

Bundelkhand University, Jhansi

Board of Studies

In accordance with NEP-2020

S.No	Name of Course		Designation	Feed Back of Students	Revision of Syllabus (mentioned in percentage)	Credit Course	Non Credit Course	multidisciplinary Courses	Vocational/Skilled Orientation course	Date of BOS	Number of value added course with title(Semester wise)
	M.Sc.	Zoology									
1.	Dr. Kameez Zahed	Asso. Prof.			Syllabus modified	credit based course introduced in M.Sc.		One out of the list provided by the university has been added	Industrial training field survey in I st & II nd semesters of M.Sc.	02-07-22	Dissertation research project in M.Sc. III rd & IV th sem
2.	Dr. Kusum Singh	Asst. prof.			revised to N.E.P. 2020						
3.	Dr. Pankaj Chandra	Asso. Prof.									
4.	Dr. Ratindra Sironiya	Asso. Prof.									
	Expert										
5.	Dr. P. K. Bajpai	Retd. Professor									
Comments											

Internal members 1 2 3

Convener

Dean

External Expert 1 External Expert 2

Coordinator

**MASTER OF SCIENCE
IN
ZOOLOGY**

TWO YEARS FULL TIME PROGRAM

**COURSE CONTENT OF VII, VIII, IX AND X
SEMESTER**

2022 JUNE

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**ORDINANCE FOR POSTGRADUATE (SEMESTER SYSTEM) PROGRAMME
ARTS, SCIENCE & COMMERCE FACULTIES (2022 onward)**

1. INTRODUCTION

1.1 Preamble

This ordinance governs all the rules and regulations as per the NEP 2020 for the traditional post graduate programs (M.A., M.Sc., M.Com, Management courses, etc) which are not covered by any regulatory bodies (AICTE, BAR Council, PCI, NCTE etc) running in the University campus or its affiliated colleges in Bundelkhand University, Jhansi. This ordinance supersedes all the previous relevant ordinances, rules and regulations.

1.2 Duration

Bundelkhand University has adopted the semester system in various Postgraduate courses as per directives of Higher Education Department, Uttar Pradesh Government vide letter No 401/seventy-3-2022 dated 09-02-2022 to accelerate the teaching-learning process and enable vertical and horizontal mobility in learning from the academic session 2022- 23 onwards.

The duration of PG courses shall be two years comprising of four semesters. In case a student(s) exits from this programme after completion of the first year (2 semesters), he/she may take exit from the programme and shall be awarded the Degree of Bachelor in Research. After the successful completion of two years (4 semesters) a student shall be awarded the Master's degree in the concerned subject. The maximum duration to complete the course shall be four years.

1.3 Eligibility for Admission

- Candidate, who wishes to seek admission in a course of study prescribed for a post graduate degree of the University, shall be admitted to campus or an affiliated college unless he/ she has:
 - passed the three years Bachelor's degree course Examination of the University of Uttar Pradesh or any other Indian University incorporated by any law in force at the time of admission.
 - or
 - passed any other equivalent examination recognized by the University as equivalent thereto.
 - passed any other equivalent examination recognized by a Foreign University as equivalent thereto
- The date of admission shall follow the University academic calendar.

1.4 Choice of Subject and Course Structure

- i. University/ College shall admit students as per the eligibility criteria and availability of seats decided by the university.
- ii. A student shall take admission to post graduation first year ~~or~~ fourth year of Higher Education program of NEP 2020 after successful completion of Graduate course from NEP 2020 or old course of Science/ Arts/ Commerce/

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Management, etc. He/she shall have to choose respective faculty courses as per guidelines of NEP 2020 depending on the number of seats available in concerned subject and eligibility criteria. In case a candidate is willing to change the faculty, the following condition is required

The candidate should have passed Bachelor degree in Science/ Commerce of NEP 2020 or old courses may take admission in some subjects of Arts faculty (excluding practical subjects like geography, psychology etc). Similarly, the Student from Commerce of NEP or old course of commerce may also be eligible to take admission in Arts subjects. Arts, Management and Commerce candidates cannot be admitted in Science subjects.

- iii. Student(s) shall select subjects for Post graduation course from the major subjects that he / she had opted in the graduation course and shall continue with the same subjects in all the four semesters of the PG programme.
- iv. The course structure shall be as follows:
 There shall be four compulsory theory papers in the first semester. In the second and third semester there shall be two compulsory papers and one/two elective papers. The elective papers are the specialization papers.
 Student(s) shall have to select one Minor Elective Course as Minor subject from any other faculty (except own faculty) or interdisciplinary subject in the first semester of the first year.
- v. Student(s) shall take a Research Project /Survey/ Industrial /Field training program in both the years (Semester II and IV). No pre-requisite shall be required for this.
- vi. List of Minor Elective Course: The candidate shall select any one subject from the following as minor subject in first year of post graduate course.

S No	Science	Arts	Commerce	Interdisciplinary
1.	Mathematical Biology	Tribal Culture and Heritage	Customer Relation Management	Ancient Medical Sciences
2.	Conservation and Water Resource Management	Principle of Administration and Implications	House Keeping and Hospitality	Traditional Medical Therapy
3.	Natural Resources and Conservation	Socio-Economics and Social Security	Share Market and Banking	Vedic Mathematics
4.	Pollution: Causes and Mitigation	Archeological Sites and Monuments	Retail Management and Accounting	Bio Medical Instrumentation and Health
5.	Computational Resources	Indian Constitution	Insurance Policy and Finance	Disaster, Mitigation, & Management
6.	Organic and Natural Farming	Communication and Soft Skill		Mining Plan and Resource Mapping
7.	Computer Hardware Handling	Sanskrit Knowledge System		Water Treatment System
8.	Computer Software	Technical		Climate Change

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	Handling	Translation and Trans creation		and Environmental Degradation
9.	Solar and Non Conventional Energy	Urban Economics and Planning		Medicinal and Aromatic Plants Cultivation, extraction and nutraceutical Values
10.	Cyber Crime	Actuarial Economics		
11.	Bee Keeping, Aquaculture and Fish Farming	Social Sector and Gender Economics		Non Conventional Energy Resource
12.	Entrepreneurship in Microbial and Botanical Products	Environmental Economics		Soil and Water Testing
13.				

2. SEMESTER AND CREDIT DISTRIBUTION

An academic year for post graduate program is divided into four semesters. The Odd semester may be scheduled from July to December and Even semester from January to June.

Fourth Year

	VII Sem	Credits	VIII Sem	Credits
Major	Theory – 04 Papers	5 Credits each Total Credits=20	Theory – 04 Papers	5 Credits each Total Credits=20
	Or Theory – 04 Papers Practical -02	Or 4 Credits each Total Credits=16 2 Credit each Total Credits=4 Total Credits=20	Or Theory – 04 Papers Practical -02	Or 4 Credits each Total Credits=16 2 Credit each Total Credits=4 Total Credits=20
Minor	Minor Elective-1 paper of 04 credits	04 Credits Total Credits=04		
Research Project/ Industrial training/ Survey/ Field Training	One of each 04 Credits	04 Credits Total Credits=04	One of each 04 Credits	04 Credits Total Credits=04
Total Credits		28		24
Total in Both Semester				52 Credit

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Fifth Year

Semester	IX	Credits	X	Credits
Major	Theory – 04 Papers	5 Credits each Total Credits=20	Theory – 04 Papers	5 Credits each Total Credits=20
	Or Theory – 04 Papers Practical -02	Or 4 Credits each Total Credits=16 2 Credit each Total Credits=4 Total Credits=20	Or Theory – 04 Papers Practical -02	Or 4 Credits each Total Credits=16 2 Credit each Total Credits=4 Total Credits=20
Research	One of each 04 Credits	04 Credits	One of each 04 Credits	04 Credits
Project / Industrial training / Survey		Total Credits=04		Total Credits=04
Total Credits		24		24
Total in Both Semester	48 Credit			

3. ATTENDANCE

The expression "a regular course of study" wherever it is used in these Ordinances, means attendance of at least 75% of the lectures and other teaching in campus / affiliated college in the subject for the examination at which a candidate intends to appear and at such other practical work (such as work in a laboratory) as is required by any Statute, Ordinance or Regulation in force for the time being in the University.

A shortage up to 5% of the total number of lectures delivered or practical work done in each subject may be condoned by the Principal of the college/ Head of the Department (in case of University Campus) concerned.

A further shortage up to 10% may be condoned only by the Vice-Chancellor on the specific recommendation of the Principal of the college/Head of the Department concerned (in case of University Campus).

4. EXAMINATIONS

1. There shall be examinations at the end of each semester as, for odd and even semesters in accordance with the academic calendar of the university. A candidate who does not pass the examination in any course(s) shall be permitted to appear in such failed course(s) in the subsequent examinations upto the maximum duration of the course.

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- 2. A candidate should get enrolled/registered for the first semester examination and is mandatory. If enrolment/ registration is not possible owing to shortage of attendance / rules prescribed OR belated joining or on medical grounds, such students shall not be permitted to proceed to the next semester. Such students shall re-do the first semester in the subsequent term of that semester as a regular student; however, a student of first semester shall be admitted in the second semester, if he/she has successfully completed the first semester.
- 3. It shall be mandatory for the student(s) to register for examination in each and every semester (i.e. to fill up the examination form with the requisite fee). If a student fails to register for the examination in any semester, he or she shall not be allowed to appear in that semester as a back paper student. Such student(s) shall appear in the (next) subsequent examination of that semester.

5. EVALUATION

The performance of a student in each course is evaluated in terms of percentage of marks with a provision for conversion to grade point. Evaluation for each course shall be done by a Continuous Internal Assessment (CIA) by the concerned course teacher as well as by end semester examination and will be consolidated at the end of course. The evaluation must be continuous and holistic and should be based on following parameters:

- i. Academic assessment
- ii. Skill assessment
- iii. Physical assessment
- iv. Personality assessment
- v. Extra-curricular assessment

5.1 THEORY PAPER

Semester Examinations shall be conducted by the university as mentioned in the academic calendar. The Question paper will be set by the examiners appointed by the Vice Chancellor based on the recommendation of the board of studies. The pattern of the question paper shall be as given in annexure II.

- i. Internal Assessment(C.I.A.) -25%weightageofacourse
 - Test/ Mid-Term Assessment - 10 marks
 - Term paper/Presentation on given project/assignment - 10marks
 - Attendance/activities - 05marks
- ii. End Semester Exam (External examination)- 75% weightage of course

5.2 PRACTICAL PAPER

Practical examinations will be conducted by the examiners appointed by the Vice Chancellor on the recommendations of the Board of Studies. Each student has to present the practical records.

- i. Internal Assessment(C.I.A.) -25%weightageofacourse
 - Test/ Mid-Term Assessment - 10 marks
 - Term paper/Presentation on given project/assignment - 10marks
 - Attendance/activities - 05marks

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ii. End Semester Exam (External examination)- 75% weightage of a course

MINIMUM PASSING STANDARD

1. The minimum passing standard for combined external and internal examinations for each subject/paper shall be 45%, i.e. 45 out of 100 marks for theory and practical courses. The minimum passing standard for Aggregate in a semester end Examination shall be 45%.
2. Continuous Internal Assessment (CIA) shall be ensured by the Principal of the colleges / HODs for the Campus courses. The Principal of the colleges / HODs of the Campus shall provide the marks of the same to the university and it shall be mandatory to maintain the records of the same till the maximum duration of that course.
3. The internal assessment, field training and practical examination awards of a student who fails in any semester examination shall be carried forward to the next examination.
4. It shall be mandatory for a student to secure minimum 45% marks (i.e. 34/75) in the theory and practical paper separately.

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PROVISION FOR BACK PAPERS AND EX-STUDENTS

A Back Paper (B.P.) candidate shall be promoted to next semester. The back paper facility in a semester provides promotion to the next semester and another opportunity to obtain a minimum of the pass marks assigned for an individual paper or in the aggregate. Following category of students of Bundelkhand University shall be eligible for back paper facility as under,

1. A student shall be required to pass in minimum two subject papers in each semester. However, at the end of each year, it shall be mandatory for a student to pass in at least two subjects papers and minor paper otherwise he/she shall be deemed as failed and will be treated as a year back / ex- student.
5. Students shall get the attempts to appear in the Back paper examination in the subsequent odd / even semester till the maximum duration of the said course.
6. Special back paper examination shall be held only for regular students of the final year of PG course.
7. The candidates who fail in more than three of the total papers, will be deemed as failed. These candidates can appear only in subsequent examination of that semester as Ex- Students.

