protozoology, Prentice-Hall, Inc. Engtewood diffs. N.J. Charles E. Tuttle Company, Tokya
9. E.O. Wilson. The Diversity of Life (The College Edition), W.W. Northern & Co.
10. Molecular Biology of the Cell, B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and

J.D. Watson. GarlandPublishing Inc., New York.
11. Molecular Biology and Biotechnology. A comprehensive desk reference, R.A. Meyers (Ed.), VCH Publishers,Inc., New York.
12. Molecular Cloning: a Laboratory Manual, J. Sambrook, E.F. Fritsch and T. Maniatis, Cold Spring HarborLaboratory Press, New York.
13. Gray's Clinical Neuroanatomy by Mancall**New** Medical Pharmacology at a Glance (7th Ed.)
14. Medicine at a Glance (3rd Ed.)
15. Oxford Handbook of Neurology (2nd Ed.)

SEMESTER-II

Discipline Centric Elective Course II
(DCEC)

DEVELOPMNETAL BIOLOGY

Paper Code: Time Allowed: 3 Hours
Max. Marks:75 Credits: 4

Note for Examiners and Students:
1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 15 marks each and may contain more than one part. Question 1 will be of 15 marks and consists of short answer type questions of 2 to 3 marks each covering the entire syllabus.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.

Section-A

Developmental patterns in metazoans; Development in unicellular eukaryotes;Molecular basis of spermatogenesis, Oogenesis and fertilization.

Section-B

Cell fate and Cell lineages; Stem cells; Cleavage types and significance;Blastula; Fate maps; Comparative account of Gastrulation (sea urchin, zebrafish,xenopus,chick)Neurulation and ectoderm; Mesoderm and endoderm.

Section-C

Cytoplasmic determinants, Cell commitment, specification, induction, competence, Determination anddifferentiation, Cell specification in nematodesGerm cell determinants, Germ cell migration, Cell-Cell interaction,Mutants and transgenics in analysis of development

Section-D

Caenorhabditis: Vulva formationGenetics of axis specification in *Drosophila, amphibia and chick*Eye lens induction, limb development and regeneration in vertebrates,Differentiation of neurons, HOX genesMetamorphosis, Environmental regulation of normal development,Sex determination

SUGGESTED READINGS

1. S.F. Gilbert. Developmental Biology. 8th Edition Sinauer Associates Inc., Massachusetts.

2. L. Wolpertet. al. Principles of Development; Oxford University Press; 2002

3. Jonathan M. W. Slack. Essential Developmental Biology, 3rd Edition. 2012, Wiley-Blackwell

4. L. W. Browder et. al. Developmental Biology, 3rd Edition; Saunders College Publishing,

Philadelphia ISBN 0-03-013514-1

5. T. Subramonium. Molecular Developmental Biology, 2nd Edition, 2013. Narosa Publishing

House

6. Ethan Bier. 'The Coild Spring'. Cold Spring Harbor Laboratory Press, New York.

SEMESTER-III

CORE COURSE IX

GENETICS

Paper Code: Time Allowed: 3 Hours
Max. Marks:75 Credits: 4

Note for Examiners and Students:
1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 15 marks each and may contain more than one part. Question 1 will be of 15 marks and consists of short answer type questions of 2 to 3 marks each covering the entire syllabus.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.

Course Objectives: Genetics is offered as a core course that provides fundamental knowledge of how organisms, populations and species evolve. Apart from Mendel's laws and basic genetics, at Master's level, this course will provide some of the most incisive analytical approaches that are now being used across the spectrum of the biological disciplines.

Overall, this course will highlight extension of Mendelian Genetics, dosage compensation, evolution of the concept of gene and its amalgamation with molecular biology and study of genetic diseases.

Section A

Mendel's laws and their chromosomal basis; extension of Mendel's principles: allelic variation and gene function- incomplete dominance and co-dominance, allelic series, testing gene mutations for allelism; gene action- from genotype to phenotype– penetrance and expressivity, gene interaction, epistasis, pleiotropy. Fine str ucture of Gene.

