

SANT GHIRA GURU VISHWAVIDYALAYA SARGUJA AMBIKAPUR (C.G.)



CHOICE BASED CREDIT SYSTEM
(CBCS)
2018-19

Syllabus

Master of M.Sc.Zology



ZOOLOGY
SANT GAHIRA GURU VISHWAVIDYALAYA
Sarguja Ambikapur (C.G.)

CHOICE BASED CREDIT SYSTEM
(CBCS)

Master of Science
In
Zoology Syllabus

SEMESTER SYSTEM
SESSION 2018-19



For Affiliated Colleges of
SANT GAHIRA GURU VISHWAVIDYALAYA
Ambikapur (C.G.) -497001

SANT GAHIRA GURU VISHWAVIDYALAYA SARGUJA, AMBIKAPUR (C.G.)

SANT GAHIRA GURU ORDINANCE 46: MASTER DEGREE (P.G.) PROGRAMMES

PROPOSED DRAFT ORDINANCE 46:

O.M.D.1.: This Ordinance shall be called "The Sant Gahira Guru Master Degree (Semester Study) Programme with Choice based Credit System.

O.M.D.2.: This Ordinance shall come into the force from the Academic Semester 2017-18.

Notwithstanding anything in the earlier laws of the Sant Gahira Guru Master Degree Programmes in the different faculties (*Ayurveda, Commerce, Education, Fine Arts, Law Life Sciences, Medicine, Management, Science & Social Sciences*) under the "semester system", the "Semester with Choice based Credit System" shall be regulated and conducted as per the provisions of this ordinance.

O.M.D.3. Definitions:

In this Ordinance, unless the context otherwise requires:

- a. "**Academic Council**" means Academic Council of the University.
- b. "**Administrative Grade Letter**" means the alphabet indicating the administrative comment in place of Grade Letter to indicate the Credit Withdrawn (W), Unfair Means (U), Absent in SEE (X). The Administrative Grade Letter has zero Grade Point associated with it.

- c. **"Board of Studies"** means PG Board of Studies in any subject constituted under the university statutes.
- d. **"Core Course"** means the course pertaining to main subject or theme of the master programme.
- e. **"Credit"** means the unit by which the academic activity of course work is measured. In these Regulations, One Credit means one hour of Class Room Teaching per week in case of theory papers and 1.5 hours in practical / laboratory work.
- f. **"Credit Courses"** means the course classified as Compulsory Core Courses(CCC), Elective Core Courses(ECC), Seminar (SEM), Project Work(PRJ), Field Study(FST), Self Study Course(SSC), Other Supportive Courses(OSC), Educational/Study Tour (EST) and Research Publications (RPJ).
- g. **"Credit Monitoring"** means an act to monitor the credit by a Credit Monitoring Committee (CMC) consists of the Head (as Chairperson) and three senior most teachers on the Roll of the Department. In case, when the Department does not have the required number of the teachers in the department than the Vice chancellor may constitute the said committee by nominating the number of expert(s) required by the Ordinance from any other university or institute who are not below the post of Professor.
- h. **"Credit Points"** means the product of 'credits assigned to the course' and 'the Grade Point secured for the same course by the student'.
- i. **"Semester Grade Point Average (SGPA)"** means the Semester Grade Point average computed on the basis of the formula prescribed in the ordinance. It measures the performance of a student in a given Semester. The SGPA is the ratio of the 'total credit points earned by the student in all the credits earned in the concerned semester' and the 'total number of credits earned in that Semester'.

- j. **"Cumulative Grade Point Average (CGPA)"** means the Cumulative Grade Point weightage average of SGPA computed on the basis of the formula prescribed for the entire Programme. It measures the overall performance of a student in a Master degree programme. The CGPA is the ratio of the 'total credit points earned by the student in all the credits earned in the Master degree programme' and the 'total number of credits earned in that Master degree programme'.
- k. **"Degree"** means Post Graduate Degree in any subject.
- l. **"Departmental Staff Council (DSC)"** means a Council of the Department consisting of its whole time faculty which falls in the category of teacher. The DSC will be empowered to consider and decide the academic matters, as specified in Master Degree Ordinances and Regulations.
- m. **"Elective Course"** means the course, which can be offered as 'optional subject' to the provisions of this Ordinance and the respective syllabus from inter or intra subjects and or disciplines including interdisciplinary or multidisciplinary nature.
- n. **"Fee"** means the fee prescribed by the University for the respective Master Degree Programme from time to time.
- o. **"Grade Letter"** means the alphabet indicating the performance of a student in a particular course. It is the transformation of the scaled marks secured by the student in a Course. Grade letters are O, A, B, C, D, E, and F.
- p. **"Grade Point"** means the numerical weightage allotted to each stratum of scaled marks corresponding to each 'Grade letter'.
However, the "Administrative Grade Letter" as defined will represent the categories mentioned in the OMD.3 sub clause 'b' of this ordinance.

- q. **"Master Degree Programme"** means a Masters Degree Programme in any subject studied at Master degree level under any faculty of the University.
- r. **"Semester End Examination (SEE)"** means the examination due to be conducted after the end of the respective semester.
- s. **"Semester"** means an academic term constituting 20(twenty) weeks. Each semester shall have at least 15 (fifteen) weeks of direct class room teaching. The Academic Year shall be of bi-semesters. Odd Semesters shall be normally from mid June to mid December and Even Semesters shall be from mid December to mid June.
- t. **"Student"** means student admitted to Master Degree Programme in any subject being run under the University Ordinance and Regulations.