8. PROMOTION RULES

8.1 Semester Course & Examination:

The students who have taken admission in any post-graduation programme in a session and who have put in the minimum percentage of attendance for appearing at the Examination, presented himself/herself for internal assessment and have filled in the examination form in time for appearing at the End Semester Examination shall be allowed to appear at the respective examinations.

8.2 Declaration of results

After appearing in the Examination of both the semesters in a particular year, the student can be put in the following categories in the context of declaration of the results of the Semester Examination:

- Passed
- Promoted with Back Paper(s)
- Failed

8.3 Promotion to next Semester:

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All students under category Passed and promoted with back papers shall be promoted to the next Semester.

"Failed" students may clear their UNCLEARED courses in subsequent examinations as ex-students.

Students promoted with back papers shall clear their back papers in subsequent examinations as ex-students.

A student who has failed in a course shall get two more chances to clear this course subject to the maximum duration for passing the course. Further, each candidate shall have to clear all the courses within the maximum period of seven years from the date of his/her latest admission.

A candidate who has qualified for the Degree shall be placed in the First / Second Division as per following table:

8. COMPUTATION OF SGP AND CGPA

The guidelines formulated by Bundelkhand University shall be followed in order to bring uniformity in evaluation system of every CBCS based Course and computation of the SGPA (Semester Grade Point Average) and CGPA (Cumulative Grade Point Average) based on students' performance in examination. The number of core, elective, open elective papers and foundation papers and the required credit for each paper shall be formulated by respective Board of Studies (BOS) and faculty board. For the purpose of computation of work load the UGC proposed mechanism is adopted i.e. one credit=1 Theory period of one hour duration, 1 credit=1 Tutorial period of one hour duration, 1 credit=1 Practical period of one hour duration. The credit(s) for each theory paper/practical/tutorial/dissertation will be as per the respective Board of Studies of departments.

Letter Grade	Numerical grade
O (outstanding)	10
A+ (Excellent)	9
A (very good)	8
B+ (Good)	7
B (average)	6
F (Fail)	<5
Ab (Absent)	0

The minimum passing marks shall be 45% of the maximum marks as prescribed in the University Examination and 45% of marks in the aggregate marks in the subject including internal / sessional marks. i.e. Minimum Passing Grade is "B".

A student who obtains Grades "O" or "B" shall be considered as PASSED. If a student secures "F" grade, he/she shall be considered as FAILED and shall have to re appear in the examination. It is mandatory for a student to earn the required SGPA as in each semester. If a student is not able to secure 45% / B grade in any theory / practical / internal / sessional / viva-voce / internship / project examination, the awarded grade point shall be ZERO (0).

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9.1 The University, adopts absolute grading system where in the marks are converted to grades, and every semester results will be declared with semester grade point average (SGPA) and year result will be declared with year grade point average (YGPA). The Cumulative Grade Point Average (CGPA) will be calculated in end of final semester. The grading system except pharmacy department will be with following letter grades and grade points scale as given below:

Table A (For all courses except Pharmacy courses)

Level	Outstanding	Excellent	Very Good	Good	Average		Fail
Letter Grade	O	A+	A	B+	B		F
Grade Points	10	9	8	7	6		0
Score (Marks) Range (%)	≥ 90 (90-100)	$< 90,$ ≥ 80 (80-89.99)	$< 80,$ ≥ 70 (70-79.99)	$< 70,$ ≥ 60 (60-69.99)	$< 60,$ ≥ 45 (50-59.99)		< 45 (0-35.99)

1.1 A student obtaining Grade "F" shall be considered failed and will be required to reappear in the examination. Such students after passing the failed subject in subsequent examination / will be awarded with grade respective of marks he/she scores in the subsequent examination/s.

1.2 The University has the right to scale/moderate the theory exam / practical exam / internal exam / sessional marks of any subject when ever required for converting of marks into letter grades on the basis of the result statistics of university as in usual practice, i.e. marks obtained in decimal will be converted in nearest integer.

9. CONVERSION OF GRADES IN TO PERCENTAGE

1.3 Conversion formula for the conversion of CGPA into Percentage is $CGPA \text{ Earned} \times 10 = \text{Percentage of marks scored}$.

Illustration: $CGPA \text{ Earned} 8.2 \times 10 = 82.0\%$

2. AWARD OF DIVISION

Division shall be awarded only after the final semester examination based on integrated performance of the student for all the semesters as per following details.

2.1 A student who qualifies for the award of the degree securing "B" or above grades in all subjects pertaining to all semesters, and in addition secure as a CGPA of 8.0 and above shall be declared to have passed the examination in **FIRST DIVISION WITH HONOURS**.

2.2 A student who qualifies for the award of the degree securing "B" or above grades in all subject pertaining to all semesters, and in addition secures a CGPA of 7.0 and above shall be declared to have passed the examination in **FIRST DIVISION**.

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DEPARTMENT OF ZOOLOGY
BUNDELKHAND UNIVERSITY JHANSI (U.P.)

SEMESTER-I

Paper	Paper Code	Paper Name	Internal Marks (10 +10+5)	Theory Marks	Total	Credit
1	ZOY - 701	Comparative Structure & Function of Invertebrates	25	75	100	4
2	ZOY- 702	Quantitative Biology	25	75	100	4
3	ZOY - 703	Instrumentation and Biotechnology	25	75	100	4
4	ZOY- 704	Molecular Cell Biology	25	75	100	4
5	ZOY- 705	Practical Related to 701 to 704	25-Internal 75-External		100	4
6	ZOY- 706	research project/industrial training/survey/field training	Submission of progress report		100	4
7	ZOY- 707	*Minor Subject/open elective paper from table	25	75	100	4
Total					700	28

*Student(s) shall have to select one elective course as minor subject from any other faculty (except own faculty) as prescribed in university ordinance for post graduate programme. Table is attached herewith

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DEPARTMENT OF ZOOLOGY
BUNDELKHAND UNIVERSITY JHANSI (U.P.)

SEMESTER-II

Paper	Paper Code	Paper Name	Internal Marks	Theory marks	Total	Credit
1	ZOY -801	Genetics	25	75	100	4
2	ZOY-802	Taxonomy and Evolution	25	75	100	4
3	ZOY -803	Biochemistry	25	75	100	4
4	ZOY-804	Ecology and animal behavior	25	75	100	4
5	ZOY-805	Practical Related to 801 to 804	25-Internal 75-External		100	4
6	ZOY-806	research project/industrial training/survey/field training	Submission of research project		100	4
Total					600	

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**DEPARTMENT OF ZOOLOGY
BUNDELKHAND UNIVERSITY JHANSI (U.P.)**

SEMESTER-III

Paper	Paper Code	Paper Name	Internal Marks (10 +10+5)	Theory Marks	Total	Credit
1	ZOY - 901	Comparative Structure & Function in vertebrates	25	75	100	4
2	ZOY-902	Molecular cytogenetics	25	75	100	4
3	ZOY - 903/ 904/ 905/ 906/ 907/ 908	Special A (Fish & fisheries/ Endocrinology/ Environmental biology/ Cell biology/ Applied Zoology /Entomology)	25	75	100	4
4	ZOY- 909/ 910/ 911/ 912/ 913 / 914	Special B ((Fish & fisheries/ Endocrinology/ Environmental biology/ Cell biology/ Applied Zoology /Entomology)	25	75	100	4
5	ZOY-915	Practical – 1(General) Related to SNO.1&2	10-Internal 40-External		50	2
6	ZOY - 916	Practical – 2(Special) Related to SNO. 3&4	10-Internal 40-External		50	2
7	ZOY- 917	*Dissertation (Research project)	Submission of progress report		100	4
Total					600	

* 4 credits will be allocated to students after the submission of dissertation progress report

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BUNDELKHAND UNIVERSITY JHANSI (U.P.)

SEMESTER-IV

Paper	Paper Code	Paper Name	Internal Marks	Theory marks	Total	Credit
1	ZOY -1001	Infection biology and immunology	25	75	100	4
2	ZOY-1002	Developmental biology	25	75	100	4
3	ZOY 1003/1004/1005/ 1006/1007/1008	Special A (Fish & fisheries/ Endocrinology/ Environmental biology/ Cell biology/ Applied Zoology /Entomology)	25	75	100	4
4	ZOY- 1009/1010/1011/ 1012/1013/1014	Special B (Fish & fisheries/ Endocrinology/ Environmental biology/ Cell biology/ Applied Zoology /Entomology)	25	75	100	4
5	ZOY-1015	Practical Special Paper	25-Internal 75-External		100	2
6	ZOY- 1016	*Dissertation (Research project)	Submission of research project		100	4
Total					600	

GRAND TOTAL

2500

*Marks distributed as: Submission of research project – 50, presentation – 25, publication-25

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M.Sc.1st Semester
General Paper-I, ZOY-701
Comparative Structure & Function of Invertebrates

Unit – I

- Symmetry in animal organization : Asymmetry, radial, and bilateral symmetry and their Significance.
- Coelom : Evolution of coelom, Acoelomate, pseudocoelomate, coelomate groups: Protostomia and Deuterostomia.
- Organization of coelom: Enterocoelic, Schizocoelic and gonocoelic
- Metamerism : Evolution of metamerism – Pseudometamerism, cyclo metamerism. Corm theory. Embryological theory and Significance,

Unit – II

- Flagellar and ciliary movements in Protozoa
- Hydrostatic movement in Coelenterate, Annelid and Echinoderm
- Patterns of feeding and digestion in lower metazoan
- Filter feeding in Polychaeta, Mollusca and Echinodermata

Unit – III

- Different types of respiratory organs – Gills, lungs and trachea
- Respiratory pigments
- Mechanism of respiration
- Different types of excretory organs- coelomoducts, Nephridia and Malpighian tubules.
- Mechanisms of excretion and osmoregulation.

Unit – IV

- Primitive nervous system: Coelenterata and Echinodermata
- Advanced nervous system: Annelida, (Polychaeta and Oligochaeta), Arthropoda (Crustacea and Insecta) and Mollusca (Cephalopoda).
- Endocrine glands in crustaceans and Insects , Pheromones and Semiochemicals.

Unit – V

- Pattern of sexual and asexual reproduction.
- Larval forms of parasites and their phylogenic significance.
- Larval forms of annelida, crustacea, mollusca and echinodermata.
- General Characters and affinities of Minor phyla: Rotifera, Chaetognatha, Phoronida and Sipunculida.

Suggested Readings:

1. Barnes et al (2009). The Invertebrates: A synthesis. Wiley Backwell 17 .
2. Hunter: Life of Invertebrates (1979, Collier Macmillan)
3. Marshall: Parker & Haswell Text Book of Zoology, Vol. I (7th ed 1972, Macmillan)
4. Moore: An Introduction to the Invertebrates (2001, Cambridge University Press)
5. Brusca and Brusca (2016) Invertebrates. Sinauer
6. Jan Pechenik (2014) Biology of the invertebrates. McGraw Hill
7. R.L Kotepal, Text book of invertebrate, Rastogi publication.
8. EJW Barrington-Invertebrate structure and function.

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M.Sc.1st Semester
General Paper-II – ZOY 702
Quantitative Biology

Unit – I

- Basic concepts of biostatistics.
- Significance & Applications of biostatistics.
- Classification & Graphical representation of data.
- Analysis of frequency & frequency distribution

Unit – II

- Measures of central tendency (Mean, Median, Mode)
- Measures of Dispersal (Mean deviation, Standard deviation)
- Probability distribution (binomial, & normal)

Unit-III

- Sampling distribution
- Hypothesis testing
- Chi-square test
- Student's t-test

Unit-IV

- F-test & Analysis of Variance(ANOVA), ANCOVA
- Correlation
- Regression

Unit-V

- General application of computer
- M.S. Word, Excel and PowerPoint
- Hardware and software , statistical software ie. SPSS.
- Internet & E-mail

Note : Non scientific (Simple) calculator is allowed for students.

