

ORDINANCES & OUTLINES
FOR
SYLLABI AND COURSE OF READING
B. Sc. MEDICAL
2023-2024
PROGRAMME CODE: BSM



MATA GUJRI COLLEGE FATEHGARH SAHIB

An Autonomous College

Re-Accredited with Grade 'A' by NAAC

Covered under Star College Scheme, DBT, GOI

ORDINANCES

For B.Sc. Medical (Semester System)

(UNDER THE +3 SCHEME)

Applicability of Ordinances for the time being in force

1. Notwithstanding the integrated nature of a course spread over more than one academic year, the ordinances in force at the time a student joins a course shall hold good only for the examination held during or at the end of the academic year. Nothing in these Ordinances shall be deemed to debar the College from amending the ordinances subsequently and the amended ordinances, if any, shall apply to all the students whether old or new.

2. B.Sc. Medical is an integrated course comprising three parts spread over three years. Each part will consist of two semesters. The course of study of B.Sc. shall be divided in six semesters and College examination will be held at the end of every semester in the months of November/December (for semester I, III & V) and May/June (for semester II, IV & VI) or as fixed by the Academic Council.

3. This course is under Choice Based Credit System (CBCS). The CBCS provides an opportunity for the students to choose courses from the prescribed list comprising core, elective or skill based courses

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

ii. **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.

a. **Discipline Specific Elective (DSE) Course:** Elective courses offered under the main discipline/subject of study are referred to as Discipline Specific Elective.

b. **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.

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 6 credits. A Project/Dissertation work may be given in lieu of a discipline specific elective paper

c. **Generic Elective (GE) Course:** An elective course chosen from an unrelated discipline/subject, with an intention to seek exposure beyond discipline/s of choice is called a

Generic Elective. The purpose of this category of papers is to offer the students the option to explore disciplines of interest beyond the choices they make in Core and Discipline Specific Elective papers.

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.

iii. Ability Enhancement Courses (AEC): The Ability Enhancement (AE) Courses may be of two kinds: Ability Enhancement Compulsory Courses (AECC) and Skill Enhancement Courses (SEC). “AECC” courses are the courses based upon the content that leads to Knowledge enhancement; i. Environmental Science and, ii. English/Hindi/Modern Indian Language (MIL) Communication. These are mandatory for all disciplines.

SEC courses are value-base and/or skill-based and are aimed at providing hands-on-training, competencies, skills, etc.

a. Ability Enhancement Compulsory Courses (AECC): Environmental Science, English Communication/Hindi Communication/MIL Communication.

b. Skill Enhancement Courses (SEC): These courses may be chosen from a pool of courses designed to provide value-based and/or skill-based knowledge.

iv. Practical/tutorials: The practicals/tutorials will be conducted keeping in view the spirit of UGC guidelines as per the needs and requirements of the concerned subject.

4. Terms defined under CBCS are as follows:

a. Academic Year: Two consecutive (one odd + one even) semesters constitute one academic year.

b. 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.

c. 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.

d. Credit Point (CP): The numerical value obtained by multiplying the grade point (GP) by the no. of credit(C) of the respective course i.e. $CP = GP \times C$.

e. Credit(C): A unit by which the course work is measured. It determines the number of hours of instructions required per week.

i) 1 Credit = 1 Theory period of one hour duration

ii) 1 Credit = 1 Tutorial period of one hour duration

iii) 1 Credit = 1 Practical period of two hour duration

f. 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.

g. Grade Point (GP): It is a numerical weight allotted to each letter grade on a 10 point scale.

h. 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.

i. Programme: An educational programme leading to award of a degree, diploma or certificate.

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

k. Semester: Each semester will consist of 15-18 weeks of academic work. The odd semester may be scheduled from July to December and even semester from January to June.

l. Transcript or Grade Card (GC) or Certificate: Based on the grades earned, a grade certificate shall be issued to all the registered students after every semester. The grade certificate will display the course details (code, title, no. of credits, grades secured) along with SGPA of that semester and CGPA earned till date semester.

m. Semester Examinations: The comprehensive examinations conducted for summative evaluation of course.

n. L-T-P: The prescribed hours/week during a semester for Lecture-Tutorial-Practical to a particular course, in accordance with curriculum prescriptions based on respective nature

5. Eligibility Conditions for Admission:

5.1 A candidate will be eligible to join 1st semester of B.Sc. course, only if he/she has passed +2 examinations with medical) with 45% marks in the 10+2 examination (Relaxation will be given to specific categories as per Govt. rules) from CBSE, Punjab School Education Board, or any other examination recognized as equivalent thereto.

5.2 To qualify for admission to **3rd semester of the Course**, the candidate must have passed 50% of total papers of the two semesters of the 1st year. In case, the result of 2nd semester is not declared at the time of admission to 3rd Semester, the student may be admitted

provisionally and will be allowed to take examination of 3rd semester if he/she has passed in 50% of the total papers of first year (i.e. 1st and 2nd Semesters).

5.3 To qualify for admission to 5th semester of the course, the student may be admitted provisionally if the result of previous semester has not been declared and will be allowed to take examination of 5th semester, if he/she has passed 50% of the total papers of previous semesters.

5.4 The pass and reappear students of B.Sc. Part-I and II from other recognized universities shall be treated at par with the corresponding students of this College. He/she will be required to clear deficient papers of previous semesters, if any.

5.5 If any student gets admission after concealing any fact or his/her certificates are found fake after verification or he/she misleads the institution as any front or because of any other reason, his/her admission will stand cancelled/ his/her result cancelled though he/she may have been declared pass.

6. The outlines of tests and syllabi shall be such as prescribed by the Academic Council from time to time

7. The medium of instructions and examination will be English except for the non English subjects.

8. Punjabi is mandatory as per university rules. **Elementary Punjabi** in the lieu of Punjabi shall be allowed only to the following categories of candidates:

- a. Candidates who have passed their Matriculation examination from a School located outside the State of Punjab.
- b. Children of Defence personnel/Para military personnel (serving as well as retired) will be allowed to take up the subject of Punjabi, provided the father or the mother/guardian (in case father is deceased) of the candidate gives an affidavit that the candidate has not studied Punjabi at the School level.

9. A candidate must complete and pass the whole course of three years within a maximum of six years from the date of admission in B.Sc. first semester. If the candidate does not clear the lower examination within stipulated period, the higher result of the candidate will stand automatically cancelled.

10. Attendance Regulations & Condonation:

- a. A student shall be eligible to appear for end semester examinations, if he/she acquires a minimum of 75% of attendance in each subject.
- b. Request to the Principal for Condonation of shortage of attendance after the recommendation of the HOD will be forwarded to Lecture Shortage Condonation Committee. The committee can finally condone the shortage in aggregate up to 15% on medical grounds in each semester.

c. Any student representing the Institute/ University/ State/ Nation in any Academic/ Sports/ Cultural/Extra Co curricular/ NSS/NCC or any other event shall be considered on duty. His/ Her shortage of lectures shall be condoned, provided that the student is permitted in writing by the Principal/HOD concerned and a certificate to this effect signed by the competent authority where the student attended the event is taken.

d. A Student will not be promoted to the next semester unless he/she satisfies the attendance requirement of the present semester as applicable.

e. Students whose shortage of attendance is not condoned in any semester are not eligible to take their end semester examination of that particular semester and their registration for examination shall stand cancelled and no fee shall be refunded.

f. College medal will be awarded to a candidate who secures first position in the College on the basis of the marks of all the six semesters taken together. The general rules and conditions of the College/University for the Award of medal/prizes etc. will be applicable in the award of College medal to the topper of this examination

10. Examination:

10.1 Examination will be open to **regular candidates** who will fulfill the following requirements:

1. has been on the rolls of college throughout the academic terms
2. have good moral character
3. has attended 75% of the number of lectures delivered/practical in each paper, for late admission, lectures delivered will be counted from her/his date of admission.
4. In case of students, whose names are struck off on account of non payment of fee or other reasons shall not be accounted for.
5. The shortage in attendance of lectures by the candidate will be condoned as per rules approved by Academic Council from time to time.

10.2 Amount of examination fee to be paid by a candidate for each semester shall be as fixed by the College from time to time.

10.3 The minimum number of marks required to pass each semester examination will be 35% in each paper and 35% in the aggregate of the semester examination. Provided, that in papers with practicals, the percentage shall be required separately in written and practical/lab work.

10.4 Internal Assessment: The Assessment in each semester of B.Sc. Course will be 25% internal and 75% external for each Theory paper. There shall be Two Mid Semester tests in each Semester. Internal Assessment of 25% will be based on Continuous Comprehensive Assessment (CCA) pattern and the breakup will be as under:

- (i) Mid Semester Tests : 50%
- (ii) Assignment/Seminar/Class Test/Tutorial/Quiz etc. : 25%
- (iii) Attendance : 25%
- (iv) The candidate is required to secure atleast 35% marks both in external examination and in internal assessment separately in each paper in order to qualify in an examination.

10.5 A candidate placed under **reappear** in any paper, will be allowed two chances to clear the reappear, which should be availed within consecutive two years/chances i.e. to pass in a paper the candidate will have a total of three chances, one as regular student and two as reappear candidate or rules as prescribed by University from time to time.

10.6 The **examination of reappear papers** of odd semesters will be held with regular examination of the odd semester and reappear examination of the even semester will be held with regular examination of even semester. But if a candidate is placed under reappear in the last semester of the course, he/she will be provided chance to pass the reappear with the examination of the next semester, provided his reappear of lower semester does not go beyond next semester

10.7 The Candidate shall also be entitled to grace marks under guidelines given by of University/ Academic Council from time to time.

10.8. Re-evaluation will be as per examination rules as approved by Academic Council.

10.9 A candidate who has passed B.Sc. Medical in +3 examination scheme from this College shall have two chances within a period of two years after passing the examination to improve division 55% marks. Improvement shall be allowed in not more than 50% of total theory papers offered in Part-I, II and III examination. However, previous marks of Practical/Internal Assessment will be carried forward in the paper(s) in which he/she appears for improvement.

10.10 Improvement Examinations:

- a. A student who has been declared 'pass' in the Undergraduate course he/she was admitted to, may apply for improvement within a year from the declaration of the result of the final semester and he/she can take maximum of 50% of the total papers for that course for improvement.
- b. A student shall have to appear in End semester examination of the paper chosen for improvement along with the regular students. No special exam shall be held for him/her.
- c. If a student fails to improve upon the original marks obtained in the paper chosen for improvement, his/her original marks shall be retained and he/she shall not get a second chance for improvement.
- d. Improvement examination in practical/MST paper shall not be allowed.
- e. A student taking improvement examination shall have to pay a fee decided by the college.

11. Degree Requirement:

An undergraduate degree in a discipline may be awarded if a student completes atleast 12 core papers, 2 Ability Enhancement Compulsory Courses (AECC), 4 Skill Enhancement Courses (SEC) and 6 Discipline Specific Elective (DSE) papers as mentioned in the outline of the course. A student, who earns total specified credits according to the curriculum and fulfills such other conditions as mentioned in the curriculum of the

programme, shall be issued the DMC and shall be awarded degree by Punjabi University Patiala. He/she must also pay all College dues as per rules. Moreover, there should be no case of indiscipline pending against him/her.

12. The Successful candidates shall be classified on the basis of 10-point grade following letter grades

Letter Grade	Marks	Grade Points
O (Outstanding)	91-100	10
A+ (Excellent)	81-90	9
A (Very Good)	71-80	8
B+ (Good)	61-70	7
B (Above Average)	51-60	6
C (Average)	41-50	5
P (Fair)	40	4
F(Fail)		0
D (Detained)		0
Ab (Absent)		0

Computation of SGPA and CGPA

The UGC recommends the following procedure to compute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (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.

$$\text{SGPA (Si)} = \frac{\sum(C_i \times G_i)}{\sum C_i}$$
 where C_i is the number of credits of the i th course and G_i is the grade point scored by the student in the i th 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.

$$\text{CGPA} = \frac{\sum(C_i \times S_i)}{\sum C_i}$$
 where S_i is the SGPA of the i th semester and C_i is the total number of credits in that semester.
- iii. The SGPA and CGPA shall be rounded off to 2 decimal points and shall be reported in the transcripts.

**Illustration of Computation of SGPA and CGPA and Format for Transcripts
(The table below gives an example to calculate SGPA for Semester I)**

**Illustration for SGPA (semester-I)
(The table below gives an example to calculate SGPA)**

Course	Credit	Grade letter	Grade points	Credit points × Grade
Core Course I	4	A	8	4×8=32
Core Course II	4	B+	7	4×7=28
Core Course III	6	A	8	6×8=48
CC-Practical paper I	2	C	5	2×8=16
CC-Practical paper II	2	B	6	2×6=12
Ability enhancement compulsory course I	5	B	6	5×6=30
Ability enhancement compulsory course II	2	A	8	2×8=16
Total	25			Total Grade Points =182

Thus, SGPA= 182 divided by 25= 7.28d

**Illustration for CGPA (example)
(The table below gives an example to calculate CGPA)**

SEMESTER 1	SEMESTER 2	SEMESTER 3	SEMESTER 4	SEMESTER 5	SEMESTER 6
CREDIT 25	CREDIT 28	CREDIT 25	CREDIT 25	CREDIT 25	CREDIT 25
SGPA 7.36	SGPA 7.8	SGPA 5.6	SGPA 6.0	SGPA 7.8	SGPA 7.8

$$\begin{aligned} \text{Thus, CGPA} &= \frac{25 \times 7.36 + 28 \times 7.8 + 25 \times 5.6 + 25 \times 6.0 + 25 \times 7.8 + 25 \times 7.8}{153} \\ &= \frac{184 + 218.4 + 140 + 150 + 195 + 195}{153} \\ &= 7.07 \end{aligned}$$

Transcript (Format): Based on the above recommendations on Letter grades, grade points and SGPA and CGPA, the University may issue the transcript for each semester and a consolidated transcript indicating the performance in all semesters.