O.M.D.4.Course Structure:

1. A Master Degree programme shall consist of the duration of at least two academic years consisting four semesters. A candidate will be required to complete this programme within 4 years from the date of his/her first admission in the semester - I.

Provided that subject to the approval of the UGC Regulations, when the Master Degree Programme is of one academic year and spreads in the two academic semesters then the study has to be completed within a period of two years from the date of admission in the Semester - I.

2. Subject to the provisions of this Ordinance the programme/study shall be based on (a) Semester System Examination, (b) Continuous Assessment, (c) Choice Based Credit System, and (d) Semester Grade Point Average and Cumulative Grade Point Average Systems.

3. **"Core Course"** means a 'course/subject', the knowledge of which is considered essential for a student of the respective programme. This may also include elective courses.
4. **"Elective Course"** allow students to acquire knowledge and skills in areas of their choice. Such course(s) may be offered by concerned department and / or other departments within the university. This may be inter or/ and intra department/institution subject to the approval by the university.
5. The Course of respective Master Degree Programme shall have following (i) Course Code(CC), (ii)Course Title (CT), (iii) Course type such as Compulsory Core Courses(CCC), Elective Core Courses(ECC), Seminar (SEM),Project Work(PRJ), Field Study(FST), Self Study Course(SSC), Other Supportive Courses(OSC), Educational/Study Tour (EST) and Research Publications(RPJ) (iv) Credits Assigned, (v) Number of Contact Hours for Lecture(L), Tutorial (T) and Practical or other (P) to be assigned per week.

S No.	Course Code	Course Title	Course Type	Credits	Contact Hours Per week		
					L	T	P

6. Fifteen (15) hours of theory teaching will lead to one credit(which means one hour per week theory teaching in a semester is equivalent to one credit) and in case of practical 45 hours of laboratory work will lead to two credits (Which means 3 hour practical classes per week in a semester is equivalent to two credits). Each semester of Master's course shall offer 30 credits or more. Number of semester of Examinations and minimum credit required to be earned for Master Degree in various post-graduate courses specified as under:

S No.	Course Code	Number of Semesters	Minimum Required Credit
1.	All Two Year Master Degree Programme	Four	120
2.	All One Year Master Degree Programme	Two	60

Note: The curriculum may be described in the syllabus in form of 'Courses' or 'Papers'. The number of papers, course type and credits with detailed syllabus for each course shall be described in the 'syllabus of the respective course'. Candidate will be required to earn minimum credits prescribed for the respective Master Degree.

7. Each course shall be assigned a specific number of credits. A course or paper is identified by a course code designated by a string of six alphanumeric characters and a course title. In a course code the first three characters of the string indicate the Department offering the course and the later three alphanumeric characters designate a particular course. In the case of compulsory core courses (CCC) the fourth character identifies the semester numeric digit and in case of the elective core courses (ECC) the fourth character indicates the cluster of specialization. For compulsory theory core courses the fifth character is '0', for laboratory core courses it is '1' and for project/seminar it is '2' and for research publications in journals it is '3'.

The examination shall comprise of the requirement of four (in case of one year course two) semesters and the Subjects for each semester will be as per the schedule of the structure of the Master Degree Programme with the particulars mentioned therein.

8. CBCS offers flexibility for effective teaching learning processes in terms of number of contact hours for Lecture (L), Tutorial (T) and Practical or other (P) to be assigned per week for a course or paper.

9. Type of courses

There shall be following categories of courses in the MASTER DEGREE Regular Programme:

9.1. Compulsory Core Course (CCC)

- A course, prerequisite for a student to obtain the Degree in the concerned Programme.

9.2. Elective Core Course (ECC)

- A course, which is to be chosen by the student from a pool of courses offered by the Department.

9.3. Other Supportive Course (OSC)

- Subject to the availability of the course and provisions of university rules, a student admitted in a Master Degree Programme shall have option to offer **Other Supportive Courses** including Interdisciplinary (ID)/Multidisciplinary (MD) course/s offered by a Department/cluster of Departments. For formation of a cluster, two or more Departments shall come together for offering ID/MD courses depending on their available expertise and infrastructure. The Departmental Staff Council (DSC) shall be competent to decide the nature and scope and number of such courses to be offered by the concerned Department in collaboration with other Department/s.

9.4. Self Study courses (SSC)

Since one of the main objectives of the CBCS is to enable the students to learn on their own. The Self Study course(s) shall be offered to realize this objective. A list of Self Study course(s) shall be designed by different faculty of the Department and after the approval of the DSC, the course(s) shall be made available to the students for self study. Such a course(s) shall have advisory academic support of the faculty, who proposed the course, and the same faculty shall evaluate the student at the end of the semester for a Course Report of 50 marks and a viva voce examination of 50 marks. The number of credits that can be earned in a semester in SSC shall be limited to 4.