Suggested Reading:

- Biostatistical Analysis (Fourth Edition) by Jerrold H. Zarr, Pearson Education Inc., Delhi.
- Statistical Methods (Eighth Edition) by G. W. Snecdecor and W. G. Cochran, Willey Blackwell.
- Biostatistics (Tenth Edition) by W.W. Daniel and C. L. Cross, Wiley
- Introductory Biological Statistics (Fourth Edition) by John E. Havel, Raymond E. Hampton and Scott J. Meiners
- Introduction to biostatistics, Dr. P.K. Banerjee, S. Chand publication.
- Elements of biostatistics, S. Prasad, Rastogi publication.
- Biostatistics, P.N. Arora and P.K.Malhan, Himalaya publishing house.

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M.Sc.1st Semester
General Paper-III – ZOY 703
Instrumentation and Biotechnology

Unit-I

- Principle and applications of microscopy, types of microscope : Light and compound microscope, fluorescence microscope, phase contrast microscope.
- Electron microscope: SEM and TEM.
- pH meter : Principle and measurement of pH.

Unit-II

- Principle of centrifugation.
- Types of centrifuge and rotors.
- Principles of chromatography.
- Types to chromatography.

Unit-III

- Colorimeter and spectrophotometer: Beer Lambert law, absorption spectrum.
- Electrophoresis: Principle, types and applications.
- Radio tracer techniques : Detection and measurement of radio isotopes used in biology, Incorporation of radio isotopes in tissue and cells, safety measures.

Unit-IV

- Concept of rDNA technology.
- DNA modifying enzymes.
- Cloning vectors.
- Preparation of genomic and cDNA library, Molecular probes.
- Amplification of gene : Polymerase chain reaction (PCR), RAPD

Unit-V

- DNA finger printing.
- Detection of genetic diseases, Gene transfer techniques and gene therapy.
- Development of DNA drugs and vaccines.
- Live stock improvement

.Suggested Readings:

1. Karp: Cell and Molecular Biology: Wiley (2002).
2. Watson et al. Molecular Biology of the Gene. Pearson (2004).
3. Lewin. Genes VIII. Pearson (2004).
4. Pierce B. Genetics. Freeman (2004).
5. Sambrook et al. Molecular Cloning Vols I, II, III. CSHL (2001).
6. Primrose. Molecular Biotechnology. Panima (2001).
7. Clark & Switzer. Experimental Biochemistry. Freeman (2000).
8. L.Veera Kumari, Bio instrumentation MJP publishers
9. P.K. Bajpai - Biological Instrumentation & Methodology S.Chand & Co. New Delhi

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M.Sc.1st Semester
General Paper-IV – ZOY 704
Molecular Cell Biology

Unit-I

- Transport across cell membrane :diffusion active transport & uniport, symport & antiport.
- Membrane potential
- Transport across epithelia.

Unit-II

- Microfilaments, microtubules, intermediate filament & their dynamics.
- Microtubules & mitosis
- Cell movement intracellular transport, role of kinesin & dynein.

Unit-III

- Signals transduction mechanism.
- Cell surface receptors
- Second messenger system
- MAP kinase pathway
- Signaling from plasma-membrane to nucleus

Unit-IV

- Ca^{++} dependent hemophilic cell-cell adhesion
- Ca^{++} independent hemophilic cell-cell adhesion
- Gap junction & connexins

Unit-V

- Itergrins, collagens and non collagen components.
- Cyclins & cyclin dependent kinases
- Regulation of CDK-cyclin activity
- Apoptosis and Necrosis.

Suggested Readings:

1. Lodish et al: Molecular Cell Biology: Freeman & Co, USA (2004).
2. Alberts et al: Molecular Biology of the Cell: Garland (2002).
3. Cooper: Cell: A Molecular Approach: ASM Press (2000).
4. Karp: Cell and Molecular Biology: Wiley (2002). Pierce B. Genetics. Freeman (2004).
5. Lewin B. Genes VIII. Pearson (2004).
6. Watson et al. Molecular Biology of the Gene. Pearson (2004).
7. P.K Gupta, Cell and molecular biology, Rastogi publication.

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M.Sc.1st Semester
General Practical – ZOY 705

- Study the museum specimens of different invertebrate Phyla.
- Study the permanent slides of different phyla
- Study of permanent slide of larval stage of Helminthes to Echinodermata.
- Study of mitosis from anion root tips
- Absorption spectrum of colored solution using spectrophotometer/ Colorimeter
- Separation & detection of dyes/ amino acids using paper chromatography.
- pH determination of unknown solution.
- Separation of Serum and tissue protein with the help of electrophoresis.
- .Biostatics; graphical representation of data(Mean, Median, Mode & standard deviation)

Marks distribution

Duration : 6 hours

• Colorimetric estimation of unknown solution/ Chromatography.	15
• Determination of pH/ separation of protein.	15
• Biostatics Problem	05
• Preparation of slide	05
• Spotting 1-10	20
• Record & Collection	10
• Viva-Voice	05
Total Marks	75

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M.Sc. – 2nd Semester
General Paper- I – ZOY 801
Genetics

Unit - 1

- Mendalian principle : Dominance, segregation and independent assortment
- Concept of gene : Allele, multiple allele, pseudoallele
- Extra chromosomal/Cytoplasmic inheritance

Unit - 2

- Co-dominance, incomplete dominance, epistasis, gene interaction, pleiotropy.
- Genomic imprinting, anticipation, penetrance and expressivity, phenocopy.
- Linkage and crossing over
- Genetic mapping : Two points and three points cross.

Unit - 3

- Molecular anatomy of eukaryotic chromosome and telomere.
- Giant chromosome : Polytene and lampbrush chromosome.
- DNA packaging upto metaphase chromosome.
- Chromosome banding, karyotype, patterns of inheritance and pedigree analysis.

Unit -4

- Gene Mutation : Kinds of mutation.
- Mutagens.
- Structural alteration in chromosome.
- Numerical alteration in chromosome.

Unit – 5

- Mendalian and genic disorders.
- Eugenics, Euthenics and genetic counselling.
- Oncogene and tumor repressor gene,
- Chromosomal abnormalty in malignancy (chronic myloid leukemia, burkirt's lymphoma, retinoblastoma and wilm's tumor.

Suggested Readings:

1. Lodish et al: Molecular Cell Biology: Freeman & Co, USA (2004).
2. Alberts et al: Molecular Biology of the Cell: Garland (2002).
3. P.K.Gupta : Genetics and molecular biology. Rastogi publication.
4. Karp: Cell and Molecular Biology: Wiley (2002). Pierce B. Genetics. Freeman (2004).
5. Lewin B. Genes VIII. Pearson (2004).
6. Watson et al. Molecular Biology of the Gene. Pearson (2004).
7. Pierce B. Genetics. Freeman (2004).
8. Veer bala rastogi : Genetics, Meditech publication.

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M.Sc. – 2nd Semester
General Paper- II – ZOY 802
Taxonomy and Evolution

Unit – 1

- Definition and basic concepts of taxonomy.
- Scope and levels (α , β and γ) of taxonomy, phonetics, cladistics.
- Trends in biosystematics : Chemo, cyto and molecular taxonomy.
- Taxonomic procedures : Taxonomic collection and preservation, curation, process of identification.
- Taxonomic keys, zoological nomenclature (As amended till date), international code of zoological nomenclature (ICZN), role of zoological survey of India.

Unit – 2

- Lamarkism
- Theory of natural selection, Darwin Wallace theory of evolution, neodarwinism.
- Modern synthetic theory.
- Mutation theory.

Unit – 3

- Historical concepts regarding origin of life.
- Modern theory regarding origin of life.
- Theories of chemical and spontaneous origin of life at molecular level.
- The evolution of protein, examples of protein evolution and neutral theory of protein evolution.

Unit – 4

- Species, race and deme, nature of speciation.
- Instantaneous speciation : Through mutation, through macrogenesis, through chromosomal aberration.
- Gradual speciation : Allopatric and sympatric.
- Micro, macro and megaevolution, hypothesis of punctuated equilibria.
- Isolation : Types of isolation, pre-mating and post-mating isolating mechanism.

Unit – 5

- The Hardy – Weinberg principle and analysis of gene frequencies in natural population.
- Major factors influencing gene frequencies (Migration, inbreeding), effects of selection and mutation on gene frequencies, Genetic polymorphism
- Fossils, Geological time scale, zoogeographical distribution of animals.
- Evolution of horse and man.

Suggested books :

- G.G. Simpson, **Principle of animal taxonomy**. Oxford IBH Publishing company.
- V.C. Kapoor. **Theory and Practice of Animal Taxonomy**. Oxford & IBH Publishing Co.
- Strickberger, M.W. **Evolution** Jones and Barlett Publishers. Boston London.
- Dobzhansky, Th., **Genetics and Origin of Species**. Columbia University Press. Dobzhansky, Th., F.J. Ayala, G.L. Stebbins and J.M. Valentine. **Evolution**. Surjeet Publication, Delhi.
- Futuyama, D.J. **Evolutionary Biology**, Sinauer Associates, INC Publishers, Sunderland.
- Rastogi, V. B., **Organic Evolution**, Medtech Science Press, Delhi.

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M.Sc.2nd Semester
General Paper-III – ZOY 803
Biochemistry

Unit-I

- Energetics : IInd law of thermodynamics, free energy, standard free energy change
- Reducing power and redox reaction, Ernst equation
- Synthesis of ATP
- Cellular energy resources

Unit-II

- Biosynthesis of Amino acid
- Protein structure ,classification folding and denaturation
- Ramachandran plot and chaperons.
- Structure of nucleic acid (DNA and RNA)
- Biosynthesis of nucleotides

Unit-III

- Nomenclature & classification of enzyme, Co-enzyme & Iso-enzyme
- Mechanism and regulation of enzyme action
- Enzyme kinetics: Michaelis-Menten equation, concept of K_m & V_{max}
- Factors affecting rate of enzyme reaction
- Enzyme inhibition and Allosteric enzyme

Unit-IV

- Structure and classification of Carbohydrates
- Glycolysis, citric Acid cycle, HMP shunt
- Glycogenesis ,Gluconeogenesis, Glycogenolysis
- Oxidative phosphorylation

Unit-V

- Structure and classification of lipids
- Fatty acid metabolism; synthesis & degradation
- Biosynthesis of membrane lipid.
- Biosynthesis of steroids and cholesterol.

Suggested Readings:

1. Nelson & Cox: Lehninger's Principles of Biochemistry: McMillan (2000)
2. Zubayet al: Principles of Biochemistry: WCB (1995)
3. Voet&Voet: Biochemistry Vols 1 & 2: Wiley (2004)
4. Guyton, A.C. & Hall, J.E. Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. /W.B. Saunders Company. (2006).
5. Tortora, G.J. & Grabowski, S. Principles of Anatomy & Physiology. XI Edition John Wiley & sons (2006).
6. Christopher D. Moyes, Patricia M. Schulte. Principles of Animal Physiology. 3rd Edition, Pearson Education (2016).
7. Jain and Jain : Bio chemistry, S Chand publication.

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M.Sc.2nd Semester
General Paper-IV – ZOY 804
Ecology and animal behavior

Unit – 1

- Concept of ecosystem, trophic structure of ecosystem, types of ecosystem, productivity of ecosystem.
- Concept of limiting factors ,Liebig Blackman law of limiting factor, Shelford's Law of tolerance.
- Types of interaction: Commensalism, mutualism, predation grazing , parasitism, allelopathy
- Ecological succession, Ecological niche and key stone species.

Unit – 2

- Population and its characteristics, patterns of population growth
- Survival ship curve, population dispersion and its regulations.
- Adaptation in terrestrial environment and parasitic habitat.
- Biogeochemical cycles.

Unit – 3

- Biodiversity and its significance
- Causes of biodiversity loss : habitat destruction , over exploitation, introduction of exotic spp., diseases and shifting or Jhum cultivation
- Conservation : IUCN red data book, Ex- situ conservation and In- situ conservation, germ plasm banks.
- Pollution : Urban, agricultural and atmospheric (Global climate change)

Unit – 4

- Ethology and its scope, branches of ethology
- Patterns of behavior, components of behavior
- Role of hypothalamus : In feeding and drinking, in reproductive behavior, in fighting and fleeing, in sleeping and walking
- Reflexes and complex behavior, reflex arch
- Pheromones : Functions and effects

Unit – 5

- Concept of fixed action pattern and its properties
- Concept of sign or key stimulus, stimulus filtering, super normal stimulus, innate releasing mechanism
- Learning and memory : Conditioning, habituation, insight learning, association learning, reasoning
- Biological clocks : Circadian and circannual clocks
- Mimicry, altruistic behavior and kin selection

Suggested reading :

- Ecology and environment science by HR Singh, vishal publication.
- Animal behavior by Mannings.
- Animal behavior by Gundavia.
- Animal behavior by Fatik.
- Alcock ,JAnimal behavior : an evolutionary approach Sinauer Assoc.Sunderland,Mass USA.
- Bradbury , J.W and S.L. Vehrencamp: principles of animal communication Sinauer Assoc.Sunderland,Mass USA.