13. The division obtained by each student is classified on the following basis:

	Division	CGPA
a)	1 st with distinction	7.5 or more
b)	1 st	6.0 or more but less than 7.5
c)	2 nd	5.0 or more but less than 6.0

14. First, Second or Third position shall be awarded to the candidates, provided they meet the following conditions:

- a. Rank shall be solely decided on the final CGPA, on completion of degree credit requirement.
- b. The candidate has completed all the prescribed requirements, in the prescribed programme duration.
- c. The candidate has passed / secured valid grades in all the prescribed courses, in the first attempt.
- d. No disciplinary action is pending or has ever been lodged against him/her.
- e. In case of an exceptional tie, both candidates shall be awarded the same rank.

15. Grade Card:

At the end of each semester, a student will be given a 'Grade Card' which will contain Course Code, Title, Credits, Grades Awarded, Earned Credits and Earned Point secured by him/her in each course, together with his/her SGPA in that semester. On the completion of the programme, a Final Grade Card will be issued to the student, giving full semester-wise details about the absolute marks and grades obtained by him/her in each course together with his/her SGPA and also the CGPA and Division awarded to him/her.

16. Equivalence:

Percentage (P) equivalent to CGPA earned by a candidate may be calculated using the following formula:

$$P = CGPA \times 10$$

17. In case the ordinance is silent about any issue, it will be decided by the College Principal in consultation with the Academic Advisory Committee of the college in the anticipation of approval of the same by Academic Counsel of the College.

Outline of Programme B. Sc. medical

Semester	Core Course (CC)	Ability Enhancement Compulsory Course (AECC)	Skill Enhancement Course (SEC)	Discipline Specific Elective (DSE)
I	CC-I Botany	AECC-I Punjabi*/Basic Punjabi** AECC-II Environmental and Road Safety Awareness		
	CC-II Chemistry			
	CC-III Zoology			
II	CC-IV Botany	AECC-III Punjabi*/Basic Punjabi** AECC-IV English AECC-V Drug Abuse		
	CC-V Chemistry			
	CC-VI Zoology			
III	CC-VII Botany	AECC-VI Punjabi*/Basic Punjabi**	SEC I (choose any one) Botany Chemistry Zoology	
	CC-VIII Chemistry			
	CC-IX Zoology			
IV	CC-X Botany	AECC-VII Punjabi*/Basic Punjabi**	SEC II (choose any one) Botany Chemistry Zoology	
	CC-XI Chemistry			
	CC-XII Zoology			
V		AECC-VIII Punjabi*/Basic Punjabi**	SEC III (choose any one) Botany Chemistry Zoology	DSE -I Botany
				DSE-II Chemistry
				DSE-III Zoology
VI		AECC-IX Punjabi*/Basic Punjabi**	SEC IV (choose any one) Botany Chemistry Zoology	DSE IV Botany
				DSE-V Chemistry
				DSE-VI Zoology
*Language subjects will be taught as per state government rules.				
** For students from other states				

SYSTEMATICS & DIVERSITY OF LIFE - PROTISTS TO CHORDATES

Course Code BCC(Z)-103	Credits	Evaluation pattern		Time allowed for external evaluation
		External Evaluation	Internal Assessment	
Theory	4	75	25	3Hrs
Practical	2	50	-	3Hrs

COURSE LEARNING OBJECTIVES :

The course would provide an insight to the learner about the existence of different life forms on the Earth, and appreciate the diversity of animal life. It will help the student to understand the features of Kingdom Animalia and systematic organisation of the animals based on their evolutionary relationships, structural and functional affinities. The course will also make the students aware about the characteristic morphological and anatomical features of diverse animals; economic, ecological and medical significance of various animals in human life; and will create interest among them to explore the animal diversity in nature.

COURSE LEARNING OUTCOME :

Upon completion of the course, students will be able to:

- Learn about the importance of systematics, taxonomy and structural organization of animals.
- Appreciate the diversity of animals living in varied habit and habitats.
- Understand evolutionary history and relationships of different phyla through functional and structural affinities.
- Critically analyse the organization, complexity and characteristic features of different phyla
- making them familiarize with the morphology and anatomy of representatives of various animal phyla.
- Understand the economic importance of non-chordates and chordates, their interaction with the environment and role in the ecosystem.

INSTRUCTIONS TO THE PAPER SETTER

The question paper will consist of three sections A, B and C. Section A and B will have four questions each from the respective section of syllabus and will carry 12 marks each. Section C will consist of 9 short- answer type questions of three marks each and will cover the entire syllabus uniformly .

INSTRUCTIONS FOR CANDIDATES

Candidates are required to attempt two questions each from Section A and B and the entire section C

SECTION A

Unit 1: Kingdom Protista

General characters and classification up to classes; Locomotory Organelles and locomotion in Protozoa

Unit 2: Phylum Porifera

General characters and classification up to classes; Canal System in *Sycon*

Unit 3: Phylum Cnidaria

General characters and classification up to classes; Polymorphism in Hydrozoa

Unit 4: Phylum Platyhelminthes

General characters and classification up to classes; Life history of *Taenia solium*

Unit 5: Phylum Nematelminthes

General characters and classification up to classes; Life history of *Ascaris lumbricoides* and its parasitic adaptations

Unit 6: Phylum Annelida

General characters and classification up to classes; Metamerism in Annelida

Unit 7: Phylum Arthropoda

General characters and classification up to classes; Vision in Arthropoda, Metamorphosis in Insects

Unit 8: Phylum Mollusca

General characters and classification up to classes; Torsion in gastropods

Unit 9: Phylum Echinodermata

General characters and classification up to classes; Water-vascular system in Asteroidea

SECTION B

Unit 10: Protochordates

General features and Phylogeny of Protochordata

Unit 11: Agnatha

General features of Agnatha and classification of cyclostomes up to classes

Unit 12: Pisces General features and Classification up to orders; Osmoregulation in Fishes

Unit 13: Amphibia

General features and Classification up to orders; Parental care

Unit 14: Reptiles

General features and Classification up to orders; Poisonous and non-poisonous snakes, Biting mechanism in snakes

Unit 15: Aves

General features and Classification up to orders; Flight adaptations in birds

Unit 16: Mammals

General features, Classification up to orders; Origin of mammals

SUGGESTED READINGS

- Ruppert and Barnes, R.D. (2006). *Invertebrate Zoology*, VIII Edition. Holt Saunder International Edition.
- Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002).
- *The Invertebrates: A New Synthesis*, III Edition, Blackwell Science

- Young, J. Z. (2004). *The Life of Vertebrates*. III Edition. Oxford university press.
- Pough H. *Vertebrate life*, VIII Edition, Pearson International. Hall B.K. and Hallgrímsson B. (2008). *Strickberger's Evolution*. IV Edition. Jones and Bartlett Publishers Inc.

BCC (Z)-103 P**ANIMAL DIVERSITY****PRACTICAL (CREDITS 2)****Maximum Marks: 50**

1. Study of the following specimens (classification, biogeography and morphology):

Amoeba, Euglena, Plasmodium, Paramecium, Sycon, Hyalonema, and Euplectella, Obelia, Physalia, Aurelia, Tubipora, Metridium, Taenia solium, Male and female Ascaris lumbricoides, Aphrodite, Nereis, Pheretima, Hirudinaria, Palaemon, Cancer, Limulus, Palamnaeus, Scolopendra, Julus, Periplaneta, Apis, Chiton, Dentalium, Pila, Unio, Loligo, Sepia, Octopus, Pentaceros, Ophiura, Echinus, Cucumaria and Antedon, Balanoglossus, Herdmania, Branchiostoma, Petromyzon, Sphyrna, Pristis, Torpedo, Labeo, Exocoetus, Anguilla, Ichthyophis/Ureotyphlus, Salamandra, Bufo, Hyla, Chelone, Hemidactylus, Chamaeleon, Draco, Vipera, Naja, Crocodylus, Gavialis, Any six common birds from different orders, Bat, Funambulus, Loris

2. Study of the following permanent slides:

T.S. and L.S. of *Sycon*, Study of life history stages of *Taenia and Fasciola*, T.S. of Male and female *Ascaris*, Setae, Septal nephridia, ovary in Earthworm, Trachea in Cockroach, Radula of *Pila*, T.S. Arm of Star Fish, T.S. of *Branchiostoma* Through different regions.

3. Key for Identification of poisonous and non-poisonous snakes

Guidelines for conduction of Practical Examination**Maximum Marks: 50****Time Allowed : 3hrs**

1. To identify, classify and write morpho ecological note on specimen A, B, C, D and E
5x4=20
2. To identify the given permanent slide F, G, H and I writing two identification points for each
4x2=8
3. To identify the poisonous / non-poisonous snake J and K 2x3=6
4. Project 06
5. Note Book 05
6. Viva 05

TEACHING LEARNING PROCESS

- classroom lectures
- observations in nature through real animals/preserved specimens/models.
- presentations/animations/ videos
- Field-based project activities
- Visit to Zoo/ National parks/ Museums

BCC(Z)-203: COMPARATIVE ANATOMY AND DEVELOPMENTAL BIOLOGY OF VERTEBRATES

Course Code BCC(Z) 203	Credits	Evaluation pattern		Time allowed for external evaluation
		External Evaluation	Internal Assessment	
Theory	4	75	25	3Hrs
Practical	2	50	-	3Hrs

COURSE LEARNING OBJECTIVE:

This course aims to provide the students a thorough knowledge of structural details and comparative account of the different organ systems of the body from lower to higher vertebrates enabling them to appreciate the incredible vertebrate diversity. The course furnishes an understanding of evolutionary basis of morphological and anatomical differences as well as similarities that occur among vertebrates. It helps students propose possible homology between structures, and understand how they evolved as the vertebrates dwelled different habitats. The paper also aims to provide in-depth knowledge on the embryonic and post embryonic developmental processes.

COURSE LEARNING OUTCOME:

Upon completion of the course, students will be able to:

- Learn the comparative account of integument, skeletal components, their functions and modifications in different vertebrates.
- Understand the evolution of heart, modification in aortic arches, structure of respiratory organs used in aquatic, terrestrial and aerial vertebrates; and digestive system and its anatomical specializations with respect to different diets and feeding habits.
- Learn the evolution of brain, sense organs and excretory organs to a complex, highly evolved form in mammals
- Learn to analyze and critically evaluate the structure and functions of vertebrate systems which helps them to discern the developmental, functional and evolutionary history of vertebrate species.
- Understand the events that lead to formation of a multicellular organism from a single fertilized egg
- Describe the general patterns and sequential developmental stages during embryogenesis and understand how the developmental processes lead to establishment of body plan of multicellular organisms.
- Understand the process of post embryonic development
- Discuss the general mechanisms involved in morphogenesis and to explain how different cells and tissues interact in a coordinated way to form various tissues and organs.

INSTRUCTIONS TO THE PAPER SETTER

The question paper will consist of three sections A, B and C. Section A and B will have four questions each from the respective section of syllabus and will carry 12 marks each. Section C will consist of 9 short- answer type questions of three marks each and will cover the entire syllabus uniformly .

INSTRUCTIONS FOR CANDIDATES

Candidates are required to attempt two questions each from Section A and B and the entire section C

SECTION A

Unit 1: Integumentary System

Derivatives of integument w.r.t. glands and digital tips

Unit 2: Skeletal System

Evolution of visceral arches

Unit 3: Digestive System

Brief account of alimentary canal and digestive glands

Unit 4: Respiratory System

Brief account of Gills, lungs, air sacs and swim bladder

Unit 5: Circulatory System

Evolution of heart and aortic arches

Unit 6: Urinogenital System

Succession of kidney, Evolution of urinogenital ducts

SECTION B

Unit 7: Nervous System

Comparative account of brain

Unit 8: Sense Organs

Types of receptors

Unit 9: Early Embryonic Development

Gametogenesis: Spermatogenesis and oogenesis w.r.t. mammals, vitellogenesis in birds; Fertilization: external (amphibians), internal (mammals), blocks to polyspermy; Early development of frog and humans (structure of mature egg and its membranes, patterns of cleavage, fate map, up to formation of gastrula);types of morphogenetic movements; Fate of germ layers; Neurulation in frog embryo.

Unit 10: Late Embryonic Development

Implantation of embryo in humans, Formation of human placenta and functions, other types of placenta on the basis of histology; Metamorphic events in frog life cycle and its hormonal regulation.

Unit 11: Control of Development

Fundamental processes in development (brief idea) – Gene activation, determination, induction, Differentiation, morphogenesis, intercellular communication, cell movements and cell death

RECOMMENDED BOOKS

- Kardong, K.V. (2005) *Vertebrates' Comparative Anatomy, Function and Evolution*. I Edition. McGraw-Hill Higher Education.
- Kent, G.C. and Carr R.K. (2000). *Comparative Anatomy of the Vertebrates*. IX Edition. The McGraw-Hill Companies
- Gilbert, S. F. (2006). *Developmental Biology*, VIII Edition, Sinauer Associates, Inc. Publishers, Sunderland, Massachusetts, USA.

SUGGESTED READING

- Hilderbrand, M and Gaslow G.E. *Analysis of Vertebrate Structure*, John Wiley and Sons.
- Walter, H.E. and Sayles, L.P; *Biology of Vertebrates*, Khosla Publishing House.
- Balinsky, B.I. (2008). *An introduction to Embryology*, International Thomson Computer Press.
- Carlson, Bruce M (1996). *Patten's Foundations of Embryology*, McGraw Hill, Inc.

BCC(Z)-203(P) COMPARATIVE ANATOMY AND DEVELOPMENTAL BIOLOGY OF VERTEBRATES**PRACTICAL (CREDITS 2)**

1. Osteology:

a) Disarticulated skeleton of fowl and rabbit

b) Carapace and plastron of turtle /tortoise

c) Mammalian skulls: One herbivorous and one carnivorous animal.

2. Frog - Study of developmental stages - whole mounts and sections through permanent slides – cleavage stages, blastula, gastrula, neurula, tail bud stage, tadpole external and internal gill stages.