9.5. Seminar (SEM):

The aim of the seminar is to give students an exposure to recent developments and advance topic of research interests. The seminar preparations can be undertaken only after the prior approval of the CMC of the Department. The CMC will allot Seminar Credits on merit basis out of desiring students. The said preparations will be undertaken under the guidance and supervision of a teacher of the parent department. No teacher will be allowed to guide more than three students at a time in a semester. The guiding teacher will make continuous internal assessment of the seminar. At the end of the 'Semester End Examination' the seminar will be conducted and credits will be awarded by a Board of three examiners consisting of the Head of the Department, guide and one faculty member other than a guide.

9.6. Project Work (PRJ) or Field Study (FST):

The aim of the Project Work or Field Work is to introduce students with the research methodology in the subject and to prepare them for pursuing research in theoretical, experimental or computational areas of the subject. The Project Work or Field Study has to be conducted under the guidance of a teacher of the concerned department or a scientist or any other suitable person with proven research excellence in the concerned field of study. One can conduct the Project Work or Field Work in an outside institution of national or international repute on the prior approval by the CMC of the department concerned.

The CMC will allot the Credits Project Work or Field Study to the desirous depending on their capacity and subject to the availability of the resources on the basis of their merit. The guiding teacher will make continuous

assessment of the Project Work or Field Study of a candidate under his/her supervision. SEE for the said Project Work or Field Study will be held at the unit where the study has been under taken by a Board of three examiners consisting of the concerned Head, Guide/Supervisor and one other senior faculty.

9.7. Education Study Tour (EST):

Subject to the provisions of the syllabus of the concerned Master degree Programme, the concerned Department may arrange educational tour/study tour. It will be compulsory on the part of student to join the same and on completion of tour; he/she will be required to submit its report to the University Department. The time spent for the purpose will be considered for computation of attendances in the respective semester/term. The Department may design & arrange the educational tour considering nature, scope & requirement of the respective subject. The requirement of the tour has to be incorporated in the respective syllabus. The university will determine the university contribution for tour for each student and escorting staff by administrative decision approved by the Finance Committee.

9.8. Research Publications in Journals (RPJ):

One research publication as a coauthor in a journal above impact factor 1.0 will be assigned two credits and that in other ISSN bearing journals will be assigned one credits.

10. A Master Degree study is a regular fulltime programme. Therefore, no student admitted in the said programme will be allowed to join any other programme of study during this period. This will be obligatory for the student to ensure that he has not sought admission in any other programme during this period.

O.M.D.5.Admission:

1. A candidate, who has passed Bachelor Degree programme in the concerned subject/discipline from this university or any other university established by law and recognized by the Sant Gahira Guru for the purpose of admission in the Master Degree programme of this university shall be eligible to apply for admission in the respective Master Degree programme of this university.
Provided further that a candidate, who has passed Bachelor Degree programme from the Faculty of Arts/Social Science shall be eligible to submit his candidature for any subject of the Master degree programme(s) of the said faculties except the Master degree programme in Mathematics run under the same faculties. A candidate can apply for Master Degree in Mathematics only when he has passed Bachelor degree with subject of Mathematics either from Faculty of Social Sciences/ Science.
2. The University may prescribe further stipulation with respect to minimum qualifications subject to the approval of the Academic Authorities of the university.
3. The University may prescribe different qualifications for different courses.
4. The admissions shall be granted strictly on the basis of the merit list.
5. The Department/ University may with the previous permission of the Vice-Chancellor (including the approval of the scheme entrance test/examination), hold entrance test and /or Oral examination for admission in the respective Master degree programme of the department.
6. In case when the Department conducts Entrance Test and/ or Oral Test, the university will give at least "Fifty per cent" weightage to the marks obtained by the candidate at the concerned qualifying examination.

7. It will be obligatory for the authorities involved in the admission process to strictly observe the reservation policy in admissions formulated time to time by the Union Government or State Government, UGC, Rehabilitation Council and adopted by the University. The data based information in this regard has to be provided to the university within a period of 15 days after the completion of the admissions in the respective degree.
8. Admitting authority shall have to prepare and publish the merit list in the two fold as mentioned below:-
 - (i) Candidates, who have passed the qualifying examination indicating category against each of the name in the last column such as General/S.T./S.C./S.E.B.C./Physically Challenged/Women etc.
 - (ii) Candidates, who have passed the qualifying examination from a foreign university.
9. Admission granted by the University/Department to any student shall be provisional till the enrolment/registration/enlistment is made by the University. When the admission is granted on the bases of provisional eligibility certificate, the conditions & instructions given by the University should be complied within the time limit fixed by the University or latest by the beginning of next semester otherwise, term kept by such students will be forfeited and no fees on any account will be refunded.

O.M.D.6.Medium of Instruction and Examinations :

1. English or Hindi shall be the medium of instruction & examination.
2. No student shall be allowed to change the medium to appear in the examinations once he/she has opted any medium for particular Semester.
3. No student shall be allowed to opt or write papers with two different medium in one examination.

4. Notwithstanding anything in this ordinance the University may declare English as compulsory medium for instructions and/ or examinations for any Master Degree Course keeping academic considerations in mind

O.M.D.7.Mandatory Requirement of Attendance to appear in Examination:

1. The Choice Based Credit System (CBCS) Programme of the University is a comprehensive and continuous evaluation programme .Therefore; no students shall be allowed to appear in the examination unless he has at least 75% (seventy five per cent) attendance separately in all the papers/courses.
2. The respective term/ semester of the student shall be liable for rejection in case the attendance is short in any paper/subject due to the reasons, whatsoever.