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M.Sc.IInd Semester
General Practical – ZOY 805

- Preparation of human karyotype and study the chromosomal aberration from the pictures provided
- Study of sex chromatin (Barr body) in buccal smear and hair bud
- Extraction of DNA from animal/plant tissue
- Preparation of polytene chromosome
- Solve genetic problems by punnett diagram
- Recoding of blood pressure by sphygmomanometer
- Recoding of blood sugar by gulucometer
- Estimation of clotting & bleeding time, Hb%
- Preparation of haemein crystals
- Identification of Carbohydrate, Protein , Lipids and amino acids
- Quantitative determination of biological components (protein, glycogen. RNA & DNA)
- Demonstration of reflex action.
- Problems related to evolution , population genetics etc(H.W. Principle, natural selection , adaptation, trends and genetic polymorphism

Marks Distribution**Duration:- 6 hours**

• Dissection of fish, amphibian & mammals (Virtual)	10
• Blood sugar / blood pressure/ reflex action	10
• Any two blood experiment(Bleeding, Clotting, haemin crystal, Hb%)	10
• Quantitative determination of biological components/problems related to evolution	10
• Identification of foodstuff	10
• Spotting 1-10	15
• Record and Collection	05
• Viva-voice	05

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M.Sc. 3rd Semester
General Paper-I - ZOY 901

Comparative anatomy and physiology of Vertebrate

Unit-I

- Characteristic features & classification of Protochordata. .
- Origin , Classification and characteristics of vertebrates .
- Structure & development of integument and its derivatives .

Unit-II

- Respiratory organs in different vertebrates.
- Transport of gases.
- Neuronal and chemical regulation of respiration.
- Digestive system of mammals.

Unit-III

- Evolution of Heart and aortic-arches
- Cardiac cycle and blood pressure
- Anatomy of excretory organ in vertebrates.
- Physiology of excretion : Urine formation, micturition, waste elimination, water balance, electrolyte balance and acid base balance

Unit-IV

- Comparative account of CNS & PNS
- Conduction of nerve impulse
- Sense organs : Vision, hearing and tactile response

Unit-V

- Endocrine glands & their secretions
- Basic mechanism of hormonal action
- Hypothalamo-hyperphysial portal system & neural control of pituitary gland
- Hormonal disorders

Suggested Readings:

1. Harvey et al: The Vertebrate Life (2006)
2. Colbert et al: Colbert's Evolution of the Vertebrates: A history of the backboned animals through time (5th ed 2002, Wiley - Liss)
3. Hildebrand: Analysis of Vertebrate Structure (4th ed 1995, John Wiley)
4. Kenneth V. Kardong (2015) Vertebrates: Comparative Anatomy, Function, Evolution McGrHill
5. R.L.Kotepal, text book of vertebrate zoology, Rastogi publication
6. Parker and Haswell: TextBook of Zoology, Vol. II (1978, ELBS)

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M.Sc.3rd Semester
General Paper-II – ZOY 902
Molecular Cytogenetics

Unit-I

- Enzymes and proteins involved in replication
- DNA replication in prokaryotes
- DNA replication in Eukaryotes
- DNA repair

Unit-II

- RNA polymerases, General transcription factors
- Transcription in prokaryotes
- Transcription in Eukaryotes

Unit-III

- Post transcriptional modification, capping & Polyadenylation
- Splicing and RNA editing
- Export & stability of mRNA

Unit-IV

- Genetic code & wobble hypothesis
- Factors involving in translation.
- Translation in prokaryotes
- Translation in eukaryotes

Unit-V

- Regulation of gene expression in prokaryotes; Lac Operon and trp-operon in E-coli,
- Regulation of gene expression in Eukaryotes; Role of chromatin, methylation, Phosphorylation, acetylation, Epigenetic regulation

Suggested Readings:

1. Lodish et al: Molecular Cell Biology: Freeman & Co, USA (2004).
2. Alberts et al: Molecular Biology of the Cell: Garland (2002).
3. Cooper: Cell: A Molecular Approach: ASM Press (2000).
4. Karp: Cell and Molecular Biology: Wiley (2002).
5. Watson et al. Molecular Biology of the Gene. Pearson (2004).
6. Lewin. Genes VIII. Pearson (2004).
7. P.K Gupta, Cell and molecular biology, Rastogi publication.

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M.Sc.3rd Semester
General Practical – ZOY 915


- Virtual dissection of cranial nerves, afferent and efferent branchial arteries of fishes.
- Study of museum specimens of various Vertebrates.
- Study of permanent slides of Vertebrates.
- Study of Axial & appendicular skeleton of birds & mammals
- Study of Microtomy : Section cutting and preparation of permanent slides
- Study of different models (Cell organelles and nucleic acids)

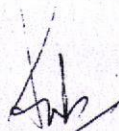
Marks Distribution

Duration:- 6 hours

1-Dissection	05
2-Microtomy	10
3-Spotting 1-10	15
4-Record	05
5-Viva	05
Total	40

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M.Sc. 3rd Semester

Special Paper-I – ZOY 903 (Fish- A) Taxonomy, Ecology and behavior

Unit – 1

- Outline Classification of fishes as proposed by Berg.
- Classification of placodermii, elasmobranchii and holocephalli.
- Classification of dipnoii and ostrichthyes .

Unit – 2

- Riverine and cold water fisheries.
- Lacustrine and estuarine fisheries.
- Coastal , offshore and deep sea fisheries.
- Systematic survey with particular references of fishes of Bundelkhand region.
- Adaptation in hill stream and deep sea fishes.

Unit – 3

- Trophic levels of fish in the food chain.
- Primary productivity of fish pond and its importance.
- Common aquatic weeds of fish ponds and their control.
- Larvicidal and predatory fishes and their importance in fish culture.
- Exotic fishes and their importance.

Unit – 4

- Courtship and parental care.
- Fish migration.
- Fish schooling behavior
- Shoaling behavior.

Unit – 5

- Diseases of aquaculture : Prevention, prophylaxis and treatment of bacterial, viral and fungal diseases.
- Protozoan and helminth diseases of fishes.
- Immune protection in fishes.
- Types and sources of aquatic pollution and its impact on fish health.

Suggested Books

- Biology of fishes ;Bone Q and Moore R. Talyor and Francis groups CRC press U. K.
- .The diversity of fishes G.S.Helfman, B.B.Collette and d.f.Facey Blackwell science USA.
- Reading in Ichthyology M.S.Love and G.M.Cailliet.Prentice-hall of India
- An introduction to fishes : S.S.Khanna ,Central book depot publication.
- Fish and fisheries of India :Jhingran,V.G. Hindustan publishing corporation New Delhi.

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M.Sc. 3rd Semester
Special Paper-I I – ZOY 909 (Fish- B)
Fish anatomy and physiology

Unit – 1

- Structure and function of skin and its derivatives.
- Structure , types and fuction of scales.
- Chromatophores : Structure ,classification and colour change mechanism.
- Determination of age growth and its relationship with scales.
- Fins : Origin ,types and their modification, locomotion in fishes.

Unit – 2

- Digestive system : Anatomy and physiology of Alimentary canal.
- Respiratory organ : Structure of gills and physiology of aqueous breathing .
- Swim bladder and webarian ossicles : Structure and function.

Unit – 3

- Circulatory system : Structure of heart and arterial system(Afferent and Efferent arteries).
- Excretory system : Structure and physiology of kidney.
- Osmoregulatory mechanism, balance of ions in fresh water and marine fishes.

Unit – 4

- Nervous system : Structure of brain and cranial nerves.
- Lateral line system : Structure, modification and significance.
- Organs of olfaction and taste.
- Electric organ, bioluminescent organ and sound producing organs.

Unit – 5

- Male and female reproductive organs.
- Reproductive cycle and maturation.
- Structure and fuctions of endocrine glands : Pituitory, thyroid, ultimobranchials, pancreas, adrenal, corpuscles of stannous, urophysis and pineal.
- Environmental and hormonal control of reproduction.

Suggested books

- Encyclopedia of fish physiology.2011 Anthony P. et all 2011 Academic press UK
- Fish physiology . (series)W.S. Hoar and.J. Randall Academic press UK
- The physiology of fishes.2013 Evans,D H and Claiborne,J.D.Taylor and Francis grp CRC press UK
- Introduction to fish physiology ;Dr. Lynwood S. Smith Narendra publishing house India.
- An introduction to fishes:G. S. Sandhu,Campus book international.
- An introduction to fishes : S.S.Khanna ,Central book depot publication.
- Fish and fisheries of India :Jhingran, V.G. Hindustan publishing corporation New Delhi.

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M.Sc. 3rd Semester

Special paper practical – ZOY 916(Fish and Fisheries)

- Virtual dissection of bony and cartilaginous fishes.
- Study of electric organ of fishes.
- Determination of age through the scale of fishes.
- Study of museum specimens of fishes.
- Study of permanent slides.
- Study of bones of fishes.

Marks Distribution:

- Dissection of fishes
- Determination of age/study of electric organ
- Spotting
- Preparation of permanent slide
- Viva – Voce
- Record and collection

Duration:-6 hours

	10
	05
	10
	05
	05
	05
Total	40

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M.Sc.3rd Semester
Special paper 1-ZOY 904 (Endo-A)
Comparative Endocrinology

Unit-I

1. History and scope of endocrinology
2. Endocrine methodologies.
3. Mechanism of hormone action
4. General and comparative structure of pituitary gland
5. Structure of Pineal gland

Unit-II

1. General & comparative structure of thyroid gland
2. General and comparative structure of parathyroid gland.
3. General and comparative structure of pancreas
4. General and comparative structure of adrenal medulla and chromaffin tissue
5. General and comparative structure of adrenal cortex and inter renal tissue.

Unit-III

1. Neuroendocrine concept & mechanism in invertebrates
2. Neuroendocrine system in coelenterates
3. Neuroendocrine system in Helminthes
4. Neuroendocrine mechanism in Annelida.
5. Neuroendocrine system in Mollusca

Unit-IV

1. Caudal neurosecretory system in fish
2. General structure of thymus in mammal
3. Ultribranchial bodies in Vertebrates.
4. Structure of ovary in mammals
5. Structure of testis in mammals

Unit-V

1. Hormones and environment
2. Care and Breeding of laboratory animals rat mice.
3. Hormones, hormones like substances and their evolution.

Suggested Reading Books

1. C.D. turner and J.P. Bagnara, General Endocrinology W.B. Saunnder's Publication
2. Mc.E.Hadkey, Endocrinology Printice Hall
3. P.J.Bently, Comparative Vertebrate Endocrinology Cambridge University Press.
4. Gorbmen and Bern, Comparative endocrinology Wiley Eastern University Edition.
5. David.O.Norris, Vertebrate Endocrinology Academic Press.

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M.Sc.3rd Semester

SPECIAL PAPER 2-ZOY 910(ENDO-B) Endocrinology Physiology

Unit-I

1. Role of hypothalamus and neuroendocrine intergration in mammals.
2. Hormones of anterior pituitary and their functional significance.
3. Growth hormone and its physiological significance.
4. Hormones of neurohypophysis and their functional significance in mammals.
5. Hormones of pars-intermedia and control of pigmentary function in vertebrates.

Unit-II

1. Evolution of thyroid function and synthesis of thyroid hormones.
2. Regulation of thyroxine secretion and its physiological significance.
3. Thyroxine and its influence of development and metamorphosis.
4. Parathyroid hormones and its physiological significance.
5. Calcitonin, thyrocalcitonin and their functional significance.

Unit-III

1. Catecholamines (Epinephrine and non-epinephrine) their biosynthesis and physiological influence on metabolism.
2. Biosynthesis and metabolism of adrenal glands.
3. Physiological significance of mineralcorticoid.
4. Physiological significance of glucocorticoids.