3. Study of the different types of placenta- histological sections through permanent slides or photomicrographs.

4. Study of placental development in humans by ultrasound scans.

5. Examination of gametes - frog/rat - sperm and ova through permanent slides or photomicrographs.

Guidelines for conduction of Practical Examination

Maximum Marks : 50

Time Allowed : 3hrs

1. To identify and draw the given view of the bone A, B , C , D and E 5x4=20

2. To identify the given permanent slide F, G, H, I and J writing two identification points for each 5x2=10
3. To identify the given stage of placenta development in photomicrograph/ slide and to comment. 2x3=6
4. Project 06
5. Note Book 05
6. Viva 05

TEACHING LEARNING PROCESS

- Class room lectures
- Use of models /photographs/diagrams/ animations/videos/ virtual dissections
- Project work visiting biodiversity parks, aquarium, sanctuaries and zoological parks to correlate the anatomical changes in the vertebrates with actual observation in living

BCC(Z)-303 PHYSIOLOGY AND BIOCHEMISTRY

Course Code BCC(Z)-303	Credits	Evaluation pattern		Time allowed for external evaluation
		External Evaluation	Internal Assessment	
Theory	4	75	25	3Hrs
Practical	2	50	-	3Hrs

COURSE LEARNING OBJECTIVES : To understand the physiology of different system in vertebrates and to know the metabolism of biomolecules and basic concepts of Enzymes.

COURSE LEARNING OUTCOME : Upon completion of the course, students will be able to:

- Gain knowledge of interactions and interdependence of physiological and biochemical processes.
- Recognize and explain the physiological systems and how they work in unison to maintain homeostasis in the body.
- Demonstrate foundation knowledge of role of proteins, lipids, nucleic acids, and carbohydrates in metabolic pathways along with their regulation.

INSTRUCTIONS TO THE PAPER SETTER

The question paper will consist of three sections A, B and C. Section A and B will have four questions each from the respective section of syllabus and will carry 12 marks each. Section C will consist of 9 short- answer type questions of three marks each and will cover the entire syllabus uniformly .

INSTRUCTIONS FOR CANDIDATES

Candidates are required to attempt two questions each from Section A and B and the entire section C

SECTION A**Unit 1: Nerve and muscle**

Structure of a neuron, Resting membrane potential, Graded potential, Origin of Action potential and its propagation in myelinated and non-myelinated nerve fibres and across the synapse

Ultrastructure of skeletal muscle, Molecular and chemical basis of muscle contraction

Unit 2: Digestion

Physiology of digestion in the alimentary canal; Absorption of carbohydrates, proteins, lipids

Unit 3: Respiration

Pulmonary ventilation, Respiratory volumes and capacities, Transport of Oxygen and carbon dioxide in blood

Unit 4: Excretion

Structure of nephron, Mechanism of Urine formation, Counter-current Mechanism

Unit 5: Cardiovascular system

Composition of blood, Hemostasis, Structure of Heart, Origin and conduction of the cardiac impulse, Cardiac cycle

SECTION B**Unit 6: Reproduction and Endocrine Glands**

Physiology of male reproduction: hormonal control of spermatogenesis; Physiology of female reproduction: hormonal control of menstrual cycle

Structure and function of pituitary, thyroid, Parathyroid, pancreas and adrenal

Unit 7: Carbohydrate Metabolism

Glycolysis, Krebs Cycle, Pentose phosphate pathway, Gluconeogenesis, Glycogen metabolism, Review of electron transport chain, Overview of ETC.

Unit 8: Lipid Metabolism

Biosynthesis and β oxidation of palmitic acid

Unit 9: Protein metabolism : Transamination, Deamination and Urea Cycle

Integration of metabolic pathways (only overview)

Unit 10: Enzymes

Introduction, Mechanism of action, Enzyme Kinetics, Inhibition and Regulation

RECOMMENDED BOOKS

- Guyton, A.C. and Hall, J.E. (2011). *Textbook of Medical Physiology*, XII Edition, Harcourt Asia Pvt. Ltd/ W.B. Saunders Company
- Nelson, D. L., Cox, M. M. and Lehninger, A.L. (2009). *Principles of Biochemistry*. IV Edition. W.H. Freeman and Co
-

SUGGESTED READINGS

- Tortora, G.J. and Derrickson, B.H. (2009). *Principles of Anatomy and Physiology*, XII Edition, John Wiley & Sons, Inc.
- Widmaier, E.P., Raff, H. and Strang, K.T. (2008) *Vander's Human Physiology*, XI Edition., McGraw Hill
- Guyton, A.C. and Hall, J.E. (2011). *Textbook of Medical Physiology*, XII Edition, Harcourt Asia Pvt. Ltd/ W.B. Saunders Company
- Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). *Biochemistry*. VI Edition. W.H Freeman and Co
- Nelson, D. L., Cox, M. M. and Lehninger, A.L. (2009). *Principles of Biochemistry*. IV Edition. W.H. Freeman and Co.
- Murray, R.K., Granner, D.K., Mayes, P.A. and Rodwell, V.W. (2009). *Harper's Illustrated Biochemistry*. XXVIII Edition. Lange Medical Books/Mc Graw Hill.

BCC(Z)-303 P

PRACTICAL: PHYSIOLOGY AND BIOCHEMISTRY

(Credits 2)

1. Enumeration of Red blood cells and white blood cells
2. Estimation of Haemoglobin using Sahlis Haemoglobinometer
3. Determination of Differential White Blood corpuscles in human blood
4. Determination of Bleeding and clotting time of blood
5. To observe the coagulation of blood
6. To prepare Haemin crystals
7. To determine the Blood Groups in man
8. To study the activity of salivary amylase in optimum conditions and to study the effect of temperature and pH on its activity
9. Qualitative analysis of Carbohydrates and proteins
10. Examination of permanent histological sections of mammalian oesophagus, stomach, intestine, lung, kidney, thyroid, pancreas, adrenals, testis, ovary and whole mount of Striated muscle, unstriated muscle and cardiac muscle.
11. Study of hormonal disorders of glands studied in theory through charts/models/histological sections.

Guidelines for the conduction of practical Examination

Time Allowed: 3 Hrs Maximum Marks: 50

1. Identification of the three permanent slides and to write two identification points for each.
3x2=6
2. Identify the hormonal disorder and comment 4
3. To perform the given physiological experiment I, II (major) and III (minor) and to write the principle, observation and conclusion 10+10+ 5=25
4. Project 05
5. Note Book 05
6. Viva

TEACHING LEARNING PROCESS

- Problem based assignments
- Case studies
- Videos
- Chalk and talk method
- Laboratory exercises

**BSEC (Z)-304 (i): AQUARIUM FISH KEEPING
(CREDITS 2)**

COURSE LEARNING OBJECTIVES: To provide the students the skill of setting up the aquarium to make them able to get self-employed.

COURSE LEARNING OUTCOMES:

Ability to

- Get knowledge of exotic and endemic aquarium fish
- Biology of aquarium fish
- Get skill of Budgeting, Construction and Maintenance of Aquarium and transportation of fish
- Set up aquarium fish keeping as cottage industry

Note : The contents of the course are to be taught through practical identification of aquarium fish, setting up of aquarium at small level in laboratory and visit to the cottage aquarium industry.

SECTION A

Unit1: Introduction to Aquarium Fish Keeping:

The potential scope of Aquarium Fish Industry as a Cottage Industry, Exotic and Endemic species of Aquarium Fishes.

Unit 2: Biology of Aquarium Fishes:

Common characters and sexual dimorphism of Fresh water and Marine Aquarium fishes such as Guppy, Molly, Sword tail, Gold fish, Angel fish, Blue morph, Anemone fish and Butterfly fish.

Unit 3: Food and feeding of Aquarium fishes

Use of live fish feed organisms. Preparation and composition of formulated fish feeds.

SECTION B

Unit 4: Fish Breeding and Rearing

Introduction to fish breeding and rearing with special reference to gold fish.

Unit 5: Fish Transportation

Live fish transport - Fish handling, packing and forwarding techniques.

Unit 6: Maintenance of Aquarium

General Aquarium maintenance – budget for setting up an Aquarium. Fish Farm as a Cottage Industry.

Guidelines for the conduction of Practical Examination**Time Allowed :3Hrs****Maximum Marks 50**

1. Identification of the given 5 aquarium fish	5x2=10
2. Identification of sexual dimorphism in the given aquarium fish	5
3. Preparation of fish feed	5
4. Report on visit to Aquarium industry	10
5. Project (Preparation and maintenance of aquarium set up at lab level)	10
6. Viva	5
7. Note Book	5

Paper Code: BSEC(Z)-304 (ii)**VERMICOMPOST TECHNOLOGY****(CREDITS 2)**

COURSE LEARNING OBJECTIVES: To acquaint the students with the skill of setting up vermicompost units at domestic level or commercial level.

COURSE LEARNING OUTCOME :

Aquisition of skill of setting up vermicompost units at domestic level or commercial level.

SECTION A**Unit-I General Vermiculture/ Vermicompost**

1. Introduction to vermiculture. definition, meaning, history, economic important, their value in maintenance of soil structure, role as four r's of recycling reduce, reuse, recycle, restore.
2. The matter and humus cycle (product, qualities). Ground population, transformation process in organic matter.
3. Choosing the right worm. Useful species of earthworms. Local species of earthworms. Exotic species of earthworms.

Unit-II Earthworm Biology and Rearing

1. Key to identify the species of earthworms.
2. Biology of *Eisenia fetida*.
 - a) Taxonomy Anatomy, physiology and reproduction
 - b) Vital cycle of *Eisenia fetida*: alimentionation, fecundity, annual reproducer potential and limit factors (gases, diet, humidity, temperature, pH, light, and climatic factors).
3. Biology of *Eudrilus eugeniae*.
 - c) Taxonomy Anatomy, physiology and reproduction of Eudrilidae.
 - d) Vital cycle of *Eudrilus eugeniae*: alimentionation, fecundity, annual reproducer potential and limit factors (gases, diet, humidity, temperature,pH, light, and climatic factors).

SECTION B**Unit-III Vermicompost Technology (Methods)**

1. Small Scale Earthworm farming for home gardens - Earthworm compost for home gardens
2. Conventional commercial composting - Earthworm Composting larger scale

3. Earthworm Farming (Vermiculture), Extraction (harvest), vermicomposting harvest and processing.

Unit IV: Vermicompost Technology (Products)

1. Nutritional Composition of Vermicompost for plants, comparison with other fertilizers
2. Vermiwash collection, composition & use
3. Enemies of Earthworms, Sickness and worm's enemies. Frequent problems. How to prevent and fix them.

BSEC(Z)-304 (ii)P

VERMICOMPOST TECHNOLOGY PRACTICALS

- 1 Key to identify different types of earthworms
- 2 Field trip- Collection of native earthworms & their identification
- 3 Study of Systematic position, habits, habitat & External characters of *Eisenia fetida*
- 4 Study of Life stages & development of *Eisenia fetida*
- 5 Study of Life stages & development of *Eudrilus eugeniae*
- 6 Comparison of morphology & life stages of *Eisenia fetida* & *Eudrilus eugeniae*
- 7 Study of Vermiculture, Vermiwash & Vermicompost equipments, devices
- 8 Preparation of vermibeds, maintenance of vermicompost & climatic conditions.
- 9 Harvesting, packaging, transport and storage of Vermicompost and separation of life stages
- 10 Study of diseases & enemies of earthworm

Guidelines for the conduct of Examination

M.M. 50 Time allowed: 4hr

1. To identify the given species of Earthworm and to write a note on its morphology and life cycle. To write the principle and working of the given instrument 10
2. Identify the disease/ enemy of earthworm and comment 5
3. Identify the equipment/ device used in vermicomposting and comment 5
4. Comment on the effect of the given climatic condition on vermicomposting. 5
5. Comment on the given stage in vermicompost technology (preparation and maintenance of vermibed/ harvesting/packaging/transport/ Storage) 5
6. Practical note book 05
7. Viva 05
8. Project (setting up of vermicompost unit at laboratory level) 10

Paper Code: BSEC(Z)-304 (iii)

BIOTECHNIQUES

(CREDITS 2)

COURSE LEARNING OBJECTIVES : To acquaint the students with the principle, working and application of various biotechniques to make them able to use them in their various research projects.

COURSE LEARNING OUTCOME :

On completion of the course the student will be able to know the ability to know the

- General safety measures to be followed in labs
- principles and acquire skill in techniques of spectrophotometry, Chromatography, Electrophoresis, Microtomy .

SECTION A

Unit I : General safety measures, Personal protection. Physical, Chemical and biological hazards. First Aid : Burns, Eye Injuries , Bleeding and poisoning.

Unit II: Sterilization of glassware, Principle and working of Laminar flow and Autoclave.

Unit III: Concept of pH and buffer ,Common laboratory buffers

Unit IV: Spectrophotometry: Beer Lambert Law, Principle and working of UV and visible. spectrophotometry.

SECTION B

Unit V: Principle of Chromatography, Types: Column, Paper, Thin layer chromatography and HPLC.

Unit VI: Principle and working of Electrophoresis; SDS and Agarose Gel

Unit VII: Principle and working of Light and electron microscope, Principle and working of SEM, TEM.

Unit VIII: Microtomy, Common fixatives and staining techniques.

Books recommended:

1. Wilson K and Walker J. Principles and techniques of biochemistry and molecular biology. Cambridge University press. 2006.
2. Plummer D.T. An introduction to practical biochemistry. 3rd Ed. Tata Mcgraw Hill Publications. 2007

LIST OF PRACTICALS

1. To demonstrate the working of HPLC.
2. Separation of biomolecules by thin layer chromatography.
3. To separate the organic compound by paper chromatography
4. Estimation of proteins by spectrophotometer.
5. To determine the pH using indicators.
6. To separate the proteins / DNA using Electrophoresis
7. To prepare a permanent slide of the tissue using the techniques of section embedding, cutting and staining.
8. Demonstration of TEM and SEM
9. To visit the research laboratories.