Provided that the Vice chancellor may on the medical ground condone the requirement of attendance not exceeding 10% (ten percent) short to the required minimum attendance on the recommendation of the Head of the concerned Department that the illness was of such a serious nature (recorded by the doctor treating him/her) that it was beyond his or her control to attend the classes during the said period. The production of false certificate in this regard will be a ground for rejection from the Master degree programme and criminal action.

Provided further that the Vice chancellor may on any other reasonable ground condone 5% (five per cent) attendance lesser than to the required 75% (seventy five per cent) to his satisfaction on the recommendation of the concerned Head of the Department.

3. A student, who represented the university/ institution/ Department/Centre/ State or Nation in Sports, N.C.C., N.S.S., Cultural or other Activities conducted and / or sponsored officially by such institution(s) or agencies shall be entitle to

relaxation of ten percent in the attendance required for the purpose. Such cases should also be recommended by the concerned Head before he/she proceeds for leave and forwarded his application with appropriate documents to prove his participation. Submission of his case without prior permission will not be considered in any case.

Explanation: The University in no case will grant relaxation in attendance to a student, separate or combined on all the heads mentioned in O.M.D. 7 exceeding 15% (fifteen percent). Therefore, no candidate, who does not have 60% (sixty) or more than 60% (sixty per cent) attendance, will not be allowed to appear in the examination for reasons and grounds whatsoever.

O.M.D.8. Advisory for Students:

- 1: Each Department shall develop 'Advisory Mechanism' to address complex nature of the issues including advice to elect the course(s) from the category of elective courses.
2. Each Department will appoint Advisors in appropriate number required for the purpose.
3. The Department may Prepare "Student Hand Book" containing the detail of the courses available at the Department. This includes both the 'Core' and 'Elective Course (s)'.
3
4. A student subject to the availability of the elective courses will be required opt course(s) and submit his 'Option in writing' in triplicate on the prescribed 'Performa' for his registration in the concerned semester to the Head of the Department immediately after the commencement of the respective semester; i.e. on or before the last date notified by the concerned department.
3

5. The last date for registration and permission for election of subject should not exceed more than two weeks after the commencement of the semester.
6. A student may be permitted to withdraw from his registration from two weeks from the date of the registration.
7. A student may be permitted to withdraw from/change the elective subject opted by him after the allocation. However, he/she will not be allowed to withdraw/ change the same on or before the last date fixed for exercising his/her option to opt the same. Provided further that no student will be allowed to withdraw or change the option, who has been allowed for late registration/permission or entry.

O.M.D.9. Semester Schedule:

1. A Semester shall consist of the duration of Fifteen weeks (90 working Days)
2. First Semester of each Academic year will commence from July 15th of every Academic year.
3. Mid-academic year Semester(s) will commence on the stipulated date notified by the university or within in a period of seven days after the completion of the examination of the preceding semester for those students, who fall in this category can seek provisional admission.
Their admission will be regularized within a period of seven days after the date of the declaration of the result of the said semester.

O.M.D.10. Examination Schedule:

1. **Proposed Time of Examinations:** The examinations of the "Even Semester(s)" shall commence in the month of May in case of "Odd Semester(s)" it may commence in the month of December.

2. **Examination Application:** A candidate shall be required to apply on the prescribed 'Examination Application Form' for the 'Semester End Examination' to the Registrar/Dean/ Controller of Examinations through the Head of the concerned Department.
3. 'Examination Application Form' must consist with following particulars and certificates signed by the appropriate authorities:
 - (a) Candidate has attended minimum number of lectures etc. in respect of all the Courses.
 - (b) Statement of 'No due Certificate' with regard to all the dues including the fee due on all the heads.

O.M.D.11. Salient Features of the Choice Based Credit System:

1. PG Departments of the different Faculties of the University shall design the Semester based Choice Based Credit System (CBCS) for Master Degree programme. Students will be provided choice to select courses offered by the respective Department of the same faculty or any other Department of the same or any other Faculty, depending on his/her interest, needs and long term goals as well as the feasibility in terms of the available expertise and infrastructure at the Department level.
2. Each PG Department shall design and offer courses after the due consideration and approval of the **Departmental Staff Council (DSC)** and concerned authorities of the University.
3. **Composition of the DSC:** The DSC shall consist of all the regular faculty of concerned Department and the Head of the Department shall chair it. The DSC shall recommend to the Vice chancellor for approval the constitution of "Credit Monitoring Committee (CMC)", which consists of the Head of the Department and three senior most teachers of the

department. The Department having the faculty strength of less than three (including HOD) shall co-opt maximum up to two members of the rank of Professor of the same subject from other Universities with the permission of the Vice-Chancellor. The Vice chancellor shall have prerogative to drop, alter or substitute any name suo moto or on the further recommendation of the same. In the absence of the HOD, the DSC/CMC shall be chaired by the next senior faculty member of the concerned Department.