Unit-IV

1. Gastrointestinal hormone and their physiological significance and its dysfunction
2. Physiological significance of insulin in carbohydrates metabolism
3. Physiological significance of glucagon in carbohydrates metabolism.
4. Insulin and insulin like peptides and their role in early mammalian development.

Unit-V

1. Neuroendocrine system in insects
2. Synthesis and functions Brain hormones in insects
3. Gonadal hormone in insects
4. Neuro secretion in crustacean.

Suggested Reading Books

1. C.D. turner and J.P. Bagnara, General Endocrinology W.B. Saunnder's Publication
2. Mc.E.Hadkey, Endocrinology Printice Hall
3. P.J.Bently, Comparative Vertebrate Endocrinology Cambridge University Press.
4. Gorbmen and Bern, Comparative endocrinology Wiley Eastern University Edition.
5. David.O.Norris, Vertebrate Endocrinology Academic Press.

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M.Sc.3rd Semester
Special Paper Practical –ZOY 916(Endocrinology)

General and comparative Endocrinology

1. Virtual dissection of endocrine gland in vertebrate and invertebrates (Cockroach, Grasshopper and Butterfly).
2. Determination of protein and glycogen in the endocrine material using colorimeter.
3. Microtomy of endocrine material (Preparation of paraffin blocks, sectioning and staining)
4. Identification of endocrine gland.
5. Identification of chemical structure of peptides and steroid hormones.
6. Determination of blood sugar level.

Scheme of Practical Examination

- | | |
|--|----|
| 1. Dissection of endocrine glands in Vertebrate / Invertebrates with display and Diagram | 10 |
| 2. Biochemical estimation of protein, glycogen in endocrine tissue/ Determination of blood sugar level | 05 |
| 3. Microtomy of endocrine material | 10 |
| 4. Identification and comments of spotting (Slides-3, Molecular structure of hormones-2) | 10 |
| 5. Viva-voce/Practical record | 05 |

Total **40**

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M.Sc. 3rd Semester
Special Paper-I – ZOY 905 (Environmental Biology-A)
Fundamentals of Environmental Biology

Unit- I: Definition, Principles and scope of Environmental Biology

Man and Environment, Components of atmosphere and biosphere, Physicochemical and biological factors in the Environment, Structure and composition of Biosphere. Biomes and Climates

Unit- II: Nature of ecosystem

Ecosystem structure and functions, types of ecosystems, Abiotic and biotic components, Terrestrial and aquatic ecosystems, Productivity, Food chain, food web, energy flow through ecosystem, biogeochemical cycles, Ecological Pyramids Basics of Ecosystem restoration

Unit- III: Population ecology

Density, natality, mortality, growth curves, Commensalism, Mutualism, Parasitism, Predator- Prey relations, Population dynamics, Ecological succession, Ecological Models

Unit- IV :Environmental Pollution

Classification of pollutants, Nuclear hazards and human health risks, Sources, Effects and control of Air, water, soil and noise pollution Ganga Action plan (GAP), public health issues, Plastic waste management rules, Bhopal gas tragedy, etc

UNIT – V: Environmental Microbiology and Toxicology

Introduction to toxicology, dose-response relation, additive-synergistic and antagonistic effects, factors affecting toxic responses, route of administration, toxicity testing, types of toxicity, Pesticides ,metals, solvents and vapours, radiation and radioactive materials, chemical carcinogens, food additives, fluorosis and arsenic poisoning.

Microbiology- organisms in nature & their importance, Biotransformation, bioconversion, phytoremediation and bioremediation, microbiology of water, air and soil ,microbes as pathological agent in plant, animal and man.

Reference Books-

1. Environmental chemistry - Sodhi
2. Principals of Environmental chemistry - Manhan
3. Environmental hazards & human health R.B. Philip
4. Toxicology - principles & applications - Niesink & Jon devries
5. Principles of microbiology - Pelzar
6. Microbial bio technology - A.N. Glazer
7. Microbial ecology - R.M. Atlas

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M.Sc. 3rd Semester
Special Paper-I I – ZOY 911 (Environmental Biology-B)
Biodiversity and Energy Conservation

Unit- I: Biodiversity Conservation

Introduction to biodiversity concepts, significance and distribution, Levels of biological diversity, Threats to biodiversity, principles of biodiversity conservation in-situ and ex-situ conservation, acceleration of ecological succession, Mega biodiversity zones and Hot spots. Man and biosphere programme

Unit- II: Uses of biodiversity

Sources of food, medicines, raw material, aesthetic, cultural and ecosystem services, strategies for sustainable exploitation of biodiversity.

Unit- III: Energy Resources and Conservation

Renewable and non-renewable energy resources, sun as source of energy, solar radiation and its spectral characteristics, fossil fuels classification, composition.

Physiochemical characteristics and energy content of coal, petroleum and natural gas. Principle of generation and conservation of conventional and non-conventional energy.

Energy from biomass and biogas, energy conservation policies.

Unit- IV: Natural Resources and Movements

Land resources, Causes of deforestation; Impacts of mining and dam building on environment.

Water resources: Over exploitation of water resources; Floods, droughts, and international & interstate conflicts over water

Contemporary Indian issues related to mining, dams, forests, energy etc (e.g., National Solar Mission, Cauvery River water conflict, Sardar Sarovar dam, Chipko movement, Appiko movement, Tarun Bharat Sangh, Bishnois of Rajasthan, Narmada Bachao Andolan, etc) Environmental justice: National Green Tribunal and its importance.

Unit- V: Wetlands-

Concept, classification, importance, uses and threats to the wetlands, Productivity and development of Wetlands, Important wetlands of India. Ramsar convention and National Wetland Policy.

References

1. Living in the environmental - T.J. Miller.
2. Natural resource conservation - Owen & Chiras.
3. Encyclopedia Energy - I & II.
4. Global Biodiversity - W.R. L.IUCN
5. Ecology of natural resource - Ramade
6. Ecology - P.D. Sharma
7. Keddy P.A (2000). Wetland Ecology: Principles and Conservation.
8. Singh, J.S., Singh, S.P., and Gupta, S.R. (2017). Ecology, Environmental Science and Conservation. S. Chand Publishing, New Delhi.

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M.Sc. 3rd Semester
SPECIAL PAPER PRACTICAL I – ZOY 916 (Environmental Biology)
Biodiversity, Ecological Studies and Toxicological Studies

- Monitoring Flora and fauna and other Environmental Components.
- Collection of Zooplankton and Phytoplankton
- Analysis of soil micro flora by dilution plate method, study of rhizospheric and rhizoplane microbes
- Study of anatomical changes in plants to detect effect of pollution.
- Study of pond ecosystem
- Birds and Wildlife census.

- Biodiversity index
- Analysis of water : Dissolved Oxygen ,Biological Oxygen Demand, Chloride estimation. Dissolved Solids, Hardness of water ,Alkalinity, Acidity, Ph
- Testing of presence of bacteria : Gram + and Gram – Bacteria
- Toxicity analysis

Books/ Manuals Recommended:

- APHA, AWWA, WEF (1998). Standard Methods of water and waste water. APHA (20th Edition)
- Booth C. (1971). Methods in microbiology Volume 4 Academic press
- Pelczar M.J, Chan E.C.S and Krieg N.R. (1993). Microbiology Tata Mecgrahill New Delhi

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M.Sc. 3rd Semester
Special paper – I ZOY- 906 (Cell Biology – A)
Methods in cell and molecular biology

Unit – 1

- Microscopy : Light, Phase contrast and electron microscope.
- Basic principle and application micro-photometry.
- Tissue culture : Media, sterilization, monolayer and suspension culture, cell counting and infection.

Unit – 2

- Centrifugation : Principle and applications : Types of rotors, clinical, high speed and ultracentrifuges.
- Autoradiography: Principle, methods and applications.
- Radio immune assay.

Unit – 3

- Electrophoresis: Types, principles, methods and applications.
- Spectro photometry : Principles and applications.
- FT – IR (Fourier transform infrared) and NMR (Nuclear magnetic resonance) spectroscopy.

Unit – 4

- Preparation of recombinant DNA (Gene cloning). Restriction enzymes and modifying enzymes.
- Preparation of genomic and c-DNA libraries. General idea of expression library : Screening of gene libraries.
- Methods in gene analysis : Hybridization technique (Southern, Northern, Western Blotting).
- PCR ,RAPD, RFLP, AFLP (Genetic analysis techniques) and its applications.

Unit – 5

- Methods of protein purification.
- DNA foot printing.
- Chromosome banding: Principle, methods and applications.
- RNA silencing.

Suggested Readings:

1. Karp: Cell and Molecular Biology: Wiley (2002).
2. Watson et al. Molecular Biology of the Gene. Pearson (2004).
3. Lewin. Genes VIII. Pearson (2004).
4. Primrose. Molecular Biotechnology. Panima (2001).
5. Clark & Switzer. Experimental Biochemistry. Freeman (2000).
6. L.Veera Kumari, Bio instrumentation MJP publishers

K. Veera Kumari

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M.Sc.3rd Semester
Special Paper - II ZOY – 912 (Cell Biology - B)
Cell Structure and molecular organization

Unit – 1

- Chemical composition of cell membrane.
- Membrane protein : Spectrin, glycophorin and band 3.
- Structure and functions of lysosomes and peroxisomes.

Unit – 2

- Structure and chemical composition of mitochondria.
- Molecular organization of respiratory assemblies, ATP/ADP, translocase and Fo.F1 ATPase., ATP synthesis.
- Mitochondrial DNA : Structure expression and variability from genomic DNA.
- C-Value paradox, Cot value and its significance.

Unit – 3

- Structure and function of endoplasmic reticulum (ER).
- Structure, function and biogenesis of ribosomes.
- Cytochemistry of Golgi complex and its role in protein trafficking.

Unit – 4

- Cell nucleus: Nuclear envelop, nuclear pore complex and nucleolus.
- Nucleocytoplasmic transport : Import and export of protein and RNAs.
- Structure of chromosome, kinetochores and telomere.

Unit -5.

- General idea of oncogene and cancer : Transforming agent, proto-oncogenes and oncoproteins.
- Differences between normal cell and cancer cell : Biochemical, cytoskeletal cell surface changes, hormones in relation to cancer cells.
- Human cancer : Genetic basis and chromosomal abnormalities.
- Evolutionary origin of cancer

Book recommended:

- Cell and Mol. Biology – Gerald Karp.
- Genes VIII. B Lewin.
- Principle of Genetics – Snustad and Simmons.

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M.Sc.3rd Semester
Special Paper Practical ZOY – 916(Cell Biology)

- Histochemical demonstration of lipids, proteins (including enzymes), carbohydrate and nucleic acids (DNA/RNA).
- Chromosome staining of grasshopper testis and polytene chromosomes from salivary glands of *Drosophila*.
- Gel electrophoresis of nucleic acid (DNA/RNA). Isolation and detection of DNA/RNA on agarose gel.
- Study of permanent slides of meiosis.

Marks Distribution :

Duration: 6 hours

• Histology and Histochemistry	10
• Demonstration of Biomolecules / meiotic slides	10
• Chromosome staining of grasshopper testis /Polytene Chromosome	05
• Gel Electrophoresis of DNA	05
• Viva – Voce	05
• Record	05
Total	40

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M.Sc. 3rd Semester

Special Paper-I – ZOY 907 (Applied zoology - A)

Aquaculture

Unit – 1

- Scope and significance of various streams of applied zoology
- Scope, importance and problems of aquaculture.
- Physiochemical properties of pond water
- Types and qualities of culturable fishes

Unit – 2

- Construction and lay out of different types of ponds
- Management of hatcheries, nurseries and rearing ponds.
- Pre and post management of stocking ponds.

Unit – 3

- Fresh water prawn culture
- Pearl culture
- Fin fish culture
- Integrated fish cum duck farming.
- Sewage fed fish culture.

Unit – 4

- Construction and maintenance of fish aquaria and important aquarium fishes.
- Cage culture.
- Brackish water fish culture.
- Biofloc fish farming.

Unit – 5

- Breeding habits of carps : Bandh breeding and induced breeding
- Fish byproducts and marketing .
- Fish preservation and transportation.