Section B

Methods of gene mapping: 3- point test cross in Drosophila, pattern of inheritance by pedigree analysis and gene mapping. Gene mutation, types of gene mutations, methods for detection of induced mutations; P- element insertional mutagenesis in Drosophila; DNA damage, repair and recombination.

Section C

Regulation of Gene Expression:Regulation of gene activity in lac and trp operons of E. coli.;General introduction to gene regulation in eukaryotes at transcriptional and posttranscriptional levels; Chromatin organization and gene expression, transcription factors, enhancers and silencers, non coding genes.

Section D

Mechanisms of sex determination and Dosage Compensation: Human,DrosophilaandC. elegans. Genetic analysis of complex traits - complex pattern of inheritance, quantitative traits, threshold traits. Chromosome banding, karyotype and nomenclature of metaphase chromosome; chromosomal anomalies in malignancy (chronic myeloid leukemia, Burkitt's lymphoma, retinoblastoma and Wilms' tumor); oncogenes and tumor suppressor genes- genetic pathways to cancer.

Suggested Readings:

1. Principles of Genetics, Snustad and Simmons, John Wiley & Sons, USA [Latest edition] .

2. Modern Genetic Analysis: Integrating Genes and Genomes, Griffiths, J.F., Gilbert, M., Lewontin, C. and Miller, W. H. Freeman and Company, New York, USA[Latest edition] .

3. Genetics, J. Russell, Benjamin-Cummings Publishing Company, San Francisco, California, USA [Latest edition] .

SEMESTER-III

CORE COURSE X

Zoology: Immunology and Endocrinology

Paper Code: Time Allowed: 03 hours

Max. Marks: 75 Credits: 4

Note for Examiners and Students:

1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C and D of 15 marks each and may contain more than one part. Question 1 will be of 15 marks and consists of short answer type questions of 2 to 3 marks each covering the entire syllabus.
2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 03 hours.

Section- A

Overview of Immune System, Historical perspective of Immunology, Early theories of Immunology, Innate and adaptive immune system, Cells and molecules involved in innate and adaptive immunity, Effector mechanisms in immunity, B and T cell epitopes, Structure and function of antibody molecules, Generation of antibody diversity, Monoclonal antibodies.

Section-B

Antigens: Antigenicity and immunogenicity, antigen- antibody interaction, MHC molecules, Antigen processing and presentation, Complement system: components and pathways of complement activation, Inflammation, Hypersensivity.

Section- C

Definition and scope of endocrinology: Structure of various endocrine glands, Hormones: Classification, structure and function, Techniques for quantification, purification and characterization of hormones.

Section- D

Biosynthesis and secretion of hormones: Biosynthesis of steroid hormones, Biosynthesis of amino- acid derived small size hormone (eg. T4, Epinephrine etc), Biosynthesis and secretion of protein hormone, Regulation of biosynthesis and secretion: Inhibitors of hormone biosynthesis and their use.

Books recommended

1. Kuby. Immunology, W.H. Freeman, USA.
2. Mac E. Hadley, Jon E. Levine. Endocrinology, Pearson Prentice Hall, 2007.

SEMESTER-III
Discipline Centric Elective Course III
SEMESTER-III
Discipline Centric Elective Course III
(DCEC)

Bioinformatics and Biostatistics

Paper Code: Time Allowed: 3 Hours

Max. Marks:75 Credits: 4

Note for Examiners and Students:

1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 15 marks each and may contain more than one part. Question 1 will be of 15 marks and consists of short answer type questions of 2 to 3 marks each covering the entire syllabus.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.

SECTION-A (Biostatistics)

Basic definitions and applications, Data collection and representation. Measure of central tendencies (Mean, Median and Mode) and dispersal; measure of variability (standard deviation, standard error, range, mean deviation, coefficient of variation); probability distributions (Binomial, Poisson and Normal), sampling distribution ,Difference between parametric and non-parametric statistics, confidence interval, errors, levels of significance 3. Regression and correlation, t-test, analysis of variance, chi-square test, Basic introduction to Multivariate statistics.