4. Registration of candidates in first and subsequent semesters after the last date will not be permitted. For subsequent semesters, no minimum credit earning criteria will be applicable. Credit registration at least once in all Compulsory Credit Course shall be binding. However, earning all CCC credits for accumulation of the prescribed minimum credits shall not be required.
5. A student shall be evaluated through CCA (Comprehensive Continuous Assessment) and Semester End Examination (SEE). The distribution of marks between the CCA and the Semester end examination shall be in the ratio of 30:70. Each paper/ Course shall consist of 100 marks. However, the Programme governed by the provisions of different Councils in case of inconsistency shall be exempted from this requirement.
6. The candidate will be required to finalize the number of credits at the time of the registration in the semester and no change will be permitted after seven days of the commencement of the semester. The CMC of the concerned Department will forward the credits registration detail of all the students enrolled in the semester. The prior approval of the CMC will be essential and its decision shall be final and binding.
7. Each course shall be assigned a specific number of credits.

8. The marks obtained by a student in a course shall be converted into Grade Points and Credit Points based on scale-normalized marks. The performance of a student in a Semester shall be expressed as Semester Grade Point Average (SGPA) and the combined performance of a student in all the semesters of the Master degree programme shall be expressed as Cumulative Grade Point Average (CGPA).

9. The Department is under obligation to arrange all Compulsory Core Courses and the special number of Elective Core Courses so that the students enrolled for the course can complete/obtain prescribed minimum number of credits. However, it will not be at all obligatory for the department to make provision for all the Elective Core Courses. Department can add, remove or substitute any course and course both in the Core and/ or Elective Course(s).
10. There will be no provision to conduct supplementary, due paper of special examination for any examination. Students with 'F' or 'E' Grade will be provided an option to re-register themselves in the said course subject to their desire as 'Self Study Course' or in a 'Regular Course' subject to the feasibility and availability of the resources in the department. The credit earned will not be considered in any case if the candidate has not re-registered and the same has not been approved by the CMC of the department at the time of the registration in the respective semester.

O.M.D.12. Credits: Weightage and Distribution:

1. The term 'Credit' refers to the weightage given to a course and means the unit by which the academic activity of course work is measured. In these Regulations, One Credit means one hour of Class Room Teaching per week in case of theory papers. For a theory course of 6 credits, 6 'contact hours' per week will be assigned in time-table and thus in a semester 90 contact hours will be assigned to a 5 credit course.

2. The minimum number of credits to be earned for a degree will be 30 times the number of semesters specified in the syllabus for the degree. For example for a two year four semester course the minimum numbers of credit to be earned will be 120. In case where a candidate earned more than the minimum number credits specified, the best credits upto minimum number of credits will be considered for CGPA. However, the total credits for different courses may be different subject to the nature and design of the course concerned and norms formulated by the regulatory authorities.
3. **Distribution of Credits:** Ordinarily, all semester shall have uniform distribution of credits.
4. **Credit Card:** Every department will be under an obligation to maintain academic credit card on the prescribed Performa developed and provided by the University Examination Department for students. The Credit card shall be issued to the students before the commencement of the next semester and a student will be under the obligation to attach the copy of the same with the application for registration as student in the next semester. The department will prepare two copies of the Credit Card one each for the student and for the office record of the department.

O.M.D.13. Assessment and Evaluation:

1. The CBCS is student centric not only in the teaching-learning processes but also in their evaluation process. In CBCS, the evaluation process is divided into two parts. The first part consists of Comprehensive Continuous Assessment (CCA) and the second part consists of the Semester End Examination. The division of marks between the two shall be as per the provisions of this ordinance in ratio 30:70. In the CBCS, the evaluation process shall follow the norm that the faculty, who teaches the course, shall conduct the

Comprehensive Continuous Assessment (CCA) and the Semester End Examination (SEE). The concerned faculty shall be accountable for transparency and reliability of the entire evaluation of the student in the concerned Course.

2. The comprehensive continuous assessment and evaluation (based on the performance of the student) process in CBCS is in continuous model is conducted for the purpose to bring periodically in to the notice of the candidate about his/her progress. The assessment is divided into four discrete components for reporting the scores to the student as earned by him/ her. The CMC shall announce policy for CCA for all the courses in the Department in the beginning of the Semester and the same shall be communicated to the students.
3. The details of the Comprehensive Continuous Assessment and Semester End Examination are summarized in the Table below:

Component	Unit covered in a Course/Paper	Mode of Evaluation	Weightage in Percentage	Marks	Period of Continuous Assessment
CCA-I	First 30%	Assignment/Field-Project Study/ Tour	10%	10	First part of the Semester. *Completed by the Fifth(5 th) Week.
CCA-II	Succeeding 30%	Seminar Presentation	10%	10	Second part of the semester. *Completed by the Tenth(10 th) Week.
CCA-III	Remaining 40%	Written/MCQ Test	10%	10	Third part of the Semester. *Completed by the Fifteenth(15 th) Week.
CCA-Sub Total			30%	30	
SEE	100%	Semester End Examination	70%	70	To be completed between 18 th - 20 th week of the Semester.

4. The marks/ grades awarded for the continuous assessment shall be notified to the students within a period of ten days from the date of the completion of the assessment. In case a student fails to secure 12 out of 30 in the CCA (all three components taken). He/she shall not be allowed to appear for the Semester End Examination.
5. Students may seek clarifications within period of a week from the date of the notification of the said result. No clarifications will be entertained after the expiry of the said period.
6. The Department will constitute a committee consists of three members and the Head will be the ex officio chairperson of the Committee to supervise the whole Examination Process.
7. The marks awarded by the teacher(s) are shall be kept confidential unless moderated and approved by the CMC/Dept. Examination committee constituted for the purpose. The Committee shall be under consideration to maintain the standards of the evaluation.