Guidelines for the conduct of practical Exam**M.M. 50 Time allowed: 4hr**

1. To write the principle, procedure, observation and inference of the given two experiments 20
2. To write the principle and working of the given instrument 05
3. Practical note book 05
4. Viva 05
5. Project (Tissue fixation, Embedding , Section cutting and staining of the given tissue)

BCC(Z)-403: GENETICS AND EVOLUTIONARY BIOLOGY

Course Code BCC(Z)-403	Credits	Evaluation pattern		Time allowed for external evaluation
		External Evaluation	Internal Assessment	
Theory	4	75	25	3Hrs
Practical	2	50	-	3Hrs

COURSE LEARNING OBJECTIVES :

The course aims to provide an overview of genetics starting from the work of Mendel to the current understanding of various phenomena like recombination, sex determination and mutations . It also aims at understanding of principles of evolution and get motivated to work towards mitigating climate change so that well adapted species do not face extinction as a result of sudden drastic changes in environment and that conservation efforts for small threatened populations are focused in right direction.

COURSE LEARNING OUTCOME :

Upon completion of the course, students will be able to:

- Gain knowledge of the basic principles of inheritance.
- Analyse pedigree leading to development of analytical skills and critical thinking enabling the students to present the conclusion of their findings in a scientific manner.
- Know the mechanisms of mutations, the causative agents and the harmful impact of various chemicals and drugs being used in day to day life.
- Gain knowledge of the basic principles of population genetics
- Gain knowledge of the basic principles of population genetics.
- knowledge about the theories, evidences and process of evolution and relationship of the evolution of various species and the environment they live in
- Know the mass extinctions and their causes and effects .

INSTRUCTIONS TO THE PAPER SETTER

The question paper will consist of three sections A, B and C. Section A and B will have four questions each from the respective section of syllabus and will carry 12 marks each. Section C will consist of 9 short- answer type questions of three marks each and will cover the entire syllabus uniformly .

INSTRUCTIONS FOR CANDIDATES

Candidates are required to attempt two questions each from Section A and B and the entire section C

SECTION A

Unit 1: Introduction to Genetics

Mendel's work on transmission of traits, Genetic Variation, Molecular basis of Genetic Information

Unit 2: Mendelian Genetics and its Extension

Principles of Inheritance, Chromosome theory of inheritance, Incomplete dominance and co-dominance, Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, sex linked inheritance, extra-chromosomal inheritance

Unit 3: Linkage, Crossing Over and Chromosomal Mapping

Linkage and crossing over, Recombination frequency as a measure of linkage intensity, two factor and three factor crosses, Interference and coincidence, Somatic cell genetics - an alternative approach to gene mapping

Unit 4: Sex Determination

Chromosomal mechanisms, dosage compensation

Unit 5: Mutations

Chromosomal Mutations: Deletion, Duplication, Inversion, Translocation, Aneuploidy and Polyploidy; Gene mutations: Induced versus Spontaneous mutations, Back versus Suppressor mutations

Unit 6: Human Genetics: Syndromes – Turner's, Klinefelter's, Down's and Cri-du-chat, In Born errors of metabolism –Phenylketonuria (PKU), Alkaptonuria, Albinism, Human pedigree analysis.

SECTION B

Unit 7: Introduction to Evolutionary Theories

Lamarckism, Darwinism, Neo-Darwinism

Unit 8: Direct Evidences of Evolution

Types of fossils, Incompleteness of fossil record, Dating of fossils, Phylogeny of horse

Unit 9: Population Genetics :

Allele frequency, Genotype frequency, Hardy Weinberg law, Role of natural selection, mutation, Genetic drift

Unit 10: Processes of Evolutionary Change

Organic variations; Isolating Mechanisms; Natural selection (Example: Industrial melanism); Types of natural selection (Directional, Stabilizing, Disruptive), Artificial selection

Unit 11: Species Concept

Biological species concept (Advantages and Limitations); Modes of speciation (Allopatric, Sympatric)

Unit 12: Macro-evolution

Macro-evolutionary Principles (example: Darwin's Finches)

Unit 13: Extinction

Mass extinction (Causes, Names of five major extinctions, K-T extinction in detail), Background extinctions Role of extinction in evolution

**BCC (Z)-403 P :GENETICS AND EVOLUTIONARY BIOLOGY
PRACTICAL (CREDITS 2)**

M.M. 50

Time allowed : 3hrs

1. Study of Mendelian Inheritance and gene interactions (Non Mendelian Inheritance) using suitable examples. Verify the results using Chi-square test.
2. Study of Linkage, recombination, gene mapping using the data.
3. Study of Human Karyotypes (normal and abnormal).
4. Calculation of gene frequency from a known sample using Hardy Weinbergs principle
5. Study of fossil evidences from plaster cast models and pictures
6. Study of homology and analogy from suitable specimens/ pictures
7. a) Phylogeny of horse with diagrams/ cut outs of limbs and teeth of horse ancestors
b) Darwin's Finches with diagrams/ cut outs of beaks of different species
8. Visit to Natural History Museum and submission of report

Guidelines for the conduction of practical exam

Time Allowed: 3 Hrs Maximum Marks: 50

1. Demonstration of given gene interaction from the material provided. 06
2. Calculation of gene frequency from a known sample using Hardy Weinbergs principle 06
3. To Analyze the given two Human Karyotype and comment 06
4. To Construct gene map from the given data 05
5. To identify the Homology / analogy in the given example and to explain it 06
6. To identify the stage in Phylogeny of horse/ type of Darwin finch and to explain its evolutionary significance 06
7. Notebook 05
8. Viva 05
9. Project 05

RECOMMENDED READINGS

1. Snustad, D.P., Simmons, M.J. (2009). *Principles of Genetics*. V Edition. John Wiley and Sons Inc.
2. Ridley, M. (2004). *Evolution*. III Edition, Blackwell publishing
3. Hall, B.K. and Hallgrimson, B. (2013). *Evolution*. V Edition, Jones and Barlett Publishers.

SUGGESTED BOOKS

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). *Principles of Genetics*. VIII Edition. Wiley India.
2. Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). *Concepts of Genetics*. X Edition. Benjamin Cummings.
- 3 Russell, P. J. (2009). *Genetics- A Molecular Approach*. III Edition. Benjamin Cummings.
- 4.Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. *Introduction to Genetic Analysis*. IX Edition. W. H. Freeman and Co.

5 Douglas, J. Futuyma (1997). *Evolutionary Biology*. Sinauer Associates.

6. Hall, B. K. and Hallgrímsson, B. (2008). *Evolution*. IV Edition. Jones and Bartlett Publishers.

TEACHING LEARNING PROCESS

- Lectures using board and power-point presentations
- Assignments like constructing linkage maps, pedigree analysis, probability calculations etc
- group discussions
- case history projects to prepare pedigrees
- videos on evolutionary concepts
- Visit to natural history museum

BSEC (Z) 404 (i): APICULTURE (CREDITS 2)

COURSE LEARNING OBJECTIVES: To provide the skill to set up an apiary and get self-employed.

COURSE LEARNING OUTCOMES:

- practical identification of honey bee species, equipments, diseases
- knowledge of commercially important honey bee products.
- setting up and maintenance of an apiary get self-employed.

Note : The contents of the course are to be taught through practical identification of species of honey Bees, setting up of Garden Bee Farm and visit to the Bee farms.

SECTION A

Unit 1: Biology of Bees

History, Classification and Biology of Honey Bees, Social Organization of Bee Colony.

Unit 2: Rearing of Bees

Artificial Bee rearing (Apiary), Beehives – Newton and Langstroth, Bee Pasturage, Selection of Bee Species for Apiculture, Bee Keeping Equipment, Methods of Extraction of Honey (Indigenous and Modern).

SECTION B

Unit 3: Diseases and Enemies:

Bee Diseases and Enemies Control and Preventive measures

Unit 4: Bee Economy

Products of Apiculture Industry and its Uses (Honey, Bees Wax, Propolis), Pollen.

Unit 5: Entrepreneurship in Apiculture

Bee Keeping Industry – Recent Efforts, Modern Methods in employing artificial Beehives for cross pollination in horticultural gardens.

SUGGESTED READINGS

1. Prost, P. J. (1962). Apiculture. Oxford and IBH, New Delhi.
2. Bisht D.S., Apiculture, ICAR Publication.
3. Singh S., Beekeeping in India, Indian council of Agricultural Research, New Delhi

Practicals

1. Identification of Queen cells, Drone cells & Brood Cell.
2. Identification of Different species of Honey Bees used in commercial Apiculture industry.
3. To identify and to understand usage of Bee keeping equipment.
4. To set up an artificial bee hive.
5. Sugar feeding of colonies in scarcity period.
6. Identification of swarming tendency in a colony - Removal of Drone cells.
7. Identification of kinds of Queen cells.
8. Methods of Multiplication of Bee Colonies.
9. Steps for strengthening of colonies - Requeening technique.
10. Bee flora - Propagation of bee plants - Preparation of floral calendar.
11. Migratory Bee Keeping - measures to be taken while transporting colonies-Mapping of areas for migration.
12. To study the products of Apiculture industry
13. Extraction of Honey using Honey extractor, moisture reduction, packing and storing of Honey.
14. Steps for strengthening of colonies - Requeening technique.
15. Disease management - Identification of symptoms of Nosema. Sac brood Virus, Thai sac brood virus, American foul brood and European foul brood diseases. Preventive and control measures of the diseases.
16. Management of colonies for different hive products.
17. Natural enemies and predators of Honey Bees - management involved.
18. Visit to Apiary.

Guidelines for the conduction of Practical Examination

Time Allowed :3Hrs

Maximum Marks 50

1. Identification of the given caste of honey bee 3
2. Identification of given species of honey Bee 5
3. To identify and comment on the given Equipment 2x3=6
4. To identify and comment on the given bee disease 2x3=6
5. Report on visit to Apiary 10
6. Project(set up and rearing of artificial bee hive)10
7. Viva 5
8. Note Book 5

BSEC (Z) 404 (ii): MEDICAL DIAGNOSTICS

(CREDITS 2)

COURSE LEARNING OBJECTIVES: To acquaint the students with the skill of Diagnostic methods of blood and urine analysis, common infectious and non-infectious diseases.

COURSE LEARNING OUTCOMES: Aquisition of Skill in laboratory diagnostic methods (Blood and Urine), Sterilisation techniques, lab safety rules and understanding of Infectious and Non Infectious Diseases.

SECTION A

Unit 1: Introduction to Medical Diagnostics and its Importance

2hrs

Unit 2: Diagnostics Methods Used for Analysis of Blood

10 hrs

Blood composition, Preparation of blood smear and Differential Leucocyte Count (D.L.C) using Leishman's stain, Platelet count using haemocytometer, Erythrocyte Sedimentary Rate (E.S.R), Packed Cell Volume (P.C.V.)

Unit 3: Diagnostic Methods Used for Urine Analysis 6hrs

Urine Analysis: Physical characteristics; Abnormal constituents

Unit 4: Non-infectious Diseases 6hrs

Causes, types, symptoms, complications, diagnosis and prevention of Diabetes (Type I and Type II), Hypertension (Primary and secondary), Testing of blood glucose using

Glucometer/Kit

Unit 5: Infectious Diseases 3hrs

Causes, types, symptoms, diagnosis and prevention of Tuberculosis and Hepatitis.

Unit 6: Tumours 3hrs

Types (Benign/Malignant), Detection and metastasis; Medical imaging: X-Ray of Bone fracture, PET, MRI and CT Scan (using photographs).

SUGGESTED READINGS

- Park, K. (2007), Preventive and Social Medicine, B.B. Publishers
- Godkar P.B. and Godkar D.P. Textbook of Medical Laboratory Technology, II Edition, Bhalani Publishing House
- Cheesbrough M., A Laboratory Manual for Rural Tropical Hospitals, A Basis for Training Courses
- Guyton A.C. and Hall J.E. Textbook of Medical Physiology, Saunders
- Robbins and Cortan, Pathologic Basis of Disease, VIII Edition, Saunders
- Prakash, G. (2012), Lab Manual on Blood Analysis and Medical Diagnostics, S. Chand and Co. Ltd.

MEDICAL DIAGNOSTICS (PRACTICALS)

1. Demonstration of the use of autoclave, centrifuge and spectrophotometer.
2. Cleaning and sterilization of glassware using hot air oven, autoclave etc.
3. Determination of Blood groups
4. Estimation of Hemoglobin
5. Recording bleeding and clotting time
6. Study of permanent slides or microphotographs of the following: Hepatitis virus, *Mycobacterium tuberculosis*.
7. Estimation of creatinine, urea, ketone bodies, glucose in urine and to study risks and diseases associated with it
8. Counting of WBC, RBC & DLC, ESR.
9. Visit to hospital to study techniques ECG, MRI and X-ray
10. Visit to the any pathology lab/hospital to study laboratory safety rules, hazards, precautions during sample collection and laboratory investigation and to observe instruments of medical importance.

Guidelines for the conduction of Practical Examination

M.M. 50

Time allowed: 4hr

- | | |
|---|----|
| 1.To perform the given two experiments on the blood analysis. | 12 |
| 1. To perform the given two experiments on urine analysis | 10 |

2. Write a note on the principle and working of the given diagnostic technique	06
3. To identify the given slide/ Micrograph and give two reasons for their identification.	2
4. Practical note book	05
5. Viva	05
6. Project	10

BSEC (Z) 404 (iii) SCIENTIFIC AND TECHNICAL WRITING

COURSE LEARNING OBJECTIVES: This course is designed to help the students to develop skills that will enable them to produce clear and effective scientific and technical documents.

COURSE LEARNING OUTCOMES:

Upon completion of the course, students will be able to:

1. Demonstrate the unique qualities of scientific and technical writing style, including sentence correctness, conciseness, readability, clarity, organization, objectivity, and coherence.
2. Draft technical and professional documents to prepare them for final publication in and out of the workplace.
3. Deliver clear oral and written communication that informs, persuades, and engages the audience.