Suggested books

- An introduction to fishes : S.S.Khanna ,Central book depot publication.
- Hand book of Fisheries and aquaculture.2013 Indian Council of Agricultural Research ICAR New Delhi India
- Fish and fisheries of India :Jhingran,V.G. Hindustan publishing corporation New Delhi.
- Santhanam, R. Fisheries science Daya publishing house
- Lagler,K.Fet al.; Ichthyology, John Wiley

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M.Sc. 3rd Semester
Special Paper-II – ZOY 913 (Applied zoology - B)
Human diseases , disorders and diagnostics

Unit – 1

- Types of parasites and hosts
- Brief introduction to pathogenic microbes: Viruses and bacteria.
- Host parasite relationship

Unit – 2

- Causes , types, symptoms, diagnosis and prevention of :
Tuberculosis ,Hepatitis, Diabetes and Hypertension.
- Causes, types, symptoms, diagnosis and prevention of epidemic and pandemic diseases :
Typhoid, cholera, small pox, plague and covid-19.

Unit – 3

- Types of tumors : Benign, malignant
- Tumor associated antigen
- Immuno diagnosis and immunotherapy in cancer

Unit – 4

- Methods used for analysis of : Blood and Urine
- Medical imaging : X-Ray, MRI and CT scan

Unit – 5

- Hybridoma technology
- Gene therapy
- Development of recombinant vaccine
- Production of recombinant protein : Insulin and growth hormone

Suggested books

- Introduction to parasitology: J.D Smith
- Parasitology – T.C.Cheng
- Biology of parasites – E.J.W.Soulsbey
- Medical parasitology-K.D.Chaterjee
- Noble and Noble , Parasitology, Lea and Febiger 1973

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**M.Sc.3rd Semester
Special Paper Practical –ZOY-916 (Applied Zoology)**

- Study of specimens of fresh water fishes and aquaculture animals.
- Study of specimens of helminths and arthropods.
- Study of slides of parasites of protozoan, helminths and arthropods.
- Counting of blood cells with haemocytometer.
- Identification of fish scales.
- Haematological experiments.

MARKS DISTRIBUTION

Duration: 6 hours

• Haematological experiments.	10
• Spotting	10
• Permanent slide preparation	10
• Record and collection	05
• Viva voce	05

TOTAL 40

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M.Sc.3rd Semester
Special Paper-I – ZOY 908 (Entomology- A)
General Entomology & Insect Morphology

Unit – 1

- Insect diversity and their outline classification.
- Collection, preservation and culture of Insects.
- General organization of insect body: Head, thorax, abdomen and their appendages.

Unit – 2

- Mouthparts and relationship with feeding habits of insects.
- Wings: Origin, structure and venation.
- Structure of flight muscles and flight mechanisms in insects.

Unit – 3

- Coloration and mimicry in insects.
- Light producing organ and its mechanism.
- Sound producing organ and its mechanism.

Unit – 4

- Phase theory of locusts.
- Polymorphism in insects.
- Methods of insect communication.

Unit – 5

- Insect and Abiotic environment.
- Insect and biotic environment.
- Insects and humans.

Suggested books

- O.W.Richards and R.G.Davies, Imms textbook of Entomology. Methuen and Co. London.
- R.E.Snodgrass, Principles of insect morphology. Tata MacGraw.Hill, Bombay.
- R.M.Fox and J.W.Fox, Introduction to comparative entomology. Reinhold Publ.Corp, New York.
- R.F.Chapman. The insects structure and function(ELBS,London)
- K.K.Nayar, T.N. Ananthkrishnan and B.V.David, General and Applied Entomology. Tata MacGrow Hill, New Delhi.
- K.G.V. Smith, Insects and other arthropods of medical importance.
- H.H.Ross. A Textbook of Entomology, John Wiley and sons, New York.

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M.Sc.3rd Semester
Special Paper – II ZOY- 914 (Entomology – B)
Insect Anatomy & Physiology

Unit – 1

- Structure and function of insect integument.
- Head and its Appendages.
- The digestive system.

Unit – 2

- Respiratory system.
- Circulatory system.
- Excretory system.

Unit – 3

- Nervous system.
- Endocrine system.
- Reproductive system.

Unit – 4

- The Development.
- Sense organs.
- Visual organs.

Unit – 5

- Insect Parasitism.
- Dispersal and migration in insects.
- Behaviour : Orientation, innate and parental.\

Suggested books

- Chapmn : the insects: structure and function 4th edition.
- Pedigo : entomology and pest management , prentice hall , New delhi 1989.
- Gullan & Cranston:the insects : an outline of entomology 2nd edition Blackwell science 2000.
- Dhaliwal and Arora : principles of insect pest management,national agriculture technology information centre Ludhiana.
- Atwaal : agriculture pest of India and south east asia , kalyaani publication New Delhi.
- Klowden : physiological systems in insects, academic press 2002.

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M.Sc.3rd Semester
Special Paper Practical ZOY - 916

General Entomology

- Dissection of various organ systems (nervous, digestive, reproductive, neuroendocrine etc.) in available insects like grasshopper, cricket, cockroach, beetle, bug, wasp, honey bee, butterfly, moth, dragonfly etc.
- Preparation of permanent stained mounts of insects, their body parts and dissected organs.
- Study of permanent slides of insects, their body parts, organs and histological preparations.
- Study of insect specimens showing colouration, mimicry, light production, polymorphism, sound production and reception and other morphological modification.
- Physiological / Biochemical experiments in insects like extirpation and implantation of endocrine organs, parabiosis, ligation of dipteran/ lepidopteran larvae, preparation of isolated abdomen demonstration of digestive enzymes, excretory products, Chitin and cuticular lipids etc.
- Microtomy of insect material.

MARKS DISTRIBUTION

Duration: 6 hrs.

• Dissection with display and diagram..	10
• Mounting with identification, diagram and comments.	05
• Spotting	10
• Physiological/Biochemical Experiments	05
• Viva – Voce	05
• Practical record	05
Total	40

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M.Sc. 4th Semester
General Paper-I- ZOY 1001
Infection Biology and Immunology

Unit-I

- Introduction to parasitology, types of host and parasites.
- Parasitic adaptation in helminth parasites, parasitoids.
- Application of molecular biology in parasitic diseases.
- Biochemical and molecular mechanism of drug resistance in parasites.

Unit-II

- Innate & Acquired immunity
- Cells & organs of immune system
- Antigen & immunogenicity
- Anti body structure, function and diversity.
- Clonal selection theory.

Unit-III

- Humoral & cell mediated immune response.
- Maturation, Activation of lymphocytes (T & B cells), cytotoxic T-cells, NK cells, T-helper cells
- Major Histocompatibility Complex, antigen processing and presentation.
- Complete system
- Mammalian tole like receptors.

Unit-IV

- Monoclonal antibodies
- Antigen, antibody reaction (Precipitation and agglutination)
- Immunological technique (ELISA-Radio immunoassay, Immunohistochemistry ,Immunoelectrophoresis)

Unit-V

- Tumor immunology and Immunity to cancer.
- Transplant immunology and immunological tolerance
- Congenital & acquired immunodeficiencies.

Suggested Readings:

1. Thomas J. Kindt, Richard A. Goldsby, Barbara A. Osborne, Janis KubyKuby Immunology. W H Freeman (2007).
2. Delves Peter J., Martin Seamus J., Burton Dennis R., Roitt Ivan M. Roitt's Essential Immunology, 13th Edition. Wiley Blackwell (2017).
3. Shetty Nandini Immunology Introductory Textbook. New Age International. (2005)
4. Januway et.al. ,immunobiology- the immune system in health and diseases, Garland publishing U.S.A.
5. D.M.Weir and John Stewart: Immunology.
6. Kuby Immunology 8Ed. Macmillan publication.

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M.Sc. 4th Semester
General Paper-II – ZOY 1002
Developmental Biology

Unit-I - Historical perspective and basic concepts

- Historical review and theories of embryology
- Cell division and cell differentiation
- Developmental biology and human welfare
- Sex determination in birds and mammals

Unit-II - Early embryonic development in mammals

- Male gonads and spermatogenesis
- Female gonads and oogenesis
- Semination, Ovulation and transport of gametes
- Reproduction cycle ; estrous and menstrual cycle
- Fertilization and cleavage
- Blastulation and Gastrulation

Unit-III - Late Embryonic Development

- Morphogenesis; formation of neural tube, cell migration
- Fat map of germinal layers, extra embryonic membranes.
- Implantation in mammals
- Placentation in mammals
- Axis and patterning in Drosophila

Unit-IV - Post embryonic Development

- Metamorphosis in amphibian
- Regeneration epimorphic regeneration in reptile
- Ageing ; concept & theories
- Stem cells

Unit-V - Implication of developmental Biology

- Tretogenesis- teratological agents and their effect on embryonic development
- Amniocentesis
- Assisted reproductive techniques IVF, ICSE, GIFT etc

Suggested Books

- Gilbert, S.F. (2010) Developmental Biology, Sinauer Publisher
- Balinsky, B.I. and Fabian B.C. (1981) Introduction of Embryology
- Carlson, R.F. Patter's Foundation of Embryology
- Kalthoff. (2008) Analysis of Biological Development, Hill Publishers
- Lewis Wolpert (2002) Principales of Development Oxford University Press.
- Chordate embryology Verma and Agarwal. S.Chand Publication Recent edition

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M.Sc. 4th Semester
Special Paper-I – ZOY 1003 (Fish- A)
Pisciculture

Unit – 1

- Construction and layout of different types of ponds.
- Physiochemical properties of pond water and soil.
- Pre and post management of stocking ponds.
- Management of hatcheries, nurseries and rearing ponds.
- Management of fish germ plasm.

Unit – 2

- Dams and their impact on riverine fisheries.
- Culturable fish species of inland water .
- Planktons and their importance in fish culture.
- Construction and maintenance of fish aquaria and important aquarium fishes.

Unit – 3

- Fishing crafts and gears.
- Remote sensing technique used in fish culture.
- Fishways and screens.
- Fish feed: Natural, artificial and commercial .

Unit – 4

- Brakish water fish culture.
- Sewage fed fish culture.
- Biofloc fish farming .
- Recirculating aquaculture system.

Unit – 5

- Methods of fish preservation.
- Problem associated with fish preservation.
- Fish spoilage, rigor mortis, rancidity and enzyme spoilage.
- Transportation and marketing of fish.

Suggested books

- An introduction to fishes : S.S.Khanna ,Central book depot publication.
- Hand book of Fisheries and aquaculture.2013 Indian Council of Agricultural Research ICAR New Delhi India
- Fish and fisheries of India : Jhingran, V.G. Hindustan publishing corporation New Delhi.
- Santhanam, R. Fisheries science Daya publishing house
- Lagler, K.F. et al.; Ichthyology, John Wiley
- C.I.F.R.I; Prawn Fisheries Bulletin no 10 1977.
- Huet M.; Text book of fish culture, breeding and cultivation of fish ,fishing news(books) LTD
- Ribelin, W .E.& Migeki, G.: the pathology of fishes, the university of Wisconsin press , 1975.

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M.Sc. 4th Semester
Special Paper-I I – ZOY 1009 (Fish- B)
Aquaculture and economic importance of fishes

Unit – 1

- Cage or pen culture.
- Prawn and shrimp culture.
- Pearl culture.
- Fish culture in swamps and marshes.

Unit – 2

- Integrated and composite fish culture.
- Rice field aquaculture .
- Induced breeding and bandh breeding

Unit – 3

- Fish as a model organism.
- Genetically modified fishes and their importance.
- Chromosome manipulation (Gynogenesis, androgenesis and polyploidy).
- DNA polymorphism in fishes.

Unit – 4

- Biosensors used in aquaculture.
- Fishes as biofactories.
- Extension services : Basic principles and immerging issues of extension.
- Role of information and communication technology(ICT) in fisheries extension.

Unit – 5

- Fish by products : Fish skin, scales, fish manure, fish isinglass, fish flour, fish sausage and fish silage.
- Economic importance of fish liver oil, fish body oil.
- Chemical composition of fish liver oil.
- Shark liver oil industry in India

Suggested books

- An introduction to fishes : S.S.Khanna ,Central book depot publication.
- Hand book of Fisheries and aquaculture.2013 Indian Council of Agricultural Research ICAR New Delhi India
- Fish and fisheries of India :Jhingran,V.G. Hindustan publishing corporation New Delhi.
- Santhanam, R. Fisheries science Daya publishing house
- Lagler,K.Fet al.; Ichthyology, John Wiley
- Srivastava , C.B.L: a Textbook of fishery science and Indian fisheries, Kitaab Mahal 1985.