O.M.D.14. Semester End Examination:

1. Semester End Examination shall be conducted between 18th - 20th week of the semester.
2. The duration for per course shall be of three hours for theory courses and four hours for practical/laboratory courses, and half hour for seminar, project work or field study presentations.
3. Question papers for Semester End Examination shall be set keeping in mind to examine the candidates' creativity, comprehension, problem solving capacity, application side of the subject, interpretation and awareness capacities. It should not be expected from the students to reproduce the answers by memorizing the answers.

4. Paper Setting:

- 4.1.1. The question paper for the end-semester examinations for each course shall be set by the paper setter appointed for the purpose. It shall be the responsibility of the paper setter to ensure that the syllabus for the course is adequately covered in the question paper.
- 4.1.2. The questions may comprise; objective type, short notes, Descriptive or any other types as per the policy developed and designed by the department and approved by the competent academic authorities of the university and notified in advance. The University may retain the earlier pattern of setting papers which includes the requirement of 10/8 questions and students may be provided with choice to answer respectively 5/4 questions. The maximum marks of SEE shall be 70. All questions shall carry the marks mentioned in the paper.
- 4.1.3. The answer scripts for End-Semester Examinations shall be evaluated preferably, by the respective paper-setters and or the mechanism developed by the university.
- 4.2.1. **Appointment of paper-setter/examiner:** The Boards of Studies in each subject shall draw a panel of paper-setters/examiners ordinarily in the month of August every alternate year and forward the same to the Academic Council which shall approve the panel of Paper-Setter/Examiner. While drawing the panel, the Chairman of the Board of Studies shall take into consideration the confidential aspect of the assignment.
The Vice chancellor if present preside the meeting of the Board but will not cast his vote. In his absence the
 - Chairperson of the Board will preside the meeting.
 However, the University may constitute group of teachers to set the paper through workshop method.
 Provided further that the university may develop question bank with the help of examiners appointed subject to the provisions of this ordinance.

4.2.2. A person to be appointed as a Paper –Setter must be a full time teacher of the University/Colleges having at least 3 years Post Graduate teaching experience.

4.2.3. However, in exceptional circumstances, the Vice-Chancellor may relax the condition of experience and or alter or remove any paper setter.

4.3.1. Moderation Board and moderation of Question Papers:

There shall be a Moderation Board for each subject/programme of study, and it shall consist of-

- a) Dean of the School concerned
- b) Head of the concerned Department,
- c) Two senior teachers nominated by the Head of the Department/ Departmental committee recommended by the Dean of school and finally approved by the Vice Chancellor.

4.3.2. The functions of the Board shall be:

- a) To ensure that the question paper has been set strictly in accordance with the syllabus and instructions given by the University covering broad areas adequately.
- b) To delete question(s) set from outside syllabus and to make necessary substitution, if required.
- c) To remove ambiguity in the language of question, if any,
- d) To moderate the questions properly giving ample opportunity to candidates of both average and exceptional capabilities,

e) To ensure proper distribution and indication of marks for each question or part or parts thereof, time prescribed for the paper and to correct errors, if any, in this regard.

f) To bring to the notice of the Controller of Examinations lapses or omission on the part of the Paper-Setter, if any.

4.4. Evaluation:

1. The CBCS is student centric scheme, not only in the teaching-learning processes but also in the evaluation process.
2. In CBCS, the evaluation process is divided into two parts. The first part consists of Comprehensive Continuous Assessment (CCA) and the second part consists of the Semester End Examination.
3. The division of marks between the two shall be as per the provisions of this Ordinance i.e. the CCA will have a weightage of 30 and SEE of 70 out of 100.
4. In the CBCS, the evaluation process shall follow the norm that the faculty, who teaches the course, shall conduct the Comprehensive Continuous Assessment (CCA) and the Semester End Examination (SEE) and the concerned faculty shall be accountable for transparency and reliability of the entire evaluation of the student in the concerned Course.
5. In Comprehensive Continuous assessment and Semester End Examination evaluation for each course shall be carried out on the basis of performance of students.
6. Continuous Assessment means 'internal assessment tests' or 'sessional tests' and end-on semester means theoretical or practical laboratory examinations along with

Project work/Field study/Educational Tour or preparation of dissertation or Term paper.

- Each course shall carry credits as may be prescribed by Board of Studies time to time in the syllabus. The weightage assigned to 'Continuous Assessment' and 'Semester End Examination' shall be taken into the consideration for the purpose of determining the grade obtained by the student in a course,
- Grade point shall be calculated for each course in 10 point scale system on the basis of total marks obtained in CCA and SEE.
- The Vice chancellor on the recommendation of Board of studies and approved by the Academic Council shall appoint Paper Setter-cum Examiner or constitute Board of Examiners for each course of study subject to the provisions of this Ordinance.
- The Semester End Practical Examinations shall be jointly conducted by an external and an internal examiner.