SECTION A

Scientific writing: Importance of scientific writing, Forms of scientific writing, The elements of prose and criteria for their selection (Words, sentences, paragraphs, exercises), Basic proof Reading marks, Epitomizing (Abstracting).

Paraphrasing: The elements of effective paraphrasing, Techniques for paraphrasing.

Summarising: What makes a good Summary? Stages of Summarising.

Characteristics of Technical Communication: Document, stylistic and technical accuracy, Clarity in writing, conciseness and strategies for achieving conciseness, coherence, appropriateness,

Framing a scientific paper: Collection of literature on the given research topic, Choosing a journal (Impact factor, H-index, Science citation index (SCI), Peer reviewed Journals, Instructions to authors, Abstract, Introduction, Methods, Results, Discussion and Summary Bibliography (importance and reference style APA), Choosing a title for finishing the paper, Revising (Proofreading and editing).

SECTION-B

Writing Models: Questionnaire design, Designing effective posters and oral presentations, preparing E-mails, Letters and CVs.

Avoiding Plagiarism: What is plagiarism? Tools for avoiding plagiarism, Softwares to check the degree of plagiarism.

SUGGESTED READINGS

- Robert A. Day (1998), How To Write & Publish a Scientific Paper. Oryx Press; 5 edition New York.
- Wadhera, B.L.: Law Relating to Patents, Trade Marks, Copyright Designs and Geographical Indications, 2002, Universal Law publishing
- Coley, S.M. and Scheinberg, C.A. 1990, "Proposal writing". Sage Publications.
- From Research to Manuscript: A Guide to Scientific Writing, 2nd ed. 2009 Edition by Michael Jay Katz

LIST OF PRACTICALS

1. Crafting better sentences and paragraphs.
2. Preparation of questionnaire.
3. Epitomising (abstracting) the given literature
4. Collection of literature on the given research topic and writing a short review for the same.
5. Drafting a effective science poster on the given topic.
6. Preparation of effective oral presentation.
7. Professional Written Communication: Students prepare E-mails, Letters, CVs
8. Write a summary in about 80 words for the given report.
9. Check the given literature for plagiarism with the plagiarism check tools.

DISCIPLINE SPECIFIC ELECTIVES COURSES
FUNDAMENTALS OF ENTOMOLOGY

Course Code BDSE(Z)-503 i	Credits	Evaluation pattern		Time Allowed for External Evaluation
		External Evaluation	Internal Assessment	
Theory	4	75	25	3Hrs.
Practical	2	50	-	3Hrs.

COURSE LEARNING OBJECTIVES:

To acquaint the students with the general morphology, anatomy and physiology of an insect so that they can be able to identify the major economically important insects.

COURSE LEARNING OUTCOMES:

Ability to

- have in depth knowledge of general morphology, anatomy and physiology of an insect
- apply the knowledge to identify the major economically important insects.
- Understand the social organization of insects

INSTRUCTIONS TO THE PAPER SETTER

The question paper will consist of three sections A, B and C. Section A and B will have four questions each from the respective section of syllabus and will carry 12 marks each. Section C will consist of 9 short- answer type questions of three marks each and will cover the entire syllabus uniformly.

INSTRUCTIONS FOR CANDIDATES

Candidates are required to attempt two questions each from Section A and B and the entire section C.

SECTION – A

Unit I: Introduction: 5 hrs

General Features of Insects Distribution and Success of Insects on the Earth

Unit II: Insect Taxonomy: 8 hrs

Basis of insect classification; Classification of insects up to orders

Unit III: General Morphology of Insects: 12 hrs

External Features: Head – Eyes, Types of antennae, Mouth parts w.r.t. feeding habits, Thorax: Wings and wing articulation, Types of Legs adapted to diverse habitat, Abdominal appendages and genitalia.

SECTION – B

Unit IV: Development of insects: 10 hrs

Growth, Metamorphosis: Types and Hormonal control, Types of larvae, Types of pupae

Unit V: Physiology of Insects: 15 hrs

Structure and physiology of Insect body systems - Integumentary, digestive, excretory, circulatory, respiratory, endocrine, reproductive, and nervous system, Sensory receptors

Unit VI: Social Insects: 8 hrs

Group of social insects and their social life, Social organization and social behaviour (w.r.t. Honey Bee)

SUGGESTED READINGS

1. A general text book of entomology, Imms , A. D., Chapman & Hall, UK
2. The Insects: Structure and function, Chapman, R. F., Cambridge University Press, UK
3. Principles of Insect Morphology, Snodgrass, R. E., Cornell Univ. Press, USA
4. Introduction to the study of insects, Borror, D. J., Triplehorn, C. A., and Johnson, N. F., M Saunders College Publication, USA
5. The Insect Societies, Wilson, E. O., Harward Univ. Press, UK
6. Host Selection by Phytophagous insects, Bernays, E. A., and Chapman, R. F., Chapman and Hall, New York, USA
7. Physiological system in Insects, Klowden, M. J., Academic Press, USA
8. The Insects, An outline of Entomology, Gullan, P. J. , and Cranston, P. S., Wiley Blackwell, UK
9. Insect Physiology and Biochemistry, Nation, J. L., CRC Press, USA
10. A text book of entomology, Dr. Mathur and Dr. Upadhyay, Aman publishing house, Meerut
11. Modern Entomology, D. B. Tembhare, Himalaya publishing house

PRACTICALS (CREDITS 2)

Maximum Marks: 50

1. Study of one specimen from each insect order
2. Study of different kinds of antennae of insects
3. Study of different kinds of legs of insects
4. Study of different kinds of mouth parts of insects
5. Study of head and sclerites of any one insect
6. Study of insect wings and their venation.
7. To dissect and study the anatomy of the insect (cockroach)

.8. Methodology of collection, preservation and identification of insects.

9. Field study of insects and submission of a project report on the insect diversity

Guidelines for the conduction of Practical Examination

Time allowed: 4 hrs

M.M. 50

1. To Identify the given slide A of permanent preparation of the mouth parts and write morphological note on it 3
2. To identify the given leg of insect B and write a note on it. 04
3. To identify and classify the specimens C, D and E and write down one identifying feature of each. 3 X 4= 12
4. To identify the given system F and write its Physiology. 04
5. To identify the given Antennae of insect G and write a note on them 3
6. To demonstrate the given system of given specimen and draw a well labelled diagram and show to the examiner. 08
7. Insect collection. 06
8. Practical note book. 05
9. Viva. 05

IMMUNOLOGY

Course Code BDSE(Z)-503 ii	Credits	Evaluation pattern		Time Allowed for External Evaluation
		External Evaluation	Internal Assessment	
Theory	4	75	25	3Hrs.
Practical	2	50	-	3Hrs.

COURSE LEARNING OBJECTIVES:

To acquaint the students with the understanding of human immune system, its disorders and the basic immunological techniques.

COURSE LEARNING OUTCOMES:

On completion of course student will be able to

- compare innate and adaptive immunity,
- understand structure and functions of immunoglobulins,
- describe cell and organs of immune system,
- illustrate the various mechanisms of immune response.
- Understand the adverse effects of immune system like allergy, hypersensitivity and auto immunity.
- Apply basic techniques of antigen antibody interactions
- Elucidate the reasons for immunization and aware of different vaccination

INSTRUCTIONS TO THE PAPER SETTER

The question paper will consist of three sections A, B and C. Section A and B will have four questions each from the respective section of syllabus and will carry 12 marks each. Section C will consist of 9 short- answer type questions of three marks each and will cover the entire syllabus uniformly.

INSTRUCTIONS FOR CANDIDATES

Candidates are required to attempt two questions each from Section A and B and the entire section C.

SECTION A**Unit 1: Overview of Immune System 4 hrs**

Historical perspective of Immunology, Early theories of Immunology, Cells and organs of the Immune system.

Unit 2: Innate and Adaptive Immunity 8 hrs

Anatomical barriers, Inflammation, Cell involved in innate immunity, Adaptive immunity (Cell mediated and humoral), Active and Passive Immunity, Immune dysfunctions (brief account of autoimmunity with reference to Rheumatoid Arthritis and tolerance, AIDS).

Unit 3: Antigens 8 hrs

Antigenicity and immunogenicity, Immunogens, Adjuvants and haptens, Factors influencing immunogenicity, B and T-Cell epitopes.

Unit 4: Immunoglobulins 5 hrs

Structure and functions of different classes of immunoglobulins, Antigen antibody Interactions.

Unit 5: Antibody Diversity: 4 hrs

Variable region gene arrangement of light and heavy chain of immunoglobulin, Mechanism of variable region DNA rearrangement, Class switching among constant region genes.

Unit 6: Major Histocompatibility Complex 6 hrs

Structure and functions of MHC molecules. Endogenous and exogenous pathways of antigen processing and presentation.

SECTION B

Unit 6: Cytokines 4 hrs

Properties and functions of cytokines, Therapeutics Cytokines.

Unit 7: Complement System 4 hrs

Components and pathways of complement activation.

Unit 8: Hypersensitivity 3hrs

Gell and Coombs' classification and brief description of various types of Hypersensitivities.

Unit 9: Vaccines 5 hrs

Various types of vaccines.

Unit 10. Immune system in Health and Disease 5 hrs

Immune response to influenza virus, *Mycobacterium tuberculosis* and *Plasmodium* species.

Unit 11. Immunological Techniques: 3hrs

Immunoassays (ELISA and RIA), Polyclonal sera, Hybridoma technology: Monoclonal antibodies in therapeutics and diagnosis.

SUGGESTED READINGS

- Kindt, T. J., Goldsby, R.A., Osborne, B. A. and Kuby, J (2006). *Immunology*, VI Edition. W.H. Freeman and Company.
- David, M., Jonathan, B., David, R. B. and Ivan R. (2006). *Immunology*, VII Edition, Mosby, Elsevier Publication.
- Abbas, K. Abul and Lechtman H. Andrew (2003.) *Cellular and Molecular Immunology*. V Edition. Saunders Publication.

PRACTICALS

(CREDITS 2)

1. Histological study of primary and secondary lymphoid organs through slides/photographs
2. Preparation of stained blood film to study various types of blood cells.
3. Ouchterlony's double immuno-diffusion method.
4. ABO blood group determination.
5. Demonstration of:
 - a. ELISA
 - b. Immunoelectrophoresis
 - c. Radial Immuno Diffusion
6. Study of the autoimmune disease: Rheumatoid arthritis, Scleroderma, Lupus , Psoriasis, Grave's disease.
7. Visit to immunological research lab.

Instructions for the conduction of Practical Examination

M.M. 50

Time allowed: 4hr

1. Identify two given histological slides and write two identification points for each. $2 \times 2 = 4$
2. To perform the given experiments I and II from the syllabus. Write the principle, procedure and demonstrate it to the examiner. $10 \times 2 = 20$
3. To identify the given autoimmune diseases (through picture/models) to write the cause and symptoms note on it. $5 \times 2 = 10$
4. Visit of research lab 06
5. Viva 05
6. Practical note book 05

RESEARCH METHODOLOGY

Course Code BDSE (Z)503 iii	Credits	Evaluation pattern		Time Allowed for External Evaluation
		External Evaluation	Internal Assessment	
Theory	4	75	25	3Hrs.
Practical	2	50	-	3Hrs.

COURSE LEARNING OBJECTIVES:

This undergraduate course provides a comprehensive introduction to research process, methodologies, research theories and protocols.

COURSE LEARNING OUTCOMES:

Ability to

- Understand research process, research methodologies, and foundational research theories and protocols.
- identify a study topic, formulate inquiry questions, organize a literature review, and select appropriate research designs and methodologies.
- write a research proposal that includes an introduction, problem statement (significance of study), literature review, methods section, references, and a project timeline.

INSTRUCTIONS TO THE PAPER SETTER

The question paper will consist of three sections A, B and C. Section A and B will have four questions each from the respective section of syllabus and will carry 12 marks each. Section C will consist of 9 short- answer type questions of three marks each and will cover the entire syllabus uniformly.

INSTRUCTIONS FOR CANDIDATES

Candidates are required to attempt two questions each from Section A and B and the entire section C.

SECTION A

Unit 1. Research Methodology: Meaning of Research, Objectives of Research, Types of Research, Research Approaches, Significance of Research, Research and Scientific Method, Criteria of Good Research, Problems Encountered by Researchers in India, Research Process (an overview). 08 hrs

Unit 2. Survey and Review of Literature: Importance of literature survey, procedure (methods and tools) of literature collection. Guidelines for writing review of literature. 06 hrs

Unit 3. Research Problem and Research Proposal: Selecting the Problem, Necessity of Defining the Problem Technique Involved in Defining a Problem, an Illustration. Composition of a research proposal. Criteria for a good research proposal. 06 hrs

Unit 4. Research Design and Data collection: Meaning of Research Design, Need for Research Design. Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, Developing a Research Plan. Primary and Secondary data. Data classification and Tabulation. 06hrs

SECTION B

Unit 5. Sampling Design: Census and Sample Survey, Implications of a Sample Design, Steps in Sampling Design, Criteria of Selecting a Sampling Procedure, Characteristics of a Good Sample Design, Different Types of Sampling Designs (Completely randomized design, randomized block design, Latin square design, factorial designs). 08hrs

Unit 6. Data Analysis, Interpretation and Presentation: An introduction to Statistical Methods of Data analysis. Computer Processing in data analysis. Interpretation and Presentation of Results (Tables and graphs). 8hrs

Unit 7. Research Report Writing: Research Report Composition. Style manuals. Bibliography (importance and reference styles). 8 hrs

Unit 8. Ethical Issues in Research: Intellectual property rights, and Plagiarism. Ethics related to research participants and researchers: Copyright, Royalty, Patent law, citation, Acknowledgement 10 hrs

SUGGESTED READINGS:

- Kothari, C.R. (2004). Research Methodology: Methods and Techniques, New Age International Publishers, New Delhi
- Arya., P.P. and Pal, Y. (2001), Research Methodology in Management: Theory and Case Studies, Deep and Deep Publishers Pvt. Ltd., New Delhi
- Robert A. Day (1998), How To Write & Publish a Scientific Paper. Oryx Press; 5 edition • Frank D. Bell (1995), Basic Biostatistics: Concepts for the Health Sciences. William C. Brown
- Suresh C. Sinha and Anil K. Dhiman, (2002), Research Methodology (2 Vols-Set) Vedams Books (P) Ltd.
- Anthony, M, Graziano, A.M. and Raulin, M.L. 2009. Research Methods: A Process of Inquiry, Allyn and Bacon.
- Walliman, N. 2011. Research Methods- The Basics. Taylor and Francis, London, • New York. Wadhwa, B.L.: Law Relating to Patents, Trade Marks, Copyright Designs and Geographical Indications, 2002, Universal Law publishing
- Coley, S.M. and Scheinberg, C.A. 1990, "Proposal writing". Sage Publications.