SECTION-B (Biological databases)

Brief on programming languages commonly used in Biological Sciences, Database- introduction, Primary, Secondary and Tertiary databases; Type and kind of databases; Literature search (PUBMED and MEDLINE). ,Nucleic acid (GenBank, EMBL etc.); Structural databases- PDB, PDBsum, NDB, CATH, SCOP etc. Motifs and Pattern Databases- PROSITE, Pfam, iPfam etc. ,Protein databases (SWISS PROT, UNIPROT etc.); Structural databases- PDB, PDBsum, NDB, CATH, SCOP etc; Motifs and Pattern Databases- PROSITE, Pfam, etc. , Sequence retrieval (SRS, Entrez) and Data submission.

SECTION-C (Sequence analysis)

Sequence alignment- introduction and concepts, Local and Global alignment concepts. Similarity and Percent identity score (open, extended gap penalty). Multiple sequence alignment (MSA) - introduction and concepts. Types of multiple sequence alignment techniques. Description of major softwares (MSA, CLUSTAL variants (X, W2, OMEGA), PILEUP, T-Coffee, PROS, CONS). ,Database Scanning and Sequence similarity searches. Algorithm of FASTA. Description of BLAST algorithm. Various BLAST programs (BLASTP, BLASTN, BLASTX, PHIBLAST, PSI-

BLAST etc). Protein Structure: Classification, Structure Analysis, Secondary structure predictions, Comparative/Homology modeling, Modeling using Swiss Model Server.

SECTION-D (Genome analysis)

Introduction to genomes, sequencing techniques. Sequencing of whole genomes. Next Gen Sequencing (NGS); Assembling of genomes from short reads ,Concept of Metagenomics;Types of repeats and repeat finding techniques; Structure of genes; Prediction of gene in prokaryotic and eukaryotic genomes (GENESCAN, GeneMark, GeneSeqer etc.); Promoter prediction in E. coli and in eukaryotes , Description of major gene prediction methods

PRACTICALS:

1. Sequence (DNA & Protein) alignments
2. Genome sequence studies
3. Designing ideal primers for amplification of genetic material
4. Deciphering 3-D structure of proteins
5. Designing inhibitors of enzymes

Suggested readings:

1. Understanding Bioinformatics by Marketa Zvelebil and Jeremy Baum (2007) Publisher: Garland Science; 1 st edition ISBN-10: 0815340249, ISBN-13: 978-0815340249
2. Essential Bioinformatics by Jin Xiong (2006) Publisher: Cambridge University Press; 1st edition ISBN-10: 0521600820, ISBN-13: 978-0521600828
3. Bioinformatics: Sequence and Genome Analysis by David W. Mount (2004). Publisher: Cold Spring Harbor Laboratory Press; 2 nd edition ISBN-10: 0879697121 ISBN-13: 978-0879697129
4. An Introduction to Bioinformatics Algorithms (Computational Molecular Biology) by Neil C. Jones and Pavel A. Pevzner (2004) Publisher: The MIT Press; 1 st edition ISBN-10: 0262101068, ISBN- 13: 978-0262101066
5. Bioinformatics: A Biologist's Guide to Biocomputing and the Internet by Stuart M. Brown (2000). Publisher: Eaton Publishing Company/Biotechniques Books ISBN-10: 188129918X, ISBN- 13: 978-1881299189

SEMESTER-III

Discipline Centric Elective Course III (DCEC)

Human Infections Diseases

Paper Code: Time Allowed: 3 Hours

Max. Marks:75 Credits: 4

Note for Examiners and Students:

1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 15 marks each and may contain more than one part. Question 1 will be of 15 marks and consists of short answer type questions of 2 to 3 marks each covering the entire syllabus.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.

SECTION-A (INTRODUCTION)

Aim and scope of Medical Microbiology or Infection biology in human life; Basics terms use in clinical and medical fields to study infective agents or associated diseases. General introduction about various types of infective agents in context of human health. Detailed study about antiviral, antibiotics and antifungal.