O.M.D.15. Result Preparation:

- The final result of the examination shall be prepared on the basis of 'comprehensive continuous assessment' and 'semester end examination' along with credits earned by the respective student.

The results after computation and tabulation shall be placed before the Vice Chancellor for approval after it has been moderated/scrutinized by a Board consisting of the Head of the concerned Department and not less than two faculty members appointed by the Dean.

2. Grade Assignments:

The grades in a course will be assigned on the basis of combined marks obtained in CCA and SEE. The total of maximum marks in CCA and SEE shall be 100 in all courses with a weightage of 30% to CCA. The letter grades and points will be assigned as per table given below.

Total Marks of CAA and SEE	Grade	Grade Definition	Grade Point
90<X<=100	O	Outstanding	10
80<X<=90	A	Excellent	9
70<X<=80	B	Very good	8
60<X<=70	C	Good	7
50<X<=60	D	Fair	6
39<X<=50	E	Average	5
Les than 40	F	Failed	0

- Credit Point Assignments:** Credit points earned in a course will be equal to product of Credit assigned to the course in the syllabus and grade point earned by the student on the basis of combined score in CCA and SEE.

4. Grade Card and /Mark sheet:

The University will issue the 'Grade Card' and "Mark Sheet" at the end of each semester to each student registered for the respective course from the examination. The Grade Card shall consist of at least the following particulars:

Basic Details: i. Name of the Student. ii. Father's Name. iii. Roll Number. iv. Enrolment / Registration / Unique Number.

Performance Details: For each course i. Course Code. ii. Course Title, iii Course type, iv. Credit of course, v. CAA marks, SEE Marks, Total Marks, Grade Point, Credit Point

Summary Performance Details: i. Total credit points earned in the semester, ii. Total credit earned in the semester, iii. SGPA, iv. Credit earned in Previous Semesters and v. CGPA (calculated till the end of current semester)

5. Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA) will be calculated on the credit weighted average of the grade points obtained as given below.

$$CGPA = \frac{\sum_{i=1}^n C_i P_i}{\sum_{i=1}^n C_i}$$

Where

C_i : Number of credits earned in the i^{th} course of Semester for which SGPA is to be calculated.

P_i : Grade Point Earned in i^{th} course

i : 1, 2, ..., n represents the number of courses in which a student is registered in the concerned semester.

$$SGPA = \frac{\sum_{i=1}^n C_i P_i}{\sum_{i=1}^n C_i}$$

Where

C_i : Number of credits earned in the i^{th} course of Course till date for which CGPA is to be calculated.

P_i : Grade Point Earned in i^{th} course

i : 1, 2, ..., n represents the number of courses in which a student is registered in the concerned semester.

6. The Cumulative Grade Point Average (CGPA) of all the courses after completing the programme or all semesters at the final stage of study shall be awarded in the Final Cumulative Grade Card. The Final Grade of the Master degree programme will be assigned on the basis of Final CGPA as per table given below.

CGPA	Letter Grade	Classification
9.00 to 10.00	O	Outstanding
8.00 to 8.99	A	Excellent
7.00 to 7.99	B	Very good
5.50 to 6.99	C	Good
4.50 to 5.49	D	Fair
3.60 to 4.49	E	Average
0 to 3.59	F	Failed

7. Equivalent Percentage of marks may be computed as ten times of CGPA. The candidates with CGPA equal to or higher than 5.5 (Letter Grade C) will be considered with good academic record and shall be treated as eligible wherever the minimum percentage of 55% is specified.
8. In case of LLM examination and other cases wherever specified specifically the candidates with CGPA less than 4.8 will be declared failed.

O.M.D.16. Promotion Rules:

- a) A candidate is eligible to continue the classes of next semester immediately after the examinations of one semester is over and he/ she can appear the next semester examination with any number of back/arrear papers.
- b) A candidate shall have to appear in 1st semester examinations to be eligible for promotion to 2nd semester. If and student could not appear or apply for 1st semester examination then he/she must have to take re-admission in 1st semester afresh.
- c) A candidate may get chance to clear the all courses double the duration of the course of study .i.e. for 2 year course within four years, for 3 year courses within 6 years, for 4 year courses within eight years and for 5 year courses within ten years.

O.M.D.17.: When a candidate at a 'University Semester End Examination' fails to obtain minimum marks for passing in a particular courses he/she will be required to reappear in that

course without keeping term for that semester. The candidate will have to reappear in the semester end examination by paying fresh examination fee along with an application form. Such candidate, when obtains minimum or more than minimum marks for passing in the course, his/her actual marks of reappearance will be carried forward for award of class/CGPA.

O.M.D.18. RANKS:

First and Second Ranks will be awarded after completion of the course of study at the end of the final semester examination on the day of publication of final results.

On the basis of Average percentage of results as declared and on this basis of CGPA, Ranks will be awarded to the candidates in a subject.

O.M.D.19. General Guidelines:

- i) There will be no provision for repeat of betterment i.e. scope for appearing and paper again for obtaining better result.
- ii) If a candidate after admission in first semester could not continue the classes or could not obtain eligibility to get admission in first semester examination then he/she is to get re-admission in first semester again as fresh and he/she will not be allowed to continue study in other semester.
- iii) Candidates should be registered under Sant Gahira Guru, within 3 months of study, if not obtained earlier. The conditions for obtaining Registration must be followed as specified in the Application form. Without Registration number of Sant Gahira Guru no students will be allowed to get admission in first semester examination or 2nd semester course of study.
- iv) The dates of commencement and termination of each semester shall be as fixed by the Academic Council.