PRACTICALS

CREDIT 2

Maximum Marks: 50

Time Allowed: 3Hrs.

1. Collection of literature on the given research topic and writing a short review for the same. 2. Preparation of research proposal.
3. Preparation of questionnaire.
4. Write a chapter on materials and methods for the given experiment.
5. Write a research report with emphasis on data presentation, interpretation and bibliography.
6. Check the given literature for plagiarism with the plagiarism check tools.

Guidelines for the conduction of Practical Examination

Time Allowed: 4hrs

Maximum marks: 50

1. To present the given data as histogram / pie chart/ graph /Table (5)
2. To write bibliography in the given style (5)
3. To prepare the questionnaire on the given research problem (10)
4. Submission and presentation of research proposal (25)
5. Viva (5)

PARASITOLOGY

Course Code BDSE(Z)503 iv	Credits	Evaluation pattern		Time Allowed for External Evaluation
		External Evaluation	Internal Assessment	
Theory	4	75	25	3Hrs.
Practical	2	50	-	3Hrs.

COURSE LEARNING OBJECTIVES:

To understand the morphology, lifecycle, prevalence and pathogenicity of various animal parasites.

COURSE LEARNING OUTCOMES:

Able to identify the human and Veterinary parasites and the stages of their life cycle, prevalence and pathogenicity

INSTRUCTIONS TO THE PAPER SETTER

The question paper will consist of three sections A, B and C. Section A and B will have four questions each from the respective section of syllabus and will carry 12 marks each. Section C will consist of 9 short- answer type questions of three marks each and will cover the entire syllabus uniformly.

INSTRUCTIONS FOR CANDIDATES

Candidates are required to attempt two questions each from Section A and B and the entire section C.

Section A**Unit I: Introduction to Parasitology**

Brief introduction of Parasitism, Parasite, Parasitoid and Vectors (mechanical and biological vector) Host parasite relationship

Unit II: Parasitic Protists

Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Entamoeba histolytica*, *Giardia intestinalis*, *Trypanosoma gambiense*, *Leishmania donovani*, *Plasmodium vivax*

Unit III: Parasitic Platyhelminthes

Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Fasciolopsis buski*, *Schistosoma haematobium*, *Taenia solium* and *Hymenolepis nana*

Section B**Unit IV: Parasitic Nematodes**

Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Ascaris lumbricoides*, *Ancylostoma duodenale*, *Wuchereria bancrofti* and *Trichinella spiralis*. Study of structure, life cycle and importance of *Meloidogyne* (root knot nematode), *Pratylenus* (lesion nematode)

Unit IV: Parasitic Arthropoda

Biology, importance and control of ticks, mites, *Pediculus humanus* (head and body louse), *Xenopsylla cheopis* and *Cimex lectularius*

Unit V: Parasitic Vertebrates

A brief account of parasitic vertebrates; Cookicutter Shark, Candiru, Hood Mockingbird and Vampire bat.

SUGGESTED READINGS

- Arora, D. R and Arora, B. (2001) *Medical Parasitology*. II Edition. CBS Publications and Distributors
- E.R. Noble and G.A. Noble (1982) *Parasitology: The biology of animal parasites*. V Edition, Lea & Febiger
- Ahmed, N., Dawson, M., Smith, C. and Wood, Ed. (2007) *Biology of Disease*. Taylor and Francis Group
- Parija, S. C. Textbook of medical parasitology, protozoology & helminthology (Text and colour Atlas), II Edition, All India Publishers & Distributers, Medical Books Publishers, Chennai, Delhi Rattan Lal Ichhpujani and Rajesh Bhatia. Medical Parasitology, III Edition, JaypeeBrothers Medical Publishers (P) Ltd., New Delhi • Meyer, Olsen & Schmidt's Essentials of Parasitology, Murray, D. Dailey, W. C. Brown Publishers
- K. D. Chatterjee (2009). *Parasitology: Protozoology and Helminthology*. XIII Edition, CBS Publishers & Distributors (P) Ltd.

PRACTICALS

Maximum Marks: 50

Time Allowed: 3Hrs.

1. Study of life stages of *Entamoeba histolytica*, *Giardia intestinalis*, *Trypanosoma gambiense*, *Leishmania donovani* and *Plasmodium vivax* through permanent slides/micro photographs.
2. Study of adult and life stages of helminthes *Fasciolopsis buski*, *Schistosoma haematobium*, *Taenia solium* and *Hymenolepis nana* through permanent slides/micro photographs
3. Study of adult and life stages of nematodes *Ascaris lumbricoides*, *Ancylostoma duodenale*, *Wuchereria bancrofti* and *Trichinella spiralis* through permanent slides/micro photographs
4. Study of plant parasitic root knot nematode, *Meloidogyne* from the soil sample

5. Study of *Pediculus humanus* (Head louse and Body louse), *Xenopsylla cheopis* and *Cimex lectularius* through permanent slides/ photographs
6. Study of monogenea from the gills of fresh/marine fish [Gills can be procured from fish market as by product of the industry]
7. Study of nematode/cestode parasites from the intestines of Poultry bird [Intestine can be procured from poultry/market as a by-product]
8. Submission of a brief report on parasitic vertebrates.

Guidelines for the conduction of Practical Examination

Time Allowed: 3hrs

Maximum marks: 50

1. To identify given parasites A, B, C and D from permanent stained slide. Write disease cause and two identification points for each. 4x4=16
2. To identify parasite 'E' from root of the infected plant 04
3. To identify given parasites F and G 05
4. To identify H parasite from given sample (gills of fish/ intestine of poultry) 05
5. Project report 10
6. Viva voce 05
7. Practical file 05

WILDLIFE CONSERVATION AND MANAGEMENT

Course Code B DSE Z503 v	Credits	Evaluation pattern		Time allowed for external evaluation
		External Evaluation	Internal Assessment	
Theory	4	75	25	3Hrs
Practical	2	50	-	3Hrs

COURSE LEARNING OBJECTIVES: To educate the students about the importance of wild life, threats to wild life , its conservation and management and the important Environment and wild life policies and laws. The emphasis will be on developing interest and invoking a sense of responsibility among students towards wildlife conservation. The course also explores different techniques, perspectives, and approaches to both identify and achieve wildlife management goals.

COURSE LEARNING OUTCOMES : Upon successfully completing this course, students will be able to:

- Become aware about the importance of wildlife in general, and its conservation and management in particular.
- Comprehend the application of the principles of ecology and animal behaviour to formulate strategies for the management of wildlife populations and their habitats.
- Understand the management practices required to achieve a healthy ecosystem for wildlife
- Know the key factors for loss of wildlife and important strategies for their in situ and ex situ conservation.
- Recognize the techniques for estimation, remote sensing and Global Position Tracking for wildlife.
- Know about the Protected Area Networks in India, Ecotourism and the various environment policies and laws for conservation.

INSTRUCTIONS TO THE PAPER SETTER

The question paper will consist of three sections A, B and C. Section A and B will have four questions each from the respective section of syllabus and will carry 12 marks each. Section C will consist of 9 short- answer type questions of three marks each and will cover the entire syllabus uniformly .

INSTRUCTIONS FOR CANDIDATES

Candidates are required to attempt two questions each from section A and B and the entire section C

SECTION A**Unit 1: Introduction to Wild Life :**

(6Hrs)

Biodiversity and its importance, What is wild life, Importance of wildlife conservation , Objectives of conservation of wildlife, Conservation strategies.

Unit 2: Evaluation and Management of Wildlife

(10 hrs)

Habitat analysis: a) Physical parameters: Topography, Geology, Soil and water; b) Biological Parameters: food, cover, forage, browse and cover estimation, Standard evaluation procedures: remote sensing and GIS

Unit 3: Population Estimation:

(12 hrs)

Population Density, natality, mortality, survivorship curves, age ratio, sex ratio, fertility schedules, survivorship curve .Faecal Analysis of ungulates and carnivores, Faecal samples, Hair identification, Pug marks and census method

Unit4: Management Planning of Wildlife in Protected Areas :

(8hrs)

Estimation of carrying capacity, Human-wildlife conflict, Eco tourism / wild life tourism in forests, Climax communities: characteristics and theories, Ecology of purterbance.

SECTION B**Unit 5: Wildlife of India :**

(8 hrs)

Different types with references to animals, causes of depletion, Need of conservation of wildlife.

Unit 6: Wildlife conservation and management:

(6hrs)

Types of wildlife Conservation (In Situ and Ex Situ),

Location and Important fauna of the sanctuaries and national parks of India.

Unit 7: Wildlife Projects in India :

(6 hrs)

Importance of Wild life Projects, Major wildlife projects in India (a) Project tiger, (b) Gir Lion Sanctuary Project, (c) Crocodile Breeding Project and (d) Project Hangul (e) Project One Horned Rhinoceros.

Unit 8: Environmental Policies and Laws:

(4hrs)

Willife (Protection) Act, 1972

The Forest (Protection) Act, 1980

Environment (Protection) Act, 1986

The Biodiversity Act, 2002

RECOMMENDED BOOKS

1. Saha, G.K. and Mazumdar, S. (2017). Wildlife Biology: An Indian Perspective. PHI learning Pvt. Ltd. ISBN: 8120353137, 978-812035313
2. Sinclair, A.R.E., Fryxell, J.M. and Caughley,G. (2006). Wildlife Ecology, Conservation and Management. Wiley-Blackwell, Oxford, UK.
3. Singh, S.K. (2005). Text Book of Wildlife Management. IBDC, Lucknow. S
4. Negi, S. S. (1995), Hand Book of National Park, Sanctuaries and Biosphere Reservoirs in India, Indus publishing Co., New Delhi
5. Tirvedi, P.R. and Singh, U. K. (1996), Environmental Laws of Wildlife

SUGGESTED READINGS

1. Prater, S. H. (1980), The Book of Indian Animals, Bombay Natural History Society, Bombay.
2. Saharia, V. P. (1982), Wildlife in India, Natraj Publisher, Dehradun.
3. Caughley, G., and Sinclair, A.R.E. (1994). Wildlife Ecology and Management. Blackwell Science.
4. Sutherland, W.J. (2000). The Conservation Handbook: Research, Management and Policy. Blackwell Sciences
5. Biology and Wildlife Management: Exercises for Class, Field, and Laboratory. Blackwell Publishing.
6. Giles, R. H. (1984), Wildlife Management Techniques, Natraj Publishers, Dehradun..
7. Negi, S. S. (1995), Hand Book of National Park, Sanctuaries and Biosphere Reservoirs in India, Indus publishing Co., New Delhi
8. Prater, S. H. (1980), The Book of Indian Animals, Bombay Natural History Society, Bombay
9. Saharia, V. P. (1982), Wildlife in India, Natraj Publisher, Dehradun.
10. Online resources :
 - <https://swayam.gov.in/courses/4687-july-2018-wildlife-conservation>
 - <https://swayam.gov.in/courses/5364-jan-2019-wild-life-ecology>
 - <https://www.iucn.org/theme/protected-areas/our-work/capacity-development/moocs>
 - <https://www.zsl.org/united-for-wildlife-free-conservation-courses>

WILD LIFE CONSERVATION AND MANAGEMENT**PRACTICALS (CREDITS 2)**

1. Study of any five endangered/ threatened species.
2. Study of basic equipment needed in wild life studies : Compass, Binoculars, Radio telemetry, Global positioning system
3. Plotting of the three types of survivorship curves from the hypothetical data.
4. Study of wildlife population estimation methods: Complete and Incomplete counts (through videos)
5. Study of the Location and Important fauna of various sanctuaries and national parks of India.
6. Study of the distribution of animals through zoogeographical maps
7. A visit to a zoological park to study different wild animals and make a report

Guidelines for conduction of Examination

Time allowed : 4 hrs

M.M. 50

1. To identify the Endangered/ threatened species of the given specimen A, B and C and write a note on it.
3X 4=12
2. To plot the survivorship from the data given. 5
3. Write short note on the given method of wild life population estimation. 4
4. To identify the equipment used in wild life studies and to write a note on it 5
5. To identify the given Zoogeographical area given . Write a note on it. 4
6. Write short note on the given Sanctuary / National park of India. 4
7. Project on wild life 6
8. Practical note book 5
9. Viva 5

TEACHING AND LEARNING PROCESS:

- Traditional chalk and Talk method , LCD projector
- Case study approach.
- Projection of videos or short movies available on the subject
- Digital collection of pictures of pugmarks, hoof marks, bird's nests, wild fauna and flora
- Group discussions
- Project based reports, assignments and E-posters
- Field-based research projects
- Laboratory visits to renowned institutions like WII, Dehradun
- Field visits to various conservation sites(like Jim Corbett National Park, Aravali Biodiversity Park) and Zoological Parks

REPRODUCTIVE BIOLOGY

Course Code BDSE(Z)503 vi	Credits	Evaluation pattern		Time allowed for external evaluation
		External Evaluation	Internal Assessment	
Theory	4	75	25	3Hrs.
Practical	2	50	-	3Hrs.