SECTION-B (VIRAL INFECTIONS)

Virus associated infections: Salient features/ General characteristics, Genome overview, Incubation period, Pathogenesis/ Infection cycle, Treatment and Prevention of the diseases associated with following viruses: HIV, HPV, EBOLA, POLIO, MARBURG, RABIES, SMALLPOX, DENGUE, ROTAVIRUS, INFLUENZA and SARS GROUP. (Detailed study about any four specimens). Virus associated with cancer.

SECTION-C (BACTERIAL INFECTION)

Bacterial infections: Sailent features/ General characteristics, Genome overview, Incubation period, Pathogenesis, Treatment and Prevention of the diseases associated with following bacteria: *Staphylococcus aureus, Clostridium botulinum, Vibrio cholerae, Campylobacter jejuni, Salmonella spp., Shigella spp., Yersinia pestis, Bacillus anthracis ,Streptococcus spp. and Listeria monocytogenes.* . (Detailed study about any four specimens).

SECTION-D (FUNGAL & PROTOZOAL INFECTION)

Fungal and Protozoa infections: Salient features/ General characteristics, Incubation period, Pathogenesis, Treatment and Prevention of the diseases associated with following fungus and protozoa: *Blastomyces, Cryptococcus gattii, Coccidioides , Histoplasma , Giardia* infection , *Plasmodium* and *Leishmania, Entamoeba* infection. . (Detailed study about any four specimens).

Suggested Readings:

1. Ananthanarayan R, Paniker CKJ (2009). Textbook of Microbiology, 8th edition, University Press Publication, India.
2. Brooks GF, Carroll KC, Butel JS, Morse SA, Mietzner TA (2010). Jawetz, Melnick and Adelberg's Medical Microbiology, 25th edition, McGraw Hill Publication.
3. Abbas AK, Lichtman AH, Pillai S (2007). Cellular and Molecular Immunology, 6th edition, Saunders Publication, Philadelphia.

4. Goldsby RA, Kindt TJ, Osborne BA, Kuby J (2007). Immunology, 6th edition, W.H. Freeman and company, New York, USA.
5. Murphy K, Travers P, Walport M (2008). Janeway's Immunobiology, Garland Science Publishers, 7th edition, New York, USA.
6. Willey JM, Sherwood LM, Woolverton CJ (2008). Prescott, Harley and Klein's Microbiology.
7. Dimmock NJ, Easton AL, Leppard KN (2007). Introduction to Modern Virology,
8. 6th edition, Blackwell Publishing Ltd,UK.
9. Carter J, Saunders V (2007). Virology: Principles and Applications. John Wiley and Sons, NewYork.
10. Flint SJ, Enquist, LW, Krug, RM, Racaniello, VR, Skalka, AM (2004). Principles of Virology, Molecular biology, Pathogenesis and Control, 2nd edition, ASM press, Washington DC.

PRACTICALS:

1. Study of virus and fungal architecture using electron microphotographs or models or through permanent slides.
2. Study of the infection cycle of PLASMODIUM using model or micrograph or through permanent slides.
3. Elaborated knowledge of how animal viruses are cultivated in various media like embryonated eggs and cell cultures.
4. Study of the cytopathic effects of viruses using electron microphotographs**.**
5. Study composition, preparation and use of common selective differential media commonly used in medical microbiology – MacConkey agar, EMB agar, MH agar, Deoxycholate citrate agar (DCA).
6. Staining techniques used in medical microbiology - Gram's staining and Ziehl-Neelsen staining for acid fast bacilli (AFB).
7. Antibiotic susceptibility testing using Kirby-Bauer method.

Determine minimal inhibitory concentration (MIC) of an antibiotic using double dilution technique.

SEMESTER-III
Discipline Centric Elective Course III
(DCEC)

Research Seminar

Max. Marks:50 Credits: 2

1. **The students will choose a topic from their syllabus and do research on it, so as to write a revivewal article that can be published .**
2. **The mentor of the student and the student will also look into any small experiment if can be done and a research paper can be published.**
3. **Presentation of the article as a seminar will be the final step in completion of the course.**

SEMESTER- IV

This semester has two modules and the students will have to choose any one.

Module 1
Dissertation for 6 months in different lab /institution /organisation. The students will submit a dissertation report (5 copies) in the University and will defend the work done during the dissertation. Marks will be alloted based on the work, its presentation and questions asnwered.