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M.Sc. 4th Semester
Special Paper 1st -ZOY 1004 (ENDO-A)
Male Reproductive Endocrinology

Unit-I

1. Differentiation of the testes and male genital ducts.
2. Histology and ultra structure of testis.
3. Spermatogenic function of the testis.
4. Endocrine regulation of Spermatogenesis
5. Testosterone its structure & functions

Unit-II

1. Structure and functional significance of Sertoli cells.
2. Endocrine and paracrine function of Sertoli cells.
3. Structure and functional role of Leyding cells.
4. Metabolism of testicular androgens

Unit-III

1. Biochemistry of semen and analysis of semen.
2. Structure and physiology of male reproductive tract.
3. Metabolism of testicular androgen.
4. Inhibin and activin

Unit-IV

1. Structure and ultrastructure of mammalian sperm
2. Metabolic changes in spermatozoa during maturation
3. Capiciation of Spermatozoa
4. Testicular disorders and their remedies.

Unit-V

1. Regulation of fertility in male through ART
2. Contraception through male.
3. Hormone & sexual Behaviour
4. Effect of Environmental factors in reproduction

Suggested Reading Books

1. Gayatri Praksah, Reproductive Biology, Narosa Publication
2. Yen et al Reproductive Endocrinology, W.B. Saunder, s Publication.
3. A.V. Nalbandov, Reproductive Physiology of Mammals, W.H.Freeman & Co.
4. Mac. E.Hadley, Endocrinology Printice Hall.
5. Gayton and Hall Medical Physiology Elsevier Publication.

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M.Sc. 4th Semester
Special Paper 2nd -ZOY 1010 (ENDO -B)
Female Reproductive Endocrinology

Unit-I

1. Differentiation of the ovary and female genital duct.
2. Histology of ovary and ultrastructure of ovum.
3. Estrous cycle in mammals.
4. Menstrual cycle in primates.
5. Menopause

Unit-II

1. Puberty and its hormonal control and disorders
2. Implantation and its hormonal regulation and types
3. Pregnancy and hormonal regulation of pregnancy.
4. Parturition & its hormonal regulation
5. Lactation and its regulation

Unit-III

1. Fine structure and types of placenta and their significance.
2. Placental hormones and proteins secretions and significance.
3. Corpus leuteum and its functional significance
4. Neuroendocrine control of ovarian functions.

Unit-IV

1. Prostaglandins and their role in reproduction.
2. Endocrine control of ovulation and lutenization.
3. Endocrine control structure and function of mammalian oviduct.
4. Bioregulators, Acetylcholine, GABA, Interleukin, Gaseous bioregulator.

Unit-V

1. Impotency sterility ART in human
2. Invitro fertilization, ZIFT, GIFT, ICSI
3. Control of Fertility in females.

Suggested Reading Books

1. Gayatri Praksah, Reproductive Biology, Narosa Publication
2. Yen et al Reproductive Endocrinology, W.B. Saunders, Publication.
3. A.V. Nalbandov, Reproductive Physiology of Mammals, W.H. Freeman & Co.
4. Mac. E. Hadley, Endocrinology Printice Hall.
5. Gayton and Hall Medical Physiology Elsevier Publication.

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M.sc 4th Semester
Special Paper Practical-ZOY1015 (Endocrinology)

Reproductive Endocrinology

1. Dissection of various reproductive glands in vertebrates.
2. Operation in male rat: castration, vasectomy
3. Operation in female rats; Ovariectomy, Hysterectomy, adrenalectomy, thyroidectomy, laparotomy.
4. Preparation of vaginal smear, identification and staining with papeniculaou stain.
5. Preparation of sperm smear and classification of types of sperms with abnormalities.
6. Confirmation of pregnancy in urine using antibody method.
7. Separation of steroidal hormones; using thin layer chromatography.
8. Identification of permanent slides of reproductive organs.
9. Identification of chemical structures of steroidal hormones.
10. Study of human embryos at different stages of development.

Scheme of Examination

Duration: 6.00 Hrs

1. Dissection of reproductive gland	20
2. Experiments in living rats (Two) Operation in male and female	10
3. Vaginal smear and sperm studies/Embryo study	10
4. Spotting	15
5. Practical Record	10
6. Viva-voce	10

Total **75**

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M.Sc. 4th Semester
Special Paper-I – ZOY 1005 (Envi. Biol. - A)
Environmental Management

Unit- I: Environmental Management

Introduction and scope of environmental management, basic concepts of sustainable development, Role of natural products, Environmental Impact Assessment (EIA), environmental management plan (EMP), international organization for standardization (ISO), environmental safety, Remote sensing, GIS technology and its uses, environmental monitoring.

Unit- II: Water Pollution Management

Water quality standard, physico-chemical and biological properties of sewage, effects of water pollutants on phytoplankton productivity, bio-indicators of water pollution., Biological treatment of waste waters, chemical and other methods for disinfection. , Water management strategies, rain water harvesting, recharging of ground water, Treatment of Industrial effluents.

Unit- III: Air Pollution Management

National air monitoring programme, effects of air pollution on human health, Vehicular pollution monitoring, Air pollution control equipments, control of sulphur dioxide and control of NO₂. Hazardous air pollutants and their management, scope of green belt development

Unit- IV: Waste and Disaster Management

Solid waste management methods - Sanitary land filling, Recycling, Vermi composting, energy recovery from organic waste, Hospital Waste Management, Control measures for various types of urban, industrial l waste, Hazardous waste, E-waste, etc; Waste segregation and disposal, Disaster Management.

Unit- V: Environmental Health Management

Effects of mercury, lead, chromium, cadmium, arsenic and nitrate on human health, Prevention and protection of community health from water borne diseases, Prevention of Air borne disease, Effects of weather and climate on diseases

References :

1. Solid Waste Management CPCB. New Delhi.
2. Ecotechnology for pollution control & environmental management
- By R.K. Trivedi & Arvind Kr.
3. Basic Environmental Technology - J.A. Nathanson

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M.Sc. 4th Semester
Special Paper-II – ZOY 1011 (Envi. Biol. - B)
Environmental issues and legislation

Unit- I: Climate Change

Global warming, Greenhouse effect, Acid rain, Ozone Depletion, El-Nino effect, Impact of Climate change, Carbon sink, Carbon credit, Soil erosion, Deforestation, National action plan on Climate change, Green Economy

Development without destruction: Eco-transport, Eco farming, green belts

Unit- II: Wild Life Conservation

Endemic and endangered species of India, major causes of extinctions of wild life, threats to wildlife, IUCN threat categories, Red data book, Birds and wildlife census, Wild life conservation, National parks and sanctuaries, Biosphere reserves, Contemporary Indian wildlife and biodiversity issues, movements, and projects (e.g., Project Tiger, Project Elephant, Vulture breeding program, Project Great Indian Bustard, Crocodile conservation project, Silent Valley movement, Save Western Ghats movement, etc)

Unit- III: Global conventions and Protocols

Earth Summit, UNFCCC, Montreal and Kyoto protocols, Convention on Biological Diversity(CBD), Ramsar convention, The Chemical Weapons Convention (CWC), UNEP, CITES, etc

Unit- IV: Environmental legislation

Wildlife Protection Act 1972, The Water (Prevention and Control of Pollution) Act 1974. Prevention and Control of Air Pollution Act 1981, Forest Conservation Act 1981, Environment (protection) Act 1986, Biological Diversity Act, 2002, Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 and new legislations related to environment.

Unit- V: Environmental Policies and Rules

National Forest policy, Hazardous waste (Management and Handling) Rules, 1989, Bio-Medical Waste (Management and Handling) Rules, 1998, E- Waste Management Rules, 2016, Plastic Waste Management Rules, 2016, National Wetland Policy

References-

1. Divan, S. and Rosencranz, A. (2002). *Environmental Law and Policy in India: Cases, Material & Statutes*, 2nd Edition. Oxford University Press, India.
2. Raven, P.H, Hassenzahl, D.M., Hager, M.C, Gift, N.Y. and Berg, L.R. (2015). *Environment*, 9th Edition. Wiley Publishing, USA.
3. Singh, J.S., Singh, S.P. and Gupta, S.R. (2017). *Ecology, Environmental Science and Conservation*. S. Chand Publishing, New Delhi
4. Primack, R.B. (2014). *Essentials of Conservation Biology*, Oxford University Press, USA

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M.Sc. 4th Semester
SPECIAL PAPER PRACTICAL 2 – ZOY 1015 (Environmental Biology)
Pollution Monitoring, Analysis and Waste Management

Air pollution indices. Air Pollutant analysis, Auto – exhaust monitoring. High Volume Sampler and Stack Gas analysis kit, Estimation of the amount of oxides of Sulphur, oxides of Nitrogen in the ambient air, Estimation of the amount of in the ambient air, Air Pollution Tolerance Index, Indicator plants for Air pollution

Noise Pollution Monitoring studies

Quantitative analysis - Gas chromatographic techniques, Titrimetric methods, Colorimetric methods, AA Spectro photometric analysis, HPLC techniques, Ion exchange chromatography, Electrophoresis methods, PCR technique

Environmental monitoring using remote sensing - Remote Sensing – Raster Analysis, Remote Sensing – Vector Analysis, GIS Analysis, GPS in Remote Sensing Analysis, Modelling

Sampling methods of soil and solid waste - Analysis of Moisture content, Organic Matter, Organic Carbon, Analysis of Sodium and Potassium, Nitrogen content, Potassium, Phosphorus, Preparation of Compost

Chemical toxicity tests in wastewater (Industrial), Heavy metal analysis, Predicting techniques (impact prediction).

Biological analysis of Municipal Solid waste, Waste water treatment methods

Books Recommended:

- Stern A. C., (1977), Air Pollution, Academic Press, New York
- Park- Air Pollution- Analysis.
- Aery. N.C (2002), Manual of Environmental Analysis, Ane Books Pvt. Ltd.

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M.Sc.4th Semester
Special Paper - I ZOY- 1006 (Cell Biology – A)
Chromosomes, genes and genetic engineering

Unit – 1

- Molecular organization of eukaryotic chromatin, nucleosome and higher order compaction of mitotic chromosomes.
- Genes, gene mutations and molecular mechanism of occurrence of mutations.
- Organization and significance of hetero-chromatin.

Unit – 2

- Organization of eukaryotic transcriptional machinery, promoter obstructers, enhancers, transcription factors and polymerases.
- DNA binding domains of transcription apparatus, zinc finger, steroid receptors homeo domains, Halix-loop-Helix and Leucine Zipper.
- Structural organization of eukaryotic genes : Interrupted genes and overlapping genes and their evolution.
- DNA methylation and DNAs sensitivity in relation to gene activity and chromatin organization.

Unit – 3

- Gene families : Organization, evolution and significance.
- Environmental modulation of gene activity (stress responses) : Stress genes and stress proteins.
- Molecular basis of Thalassemia, Muscular dystrophy and Cystic fibrosis.

Unit – 4

- DNA rearrangement and amplification during development with special reference to ciliates, chorion gene and ssRNA genes.
- General plan of embryonic development of Drosophila embryo, transdetermination.
- Basic idea of organization and evolutionary significance of homeoboxes.
- Basic idea of homeotic genes and homeotic mutation.

Unit – 5

- Genetic and cytological mapping of chromosome.
- Transposable elements : Charateristics and types.
- Single nucleotide polymorphisms and its significance.

Suggested reading Material :

- DeRobertis, Alberts et al.: Cell and molecular biology.
- J.D. Watson, Molecular biology of the gene.
- Gerald Karp, Cell biology.
- Lewin, Genes Vol. VIII.

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M.Sc.4th Semester
Special Paper - II - ZOY - 1012 (Cell Biology - B)
Neurobiology, Ageing and immunology

Unit - 1

- Neuron, General organization and function of nerve fibers.
- Chemical synaptic transmission, Neurotransmitters and role of synaptic vesicles in nerve transmission.
- Voltage gated channels in electrically excitable membrane.
- C- AMP and calcium as second messenger and their role in cellular regulatory mechanism.

Unit - 2

- Chromatophores : Types, structure, composition and functional significance.
- Autonomic neural regulation of melanophores and colour change.
- Ageing : Theories of ageing and the current concept.
- Free radicals and age pigments (Lipofuscin and ceroids) and their significance in cellular sequence.