INSTRUCTIONS TO THE PAPER SETTER

The question paper will consist of three sections A, B and C. Section A and B will have four questions each from the respective section of syllabus and will carry 12 marks each. Section C will consist of 9 short- answer type questions of three marks each and will cover the entire syllabus uniformly.

INSTRUCTIONS FOR CANDIDATES

Candidates are required to attempt two questions each from Section A and B and the entire section C.

COURSE LEARNING OBJECTIVES:

This course is meant for making the students learn about the various aspects of reproduction in humans. It includes a detailed study of the male and female reproductive systems as well as factors that are important in maintaining reproductive health. The students are also made aware of new technologies in assisted reproduction as well as contraceptive methods.

COURSE LEARNING OUTCOMES:

At the completion of the course, students should be able to:

Get in-depth understanding of morphology, anatomy and histology of male and female reproductive organs.

- Know different processes in reproduction starting from germ cell formation to fertilization and consequent pregnancy, parturition and lactation.
- Compare estrous and menstrual cycles and their hormonal regulation.
- Comprehend the interplay of various hormones in the functioning and regulation of the male and female reproductive systems.
- Know about the diagnosis and management of infertility, including latest methods, technologies and infrastructure in assisted reproduction.

SECTION A**Unit 1: Reproductive Endocrinology**

Gonadal hormones and mechanism of hormone action, hypothalamo – hypophyseal – gonadal axis, regulation of gonadotrophin secretion in male and female; Reproductive System: Development and differentiation of gonads, genital ducts, external genitalia, mechanism of sex differentiation.

Unit 2: Functional anatomy of male reproductive System

Functional histology and anatomy of male reproductive system in humans; Testis, epididymis, vas deferens, prostate gland, seminal vesicle; Spermatogenesis: kinetics and hormonal regulation; Sperm transportation in male genital tract and sperm maturation.

SECTION B**Unit 3: Functional anatomy of female reproductive system**

Functional histology and anatomy of female reproductive system in human; Ovary, fallopian tubes/oviducts, uterus, cervix and vagina; folliculogenesis, Oocyte maturation, ovulation, corpus luteum formation and regression; Reproductive cycles (estrous and menstrual) and their

regulation, alterations in the female genital tract during reproductive cycles; Fertilization; Implantation; Pregnancy diagnosis, foeto-placental unit; Hormonal regulation of gestation; gestational adaptations; Mechanism of parturition and its hormonal regulation; Lactation and its regulation

Unit 4: Reproductive Health and Family Planning

Contraceptive Methods; Infertility in male and female: causes, diagnosis and management; Assisted Reproductive Technologies: sperm banks, frozen embryos, in vitro fertilization, ET, EFT, IUT, ZIFT, GIFT, ICSI, PROST; Modern contraceptive technologies

SUGGESTED READINGS

- Austin, C.R. and Short, R.V. reproduction in Mammals. Cambridge University Press.
- Degroot, L.J. and Jameson, J.L. (eds). Endocrinology. W.B. Saunders and Company.
- Knobil, E. et al. (eds). The Physiology of Reproduction. Raven Press Ltd.

Practicals:

1. Examination of histological sections from photomicrographs/permanent slides of human: testis, epididymis and accessory glands of male reproductive systems; Sections of ovary, fallopian tube, uterus (proliferative and secretory stages), cervix and vagina.
2. Human vaginal exfoliate cytology through micrographs.
3. Study of modern contraceptive devices.
4. Study of human foetal development through ultrasound scans.
5. Project

Guidelines for conduction of Examination

Time allowed : 4 hrs

M.M. 50

1. To identify slides A, B, C and write two identification features for each. $3 \times 4 = 12$
2. Identify Micrograph D and write a note on it. 4
3. Identify the contraceptive method E and F. Write a note on it. $3 \times 2 = 6$
4. Identify the scans G and H and write the development features for each. $4 \times 2 = 8$
5. Project related viva 10
6. Practical note book 5
7. Viva 5

ECONOMIC ENTOMOLOGY AND PEST MANAGEMENT

Course Code BDSE(Z)- 603 i	Credits	Evaluation pattern		Time allowed for external evaluation
		External Evaluation	Internal Assessment	
Theory	4	75	25	3Hrs.
Practical	2	50	-	3Hrs.

COURSE LEARNING OBJECTIVES:

Students will gain an understanding of the impacts of arthropods of economic importance particularly in agriculture, emphasizing tactics and strategies employed in the management of pest species and the utilization of beneficial species.

COURSE LEARNING OUTCOMES: Students will gain an understanding of

- the impacts of arthropods of economic importance particularly in agriculture
- tactics and strategies employed in the management of pest species
- utilization of beneficial species for commercial use

INSTRUCTIONS TO THE PAPER SETTER

The question paper will consist of three sections A, B and C. Section A and B will have four questions each from the respective section of syllabus and will carry 12 marks each. Section C will consist of 9 short- answer type questions of three marks each and will cover the entire syllabus uniformly.

INSTRUCTIONS FOR CANDIDATES

Candidates are required to attempt two questions each from Section A and B and the entire section C.

SECTION A

Unit I: Systematic position, habits, nature of damage along with life cycle and control measures of the following pests of Sugarcane:

1. Sugarcane leaf hopper (*Pyrilia perpusila*)
2. Sugarcane top borer (*Scirpophaga nivella*)
3. Sugarcane stem borer (*Chilotrea infuscatellus*)

Unit II: Systematic position, habits, nature of damage along with life cycle and control measures of the following pests of Cotton:

1. Pink bollworm (*Pectinophora gossypiella*) along with life cycle and control measures.

2. Red cotton bug (*Dysdercus cingulatus*)
3. Cotton grey weevil (*Mylocherus maculosus*)

Unit III: Systematic position, habits, nature of damage along with life cycle and control measures of the following pests of Paddy:

1. Rice Gundhy Bug (*Leptocorisa varicornis*) along with life cycle and control measures.
2. Rice grasshopper (*Hieroglyphyus banian*)
3. Rice Hispa (*Dicladispa armigera*)

Unit IV: Systematic position, habits, nature of damage along with life cycle and control measures of the following pests of Wheat :

1. Wheat stem borer (*Sesamia inferens*) along with life cycle and control measures.
2. Termites
3. Aphids, Jassids

Unit V: Systematic position, habits, nature of damage along with life cycle and control measures of the following pests of Vegetables:

1. Red pumpkin beetle (*Aulacophora foveicollis*)
2. Pumpkin fruit fly (*Dacus cucurbitae*) along with life cycle and control measures.
3. Hadda beetle (*Epilachna vigintioctopunctata*)

Unit VI: Systematic position, habits and nature of damage of the following pests of stored grains:

1. Pulse Beetle (*Callosobruchus maculatus*) along with life cycle and control.
2. Rice weevil (*Sitophilus oryzae*)
3. Lesser grain borer (*Rhizopertha dominica*)

Unit VII: Systematic position, disease caused and control of the following insects of Medical and Veterinary importance:

1. Mosquitoes
2. House fly (*Musca domestica*) along with life cycle of house fly.
3. Blow fly (*Calliphora erythrocephala*)

SECTION B

Unit VIII: Sericulture:

Species of silkworm, Requirements of Sericulture Industry, Grain age Management, Pre and Post cocoon processing, Diseases of silkworm.

Unit IX: Apiculture:

Species of Honeybees, Flora for Apiculture, Methods & Appliances of Bee Keeping Products - (a) Honey (b) Bee wax (c) Propolis (d) Pollen (e) Royal Jelly (f) Bee Venom

Diseases of Honey bee

Unit X: Lac Culture:

Species of Lac Insect, Host Plants, Cultivation of Lac, Processing of Lac, Diseases.

Unit XI: Chemical Control:

History; Types and Classification of Insecticides

- (a) Insecticides of plant origin with special reference to nicotine; Pyrethrum; and Azadirachtin
- (b) Chlorinated Hydrocarbon insecticides with special reference to DDT; BNC; Chlordane; and Endosulfan
- (c) Organophosphorus Insecticides with special reference to Malathion; TEPP; Parathion.
- (d) Carbamate Insecticides with reference to Carbaryl and Carbofuran
- (e) Fumigants with reference to Hydrogen cyanide; Methyl bromide; and Aluminium phosphide.

Unit XII Biological Control: History; Techniques in biological control, Agents of biological Control

- (a) Vertebrates (b) Nematelminths (c) Arthropods (d) Protozoan; Microbial control with the help of Bacteria, Virus and Fungi.

Recent Methods of Pest Control:

- (a) Sterile insect release methods
- (b) Behavioural control involving use of Pheromones

SUGGESTED BOOKS

1. Attwal, A.S. : Agricultural Pests of India and South East Asia, Kalyani Publishers, New Delhi (1991).
2. Nair, M.R.G.K. : Insects and Mites of Crops in India, ICAR, New Delhi (1975). 3. Kumar, A. & Nigam, P.M. : Economic and Applied Entomology, Emkay Publications (1991). 4. Matheson, R. : Medical Entomology, Comstock Publishing Company, Inc. (1950).
5. Metcalf, R.L. & Metcalf, R.A. : Destructive and Useful Insects, McGraw Hill Book Company, Inc. New York, Toronto, London (1951).
6. Dent, D. : Integrated Pest Management, Chapman & Hal, London, New York, Tokyo, Madras (1995).
7. House, P., Sevens, I. and Jones, O. : Insect Pheromones and their use in Pest Management, Chapman & Hall, London, New York, Tokyo, Madras (1998).
8. Mishra, R.C. : Honey Bees and their Management in India, ICAR Publication New Delhi, (1995).

PRACTICAL (CREDIT 2)

Maximum Marks: 50

Time Allowed: 3Hrs.

1. External morphology and identification marks of the crops and vegetables pests : *Pyrilla perpusilla* (Sugarcane leaf hopper), *Pectinophora gossypiella* (Pink bollworm), *Leptocorisa varicornis* (Gundhy bug) *Hieroglyphus banian* (Paddy grass hopper).
2. External morphology and identification marks of the following stored grain pests : *Sitophilus oryzae* (Rice weevil), *Tribolium castaneum* (Rustred flour beetle), *Rhizopertha dominica* (Lesser grain borer/susri), *Callosobruchus maculatus* (Pulse beetle/Dhora).
3. External morphology and identification marks of the following insects of Medical/Veterinary importance-Mosquitoes (Culex, Anopheles and Aedes), house fly, blow fly, warble fly, and horse fly.
4. A study of life stages of silk worm and honey bees.
5. Collection of insects representing different orders; storage and preservation of insect material.
6. Structure and working of common sprayers: Hand Compression sprayer, Knap sack sprayer.
7. Visit to apiary and godowns for study of infestation.

Guidelines for the conduction of Practical Examination

Maximum Marks :50

Time Allowed:4hrs

Pass Marks : 40%

1. To identify specimens A, B , C, D E and F of crop pest, stored grain pest and insects of medical importance respectively, giving one outstanding morphological character and one identifying feature of each, mentioning scientific name and economic importance. $6 \times 4 = 24$
2. To identify given two larva/Pupa G and write a note on external morphology. 6
3. To name the apparatus provide and explain its structure and functioning 4
4. Project 6
5. Practical note book 5
- 6.Viva 5

FISH AND FISHERIES

Course Code BDSE(Z)-603 ii	Credits	Evaluation pattern		Time allowed for external evaluation
		External Evaluation	Internal Assessment	
Theory	4	75	25	3Hrs.
Practical	2	50	-	3Hrs.

COURSE LEARNING OBJECTIVES:

The course is designed to make the student able to identify the fish on the basis of general morphology and the techniques and challenges of aquaculture.

COURSE LEARNING OUTCOMES:

The course is designed to make the student able to

- identify the fish on the basis of general morphology
- understand the Fish preservation
- identify the Fish diseases- Bacterial, viral and parasitic
- understand the challenges of aquaculture

INSTRUCTIONS TO THE PAPER SETTER

The question paper will consist of three sections A, B and C. Section A and B will have four questions each from the respective section of syllabus and will carry 12 marks each. Section C will consist of 9 short- answer type questions of three marks each and will cover the entire syllabus uniformly.

INSTRUCTIONS FOR CANDIDATES

Candidates are required to attempt two questions each from Section A and B and the entire section C.

SECTION A

Unit: I Outline classification of Teleostei fishes with special reference to the following orders (General Characters of the order with two examples in each):

Ceratodontiformes, Lepidosueniformes, Acipensiformes, Amiiiformes, Semionotiformes, Clupeiformes, Cyprinodontiformes, Perciformes, Anguilliformes, Beloniformes, Gasterosteiformes, Gadiformes, Pleuronectiformes, Tetradontiformes, Echeiniiformes, Ophiocephaliformes

Unit: II General morphology of fish; types of fin and their modifications; Types of scale, uses of scales in determination of age; Coloration: chromatophores, pigments and biological significance of coloration in fish; Bioluminescence in fish and its significance; Electric organs, their structure and use in fish; Structure, modification and function of gills; Air breathing-accessory organs; Swim bladder-role in respiration buoyancy and osmoregulation; schooling, parental care and migration in fish.

Section B

Unit III: Inland Fisheries; Marine Fisheries; Environmental factors influencing the fish farming; Fishing crafts and Gears; Depletion of fisheries resources; Application of remote sensing and GIS in fisheries; Fisheries law and regulations.

Unit: IV Sustainable Aquaculture; Extensive, semi-intensive and intensive culture of fish; cage culture; Polyculture; Composite fish culture; Induced breeding of fish; Management of finfish hatcheries, Brood stock; Preparation of compound diets for fish; Role of water quality in aquaculture; Preservation and processing of harvested fish, Fishery by-products; Biochemical composition of fish; Nutritional value of fish; Poisoning toxicity and allergies from fish as food; Fish preservation; Fish diseases Bacterial, viral and parasitic.