Module 2
Two papers on fish biology and Aquaculture, will have to cleared and a small project on the same must be done.

Module 3
Two papers for Entomology, will have to cleared and a small project on the same must be done.

Module 4
Two Papers for Genomics and Proteomics, will have to cleared and a small project on the same must be done.

Discipline Centric Elective Course III
(DCEC)

Fish Biology

Paper Code: Time Allowed: 3 Hours
Max. Marks:75 Credits: 4

Note for Examiners and Students:

1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 15 marks each and may contain more than one part. Question 1 will be of 15 marks and consists of short answer type questions of 2 to 3 marks each covering the entire syllabus.
2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.

Section A

Characters and classification. Ostracoderms and placoderms; Cyclostomes; Chondrichthyes; Teleostomes; Actinopterygii.

Section B

General characters of Epidermis and exoskeleton; Fins; Skeletal system; Cardio-vascular system; Structure and function of gills; Air breathing organs: Swim bladder and Weberian ossicles; Excretion and osmoregulation; Alimentary canal and its modifications.

Section C

Reproduction, maturation and spawning; Fertilization, development and growth; Sex dimorphism, mating and parental care; Brain and the cranial nerves; Electric organs; The lateral line system; Bioluminescence and sound production; Olfactory, auditory and photoreceptors.

Section D

Migration of fishes; Endocrine and neurosecretory system; Larvivorous fishes; Adaptations in the hill stream fishes; Adaptations in the deep sea fishes; Exotic fishes. Fish Parasites and diseases.

Suggested Readings

1. Fish Biology and Fisheries by S.S. Khanna
2. Recent technologies in Fish and Fisheries by G.Krishnaveni et.al.
3. Freshwater Aquaculture by R.K.Rath
4. A text Book of Fishery Sciences and Indian Fisheries by Dr. CBL Srivastava
5. Aquaculture by N Arumugam

Discipline Centric Elective Course III
(DCEC)

Aquaculture

Paper Code: Time Allowed: 3 Hours
Max. Marks:75 Credits: 4

Note for Examiners and Students:

1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 15 marks each and may contain more than one part. Question 1 will be of 15 marks and consists of short answer type questions of 2 to 3 marks each covering the entire syllabus.
2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.

Section A

Inland Fisheries resources of India. Riverine Fisheries – The Ganga river system, Brahmputrariver system, East coast river system, West coast river system; Reservoir fisheries: Cold water fisheries; Estuarine fisheries resources of India - Fisheries of Chilka, Pulicat and Kolleru lake.

Different systems for aquaculture: pond culture, cage culture, raceway culture. Culture ofimportant fish species (Major carps, common carps, Chinese carps, cat fish culture andTilapia culture)

Section B

Integrated Aquaculture and waste water aquaculture Pearl Culture Frog culture Prawn culture-Fresh and brackish water. Methods of Fish Preservation – Chilling, Freezing, Freeze drying, sun-drying, smoking, salting, brining and canning; use of chemical and radiation. Preparation and management of nursery, rearing and stocking ponds

Section C

Impact of Aquaculture on Environment Methods of Fishing: Crafts and gear technology Nutrition in Aquaculture: Nutrient and non-nutrient diet components, Preparation and processing of feed, feed formulae, Natural and supplementary feed and their utilization

Section D

Role of genetics in aquaculture– gynogenesis, androgenesis, triploidy, tetraploidy, hybridization, sex reversal and breeding, production of transgenic fish, impact of GMOs on aquatic biodiversity.

Suggested Readings

1. Fishponds in Farming Systems, Zijpp, V. D., Verreth, J. A. J., Tri, L. Q., van Mensvoort, M. E. F., Bosma, R. H., and Beveridge, M. C. M., Wageningen Academic Publishers, Netherlands

2. Aquaculture Principles and Practices, Pillay, T. V. R., Blackwell Publishing, USA 3. Aquaculture and Fisheries Biotechnology Genetic Approaches, Dunham, R. A., CABI Publishing, USA