Unit - 3

- Apoptosis and cell death, the current concept and sequence in cellular sequence and ageing .
- Age associated neurodegenerative diseases, Alzheimer's and Parkinson's disease.
- Change of chromatin organization and enzyme activities during ageing.

Unit - 4

- Introductory ideas of innate and adaptive immunity.
- Cells and Tissues of immune system: General organization and functions.
- General structure of immunoglobulin (antibody) molecule.
- Antibody diversity (rearrangement, recombination in immunoglobulin genes).

Unit - 5

- Major histocompatibility (MHC) complex.
- Concept of humoral and cell mediated immune responses.
- Allergy, autoimmunity, Immune response genes and AIDS.
- Auto immune diseases.

Suggested Readings:

1. Lodish et al: Molecular Cell Biology: Freeman & Co, USA (2004).
2. Alberts et al: Molecular Biology of the Cell: Garland (2002).
3. Cooper: Cell: A Molecular Approach: ASM Press (2000).
4. Karp: Cell and Molecular Biology: Wiley (2002). Pierce B. Genetics. Freeman (2004).
5. D.M.Weir and John Stiwart: Immunology.
6. Kuby Immunology 8Ed. Macmillan publication.

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M.Sc.4th Semester
Special Paper Practical ZOY – 1015(Cell Biology)

- Preparation of mitotic chromosomes from rat bone marrow.
- Study of inversion/ inversion frequency from polytene chromosome of Drosophila larvae.
- Study on antigen antibody reactions : Blood group and Rh factor.
- Study of Monohybrid and Dihybrid crosses / sex linkage in Drosophila.
- Study of development (homeotic) and other phenotypic mutants of Drosophila.
- Demonstration of the unconditioned reflex action (Deep tendon reflex such as knee jerk reflex).
- Demonstration of DNA extraction from blood or tissue samples.
- To estimate amount of DNA using spectrophotometer.
- To calculate molecular weight of unknown DNA and protein fragments from gel pictures.

Marks Distribution:

Duration : 6 hours

• Preparation mitotic chromosome from rat bone marrow	10
• Preparation of polytene chromosomes to study inversions	10
• Analysis of Mono / Dihybrid / sex linkage crosses in Drosophila	10
• Experimental in immunology	10
• Calculation molecular weight of DNA from gel picture/ extraction of DNA	20
• Permanent slides preparations	05
• Viva-voce	05
• Record	05

Total **75**

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M.Sc. 4th Semester
Special Paper-I – ZOY 1007 (Applied zoology - A)
Applied Entomology

Unit - 1

- Apiculture
- Sericulture
- Lac culture

Unit - 2

- Characteristic features, biology, nature of damage and management measures of :
 - Insect pests of sugar cane : Scirpophaga, Chilo traea, Pyrilla, Aleurolobus.
 - Insect pests of cotton : Sylepta, Erias, Pectinophora, Dysdercus.
 - Insect pests of oil seeds : Mustard aphid, Sawfly, Castor Semi-looper

Unit - 3

- Characteristic features, nature of damage and management measures of:
 - Important insect pests of cereals and pulses
 - Important insect pests of stored grains
 - Polyphagus insects
 - Important general pests : Grasshoppers, locusts, termite, aphids

Unit - 4

- Characteristic features, nature of damage and control measures of :
 - house hold pests : Cockroaches, crickets, ants, wasps, silverfish, cloth and carpet beetle, furniture beetle
 - Role of insects as vectors of human diseases.
 - Pest management including mechanical, physical, cultural ,chemical , legal biological and recent trends of management

Unit - 5

- Mode of action of pesticides : Organophosphorous, organochlorine, carbamate, pyrethroids and neem products.
- Forest entomology : Its pests and control
- Forensic entomology and its importance
- Veterinary insects and their control

Suggested books

- O.W.Richards and R.G .Davies, Imms textbook of Entomology. Methuen and Co. London.
- R.E .Snodgrass, Principles of insect morphology. Tata MacGraw Hill, Bombay.
- R.M.Fox and J.W.Fox, Introduction to comparative entomology. Reinhold Publ.Corp, New York.
- R.F.Chapman. The insects structure and function(ELBS,London)
- K.K.Nayar, T.N. Ananthakrishnan and B.V.David, General and Applied Entomology. Tata MacGraw Hill, New Delhi.
- K.G.V. Smith, Insects and other arthropods of medical importance.
- H.H.Ross. A Textbook of Entomology, John Wiley and sons, New York.

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M.Sc. 4th Semester
Special Paper-I – ZOY 1013 (Applied zoology - B)
Parasitology and immunology

Unit – 1

- Morphology, life cycle, physiology ,pathogenicity , epidemiology and treatment of :
 - 1- Sarcodina: Entamoeba spp., Naegleria sp
 - 2- Sporozoa : Toxoplasma spp., Eimeria spp., plasmodium spp.
 - 3- Ciliata : Balantidium spp., Nyctotherus spp.,

Unit – 2

- Morphology, life cycle, physiology pathogenicity , epidemiology and treatment of :
 - 1- Homoflagellate : Trypanosoma spp. and leishmania spp.
 - 2- Intestinal flagellate : Giardia and trichomonas spp.
 - Opalinids : Opalina spp.

Unit – 3

- Protozoan diseases of fish : Costiasis, White spot diseases, Pimple disease
- Helminth diseases of fish : Yellow grab, white grab, blood flukes, tape worms, gyrodactylus.
- Bacterial diseases of fish : Cotton wool disease, tail and fin rot, dropsy, furunculosis.
- Viral diseases : Lymphocystis, pox disease

Unit – 4

- Application of molecular biology in parasitic diseases
- Biochemical and molecular mechanism of drug resistance in protozoan parasites
- Drug target identifications in protozoan parasites

Unit -5

- Components of immune system
- Innate and adaptive immunity to infection
- Structure and function of antigen and antibody
- Complement system

Suggested books

- Introduction to parasitology: J.D Smith
- Parasitology – T.C.Cheng
- Biology of parasites – E.J.W.Soulsbey
- Shetty Nandini Immunology Introductory Textbook. New Age International. (2005)
- Januway et.al. ,Immunobiology- the immune system in health and diseases, Garland publishing U.S.A.

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M.Sc.4TH Semester
Special Paper Practical ZOY – 1015(Applied Zoology)

- Insect collection and preservation for systematic studies.
- Identification of insects.
- Field studies of insects to understand their habit, habitat environment impact.
- Beneficial and harmful activities etc.
- Study of beneficial insects, benefits derived from them and useful products.
- Study of destructive insects, damage caused by them and damaged products.
- Study of insecticidal formulatives and insect control appliances.
- Simple experiments on insect control like C-50/LD-50, knock down and recovery.
- Effect, repellency / antifeedance tests, percentage damage tests for leaf eating.
- Study of ABO blood group.
- Study of prepared slides of protozoa , helminthes and arthropoda

MARKS DISTRIBUTION

Duration: 6 hours

• Identification of insects (5) upto orders	10
• Identification of insects (2) upto families	10
• Blood group testing	10
• Spotting	20
• Experiment on insect control	10
• Preparation of slide of parasite	05
• Record	05
• Viva voce	05

TOTAL 75

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M.Sc.4th Semester
Special Paper - I - ZOY - 1008 (Entomology - A)
Insect Taxonomy, Ecology and Development

Unit - 1

- Classification of Apterygota with distinctive feature, economic importance and example of various orders and their sub divisions.
- Classification of Pterygota up to orders with distinguishing characters and examples.
- Classification of Exopterygota up to orders with distinguishing characters and examples.
- Classification of Endopterygota up to orders with distinguishing characters and examples.

Unit - 2

- Classification of the Dictyoptera up to families with distinguishing characters, economic importance and examples.
- Classification of the Orthoptera up to families with distinguishing characters, economic importance and examples.
- Classification of the Hemiptera up to families with distinguishing characters, economic importance and examples.
- Classification of the Isoptera up to families with distinguishing characters, economic importance and examples.

Unit - 3

- Classification of the Lepidoptera up to families with distinguishing characters, economic importance and examples.
- Classification of the Diptera up to families with distinguishing characters, economic importance and examples.
- Classification of the Hymenoptera up to families with distinguishing characters, economic importance and examples.
- Classification of the Coleoptera up to families with distinguishing characters, economic importance and examples.

Unit - 4

- Social organization in insects (honey bees, termite, Ant etc.)
- Influence of climatic factors on insect populations.
- Adaptation of insects to their surroundings (aquatic, terrestrial and parasitic)
- Insects - host plant relationship.

Unit - 5

- Biotechnological methods for the control of pest and diseases.
- Insects as human food.
- Types of insect larvae, pupae and metamorphosis.
- Insect diapauses.

Suggested study material:

- O.W.Richards and R.G.Davies. Imms textbook of Entomology. Methuen and Co. London.
- H.H.Ross. A Textbook of Entomology, John Wiley and sons, New York.
- M.S.Mani. General Entomology.

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M.Sc.4th Semester
Special Paper -II - ZOY – 1014(Entomology – B)
Applied Entomology

Unit – 1

- Structure life history, significance nature of damage and control methods of following pests of sugarcane :
 - Scirpophaga (b) Chilo tracea (c) Pyrilla (d) Aleurolobus.
- Structure life history, significance nature of damage and control methods of following cotton pests :
 - Sylepta (b) Erias (c) Pectinophora (d) Dysdercus.
- Structure life history, significance nature of damage and control measures of following oil seed pests :
 - Mustard aphid (b) saw fly (c) Castor semilooper (d) linseed gall midge.
- Structure life history, significance nature of damage and control measures of following stored grain pests :
 - Sitophilus (b) Trogoderma (c) Rhizopertha (d) Tribolium (e) Bruchus (f) Sitotroga (g) Ephestia.
- Significance, life history and control measures of following general pests.
 - Grasshoppers (b) Locusts (c) Termites (d) Aphids (e) Hairy caterpillars.

Unit – 2

- Household pests (Cockroaches, Crickets, Ants, Wasps, Silverfish, Cloth with carpet beetle, furniture beetle, book lice, cigarette beetles and their control.
- Role of insect as vectors of human diseases.
- Mosquitoes as pests of public health importance and their control.
- Housefly : A human health hazard and its control.
- Live-stocks pests and their control.

Unit – 3

- Beneficial activities of insects.
- Apiculture
- Lac Culture
- Sericulture
- Types and significance of entomophagous Insects.

Unit-4

- Detailed information and classification of insecticide and their mode of action.
- Merits and demerits of chemical insecticides and development of resistance against them.
- Biological pest control.
- Different measures of insect pest control and integrated pest management.

Unit – 5

- Forest entomology and its pests and control measures.
- Forensic entomology and its importance.
- Veterinary insects and its control.
- Medical entomology.

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Suggested study material:

1. O.W. Richards and R.G. Davies, Imms textbook of Entomology. Methuen and Co. London.
 2. R.E. Snodgrass, Principles of insect morphology. Tata MacGraw.Hill, Bombay
 3. R.M. Fox and J.W. Fox, Introduction to comparative entomology. Reinhold Publ. Corp, New York.
- K.G.V. Smith, Insects and other arthropods of medical importance.
 - H.H. Ross. A Textbook of Entomology, John Wiley and sons, New York.
 - M.S. Mani. General Entomology.

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M.Sc.4th Semester

Special Paper practical- ZOY-1015 (Entomology)

- Insect Collection and preservation for systematic studies.
- Identification of different insect up to orders.
- Identification of insect up to families of economically important orders as studied in theory course.
- Identification of insect up to species: Mosquitoes, honeybees and stored grain beetles..
- Field studies of insects to understand their habit, habitat environmental impact, beneficial and harmful activities etc.
- Study of beneficial insects, benefits derived from them and useful products.
- Study of destructive insects, damage caused by them and damaged products.
- Study of insecticidal formulatives and insect control appliances.
- Simple experiments on insect control like LC-50, knock down and recovery effect, repellency / antifeedance tests, percentage damage tests for leaf eating insects, and stored grain pests.

Scheme of Examination

Duration : 6 Hours

• Identification of insects (10) upto orders	10
• Identification of insects (5) upto families	10
• Identification of insects of special upto species	10
• Spotting related to applied entomology	10
• Experiment on insect control	10
• Viva-voce	05
• Record/collection	05
• Seminar / Excursion/Field Trip	15

Total 75

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