SUGGESTED READINGS

1. Jhingran, V.G. 1978, Fish and Fisheries of India, Hindustan Publishing House (India), New Delhi, India.
2. Talwar, P.K., Jhingran, A.G. 1991, Inland Fishes of India, Vols I & II,. Oxford & IBH, New Delhi, India.
3. Karl, F. L., Win, C. 1969, Freshwater Fishery Biology, Brown Company Publication, Iowa.
4. Moyel, P.B; J.J. Jr., Cech. 1988, Fishes: An introduction to ichthyology, Prentice Hall, Englewood, Ciffs, N.J.
5. Nelson, J.S., 1976, Fish of the World, John Wiley and Sons, New York. 6. Biswas, S.P. 2002, Fundamentals of Ichthyology, Narendra Publishing House, Delhi, India.
7. Jayaram, K.C., 1999, The fresh water fishes of the Indian origian region, Narendra Publishing House, Delhi, India.
8. Tyagi, R; Shukla, A. 2002. Encyclopedia of Fish Series, Adaptations in Fishes, 1st Edition. Anmol Publication Pvt. Ltd., New Delhi, India.
9. Miller, S.A., Harley, J.P. 2005, Zoology. 6th Edition, McGraw Hill Publications, New York.
10. Weichert, C.K., 1965. Anatomy of the Chordates, 3rd Edition. McGraw Hill Publications, New York.
11. Q Bone and R Moore, Biology of Fishes, Talyor and Francis Group, CRC Press, U.K.
12. D. H. Evans and J. D. Claiborne, The Physiology of Fishes, Taylor and Francis Group, CRC Press, UK von der Emde, R.J. Mogdans and B.G. Kapoor.The Senses of Fish: Adaptations for the Reception of Natural Stimuli, Springer, Netherlands
13. C.B.L. Srivastava, Fish Biology, Narendra Publishing House
14. S.S. Khanna and H.R. Singh, A text book of Fish Biology and Fisheries, Narendra Publishing House.

PRACTICALS

Maximum Marks: 50

Time Allowed: 3Hrs.

1. Study of *Petromyzon*, *Myxine*, *Pristis*, *Chimaera*, *Exocoetus*, *Hippocampus*, *Gambusia*, *Labeo*, *Heteropneustes*, *Anabas*.
2. Study of different types of scales (through permanent slides/ photographs).
3. Study of crafts and gears used in Fisheries through charts/photographs
4. Water quality criteria for Aquaculture: Assessment of pH, conductivity, Total solids, Total dissolved solids.
5. Study of air breathing organs in *Channa*, *Anabas* and *Clarias* through videos/ photographs
6. Demonstration of induced breeding in Fishes (video)
7. Demonstration of parental care in fishes (video)
8. Project Report on a visit to any fish farm/ pisciculture unit/Zebrafish rearing Lab.

Guidelines for the conduction of Practical Examination

Time Allowed: 3hrs

Maximum marks: 50

1. To identify given specimen A, B and C. Write two identification points. 3x3=09
2. To identify type of fish scale 'D'. Draw the structure of the identified scale. 03
3. To identify given fishing craft/gear 'E'. Write a brief note on it. 05
4. To identify the type of breathing organ of given specimen 'F' and write a brief note on it. 03
5. Write note on parental care/migration in fish 'G'. 04
6. Write principal and procedure for the assessment of water quality for fish culture. 06
7. Project report 10
8. Viva voce 05
9. Practical file 05

ANIMAL BIOTECHNOLOGY
COURSE CODE BDSE(Z)-603 iii

Course Code BDSE(Z)603iii	Credits	Evaluation pattern		Time allowed for external evaluation
		External Evaluation	Internal Assessment	
Theory	4	75	25	3Hrs.
Practical	2	50	-	3Hrs.

COURSE LEARNING OBJECTIVES:

To acquaint the students with the molecular techniques of gene manipulation and their applications.

COURSE LEARNING OUTCOMES:

Ability to understand

- Animal Cell culture methods
- fundamental molecular tools and their applications of DNA modification and cloning, transgenic animals and their importance

INSTRUCTIONS TO THE PAPER SETTER

The question paper will consist of three sections A, B and C. Section A and B will have four questions each from the respective section of syllabus and will carry 12 marks each. Section C will consist of 9 short- answer type questions of three marks each and will cover the entire syllabus uniformly.

INSTRUCTIONS FOR CANDIDATES

Candidates are required to attempt two questions each from Section A and B and the entire section C.

SECTION A**Unit 1. Introduction** 8hrs

Concept and scope of biotechnology

Unit 2. Molecular Techniques in Gene manipulation 24 hrs

Cloning vectors: Plasmids, Cosmids, Phagemids, Lambda Bacteriophage, M13, BAC, YAC, MAC and Expression vectors (characteristics). Restriction enzymes: Nomenclature, detailed study of Type II. Transformation techniques: Calcium chloride method and electroporation. Construction of genomic and cDNA libraries and screening by colony and plaque hybridization Southern, Northern and Western blotting DNA sequencing: Sanger method Polymerase Chain Reaction, DNA Finger Printing and DNA micro array

SECTION B**Unit 3. Genetically Modified Organisms** 18 hrs

Production of cloned and transgenic animals: Nuclear Transplantation, Retroviral Method, DNA microinjection Applications of transgenic animals: Production of pharmaceuticals, production of donor organs, knock out mice. Production of transgenic plants: *Agrobacterium mediated* transformation. Applications of transgenic plants: insect and herbicide resistant plants.

Unit 4. Culture Techniques and Applications 10 hrs

Animal cell culture, Expressing cloned genes in mammalian cells, Molecular diagnosis of genetic diseases (Cystic fibrosis, Sickle cell anaemia) Recombinant DNA in medicines: Recombinant insulin and human growth hormone, Gene therapy.

SUGGESTED READINGS

- Brown, T.A. (1998). *Molecular Biology Labfax II: Gene Cloning and DNAMAnalysis*. II Edition, Academic Press, California, USA.
- Glick, B.R. and Pasternak, J.J. (2009). *Molecular Biotechnology - Principles and Applications of Recombinant DNA*. IV Edition, ASM press, Washington, USA.
- Griffiths, A.J.F., J.H. Miller, Suzuki, D.T., Lewontin, R.C. and Gelbart, W.M.(2009). *An Introduction to Genetic Analysis*. IX Edition. Freeman and Co., N.Y.,USA • Snustad, D.P. and Simmons, M.J. (2009). *Principles of Genetics*. V Edition, John Wiley and Sons Inc.
- Watson, J.D., Myers, R.M., Caudy, A. and Witkowski, J.K. (2007). *Recombinant DNA Genes and Genomes- A Short Course*. III Edition, Freeman and Co., N.Y.,USA. • Beauchamp, T.I. and Childress, J.F. (2008). *Principles of Biomedical Ethics*. VI Edition, Oxford University Press.

PRACTICALS**Maximum Marks: 50****Time Allowed: 3Hrs.**

1. Genomic DNA isolation from *E. coli*
2. Plasmid DNA isolation (pUC 18/19) from *E. coli*
3. Restriction digestion of plasmid DNA.
4. Construction of circular and linear restriction map from the data provided.
5. Calculation of transformation efficiency from the data provided.
6. To study following techniques through photographs
 - a. Southern Blotting
 - b. Northern Blotting
 - c. Western Blotting
 - d. DNA Sequencing (Sanger's Method)

e. PCR

f. DNA fingerprinting

7. Project report on animal cell culture

Guidelines for the conduction of Practical Examination

Maximum Marks :50

Time Allowed:3hrs

1. To write the principle and working of the given two Techniques 10
2. To Construction restriction map from the data provided 5
3. To Calculate the transformation efficiency from the data provided. 5
4. To perform the given Experiment, and demonstrate to the examiner 10
5. Project report 10
6. Practical record 5
7. Viva 5

ANIMAL BEHAVIOUR AND CHRONOBIOLOGY

Course Code BDSE(Z)-603 iv	Credits	Evaluation pattern		Time allowed for external evaluation
		External Evaluation	Internal Assessment	
Theory	4	75	25	3Hrs.
Practical	2	50	-	3Hrs.

COURSE LEARNING OBJECTIVES: Behaviour is one of the most important and interesting aspects of animal biology. Behaviours permit flexibility that allows animals to respond rapidly to environmental changes. This course exposes students to the broad field of animal behaviour. Students will come to understand the historical foundations of the field, current theories and major concepts for a broad range of behavioural topics. Students will learn how animals learn and communicate with each other, then move on to discuss how they find food, avoid predators, choose their mates, and rear their offspring.

COURSE LEARNING OUTCOMES: Ability to understand

- historical foundations of the field, current theories and major concepts for a broad range of behavioural topics.
- how animals learn and communicate with each other
- how they find food, avoid predators, choose their mates, and rear their offspring.

INSTRUCTIONS TO THE PAPER SETTER

The question paper will consist of three sections A, B and C. Section A and B will have four questions each from the respective section of syllabus and will carry 12 marks each. Section C will consist of 9 short- answer type questions of three marks each and will cover the entire syllabus uniformly.

INSTRUCTIONS FOR CANDIDATES

Candidates are required to attempt two questions each from Section A and B and the entire section C.

SECTION A**Unit 1: Introduction to Animal Behavior**

Origin, history and branches of Ethology; Brief profiles of ethologists (Karl Von Frish, Ivan Pavlov, Konrad Lorenz, Niko Tinbergen); Proximate and ultimate causes of behaviour; Basic concepts of ethology (Motivation, Fixed action patterns, sign stimulus); Methods and recording of a behaviour.

Unit 2: Patterns of Behaviour

Stereotyped Behaviours (Orientations, Reflexes, Echolocation in bats, Sun compass orientation in bees); Individual Behavioural patterns; Innate and Learned Behaviour; Associative learning, classical and operant conditioning, Habituation, Imprinting, insight learning.

Unit 3: Social and Sexual Behaviour

Social Behaviour: types of social interactions (solitary, pair, family, harem, matriarchy, oligarchy, aggregation); Concept of Society; Communication and the senses; Altruism, cooperation/reciprocation, selfishness, eusociality; Insects' society (with Honey bee as example, Foraging in honey bee and advantages of the waggle dance); Monkey society.

Sexual Behaviour: Asymmetry of sex, Sexual dimorphism, Mate choice, Intra-sexual selection (male rivalry), Inter-sexual selection (female choice), Sexual conflict in parental care.

SECTION B**Unit 4: Animal communication and Parental behaviour**

Animal communication: visual releasers, auditory releasers, chemical communication (pheromones, scent marking), tactile communication.

Parental Behaviour: Factors affecting parental care; types of parental care; parent-offspring conflict.

Unit 5: Introduction to Chronobiology

Historical developments in chronobiology; Biological oscillation: the concept of Average, amplitude, phase and period. Adaptive significance of biological clocks; Chrono pharmacology, Chrono medicine, Chronotherapy.

Unit 6: Biological Rhythm

Types and characteristics of biological rhythms: Short- and Long- term rhythms; Circadian rhythms; Tidal rhythms and Lunar rhythms; Concept of synchronization and masking; Photic and non-photoc zeitgebers; Circannual rhythms; Photoperiod and regulation seasonal reproduction of vertebrates.

SUGGESTED READINGS

1. Alcock John. 2005 Animal Behaviour. An Evolutionary Approach (8th Edition)
2. Alcock, J. (1998), Animal behaviour, An evolutionary approach Sinauer Assoc., Sunderland, Mass, USA.
3. Drickamer, L. C. and Vessey, S. H. (1986), Animal Behaviour - Concepts, Processes and Methods. (2nd ed.), Wordsworth Publ. Co., California.
4. Goodenough, J., McGurie and Wallace, R. A. (2001), Perspective on animal behaviour. John Wiley & Sons, Inc. New York.
5. Huntingford F. (1984), The study of animal Behaviour, Chapman and Hall, London.
6. Manning, A. and Dawkins, M. S. (1992 & 1998), An Introduction to Animal Behaviour, 4th ed.(Cambridge low price editions). Cambridge University Press, Cambridge.
7. Manning, A. (1979), An Introduction to Animal Behaviour, 3rd Edition. The English Language Book Society and Edward Arnold Publishers Ltd.
8. McFarland, D. (1985 & 1999), Animal Behaviour. Pitman Publishing Ltd. London.
9. Paul W. Sherman and John Alcock, Exploring Animal Behaviour, Sinauer Associate Inc., Massachusetts, USA.
10. Chronobiology-Biological Timekeeping: Jay. C. Dunlap, Jennifer. J. Loros, Patricia J. DeCoursey (ed). 2004, Sinauer Associates, Inc. Publishers, Sunderland, MA, USA
- 11.

Vinod Kumar (2002) Biological Rhythms: Narosa Publishing House, Delhi/
Springer Verlag, Germany.

PRACTICALS

Maximum Marks : 50 Time allowed : 3hrs

1. To study nests and nesting habits of the birds and social insects.
2. To study geotaxis behaviour in earthworm/grain or pulse pests.
3. To study the grooming behavior of Cockroach.
4. To study the phototaxis behaviour in insect larvae.
5. Visit to Forest/ Wild life Sanctuary/Biodiversity Park/Zoological Park to study behavioural activities of animals and prepare a short report.
6. Food preference in *Tribolium* or any other grain pest.
7. Study of circadian functions in humans (daily eating, sleep and temperature patterns).
8. Web construction and habituation in spider.
9. Courtship in ring dove/pigeons.
10. Use of videos to Study the :
 - a) Grooming behaviour in cockroach.
 - b) Tarsal response in butterfly/housefly.
 - c) Equilibrium study on housefly.
 - d) Effect of temperature on opercular movement in fish

Guidelines for the conduction of Practical Examination

1. Write down principle, procedure and precautions for the given experiment A. Also perform the experiment and show the results to the examiner. 10
2. Write down principle, procedure and precautions for the given experiment B. 7
3. Identify the nest C and write a note on the same. 5
4. Body rhythm chart (for one month) of the student. 8
5. Project 10
6. Practical Note book 5
7. Viva Voce 5