- v) It will be obligatory for the Head of Department to take appropriate measures against Ragging & Gender problems arising in the University Department. In case of occurrence of any such incident, the violator shall be dealt with very seriously and appropriate stringent action be taken by the Head of Department by observing principle of natural justice. The Head of Department may appoint a committee to inquire in to the matter which will also observe the principle of natural justice. The committee will submit its report to the head of Department who will forward the, same with his comment there upon to the University Registrar, for taking further necessary action in the matter.
- vi) Candidates must forward their applications for admission to University examination to the registrar on or before the prescribed date with a certificate of attendance duly signed by the Head of the Department along with the examination fees fixed by the University.
- vii) Thirty percent internal evaluation shall be within the exclusive purview of the concerned Head of Department which requires purity, transparency accuracy in the evaluation & assessment of students. The benefits of re-assessment scheme will not be made available to the students as regards the internal assessment.
- viii) There will be theory and practical examination if prescribed in the syllabus, at the end of the fourth semester. The viva voce examination will be conducted at the end of the fourth semester.
- ix) Subject to the provisions of University Act., Statutes, Ordinances, Rules and Regulations, the University will prepare, design and enact syllabus/prospectus for different Master Degree programmes under the different faculties time to time.

O.M.D.20.: EMPOWERING CLAUSE: Subject to the provisions of this ordinance, the University shall run Master Degree programme(s) prepared and approved by the Academic authorities of the University including the Board of Studies and Faculty of the respective subject and approved by the Academic Council and the Executive Council.

Semester Structure Table

Appendix –I

Note: The Department Staff Council may subject to the approval of the Board of Studies of the respective subject, respective Faculty and the Academy Council of the University, may by way of addition or deletion introduction of new or additional subject or amend the given scheme including the increase in the number of papers under the same code number or by inserting additional or new code numbers.

Provided further that the University may design different CBCS scheme for the different Master Degree programme depending on their nature, scope & requisites. In such situation, the scheme will be notified with semester wise detail, evaluation scheme and the syllabus of the respective subject/course.

Thus the actual semester structure table may vary for the different master degree programme. The one given below is for an example.

ABC: In tables given below ABC shall be replace by Three Letter Subject Code of the degree programme for example PHY for M.Sc. Physics.

The table assumes that six cluster A, B, C, D, E, F are available for Elective Core Courses each involving four courses labeled like A01, A02, A03, A04.

The Interdisciplinary courses are classified under OSC

First Semester Structure Table

S. No.	Subject Code	Course Title	Course Type	Credit	Contact Hours Per week			EoSE Duration (Hrs.)	
					L	T	P	Thy	P
1.	ABC 101		CCC	6	4	2	0	3	0
2.	ABC 102		CCC	6	4	2	0	3	0
3.	ABC 103		CCC	6	4	2	0	3	0
4.	ABC S01	Other Supportive Course	OSC	6	4	2	0	3	0
5.	ABC A01/B01/C01/D01/E01/F01		ECC	6	4	2	0	3	0
				30					

Second Semester Structure Table

S. No.	Subject Code	Course Title	Course Type	Credit	Contact Hours Per week			EoSE Duration (Hrs.)	
					L	T	P	Thy	P
1.	ABC 201		CCC	6	4	2	0	3	0
2.	ABC 202		CCC	6	4	2	0	3	0
3.	ABC 203		CCC	6	4	2	0	3	0
4.	ABC 221		PRI/FST/EST	6	4	2	0	3	0
5.	ABC A02/B02/C02/D02/E02/F021		ECC	6	4	2	0	3	0
				30					

Third Semester Structure Table

S. No.	Subject Code	Course Title	Course Type	Credit	Contact Hours Per week			EoSE Duration (Hrs.)	
					L	T	P	Thy	P
1.	ABC 301		CCC	6	4	2	0	3	0
2.	ABC 302		CCC	6	4	2	0	3	0
3.	ABC 303		CCC	6	4	2	0	3	0
4.	ABC S02		OSC	6	4	2	0	3	0
5.	ABC A03/B03/ C03/D03/ E03/F03		ECC	6	4	2	0	3	0
				30					

Fourth Semester Structure Table

S. No.	Subject Code	Course Title	Course Type	Credit	Contact Hours Per week			EoSE Duration (Hrs.)	
					L	T	P	Thy	P
1.	ABC 401		CCC	6	4	2	0	3	0
2.	ABC 402		CCC	6	4	2	0	3	0
3.	ABC 403		CCC	6	4	2	0	3	0
4.	ABC 421		PRJ/FST/ EST	6	4	2	0	3	0
5.	ABC A04/B04/ C04/D04/ E04/F04		ECC	6	4	2	0	3	0
				30					

CONTENT

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M. Sc. in ZOOLOGY

FACULTY OF LIFE SCIENCE

FIRST SEMESTER (ODD SEMESTER)

Eligibility Criteria (Qualifying Exams)

Chemistry, Botany, Zoology (CBZ-Group) & Chemistry, Geology, Zoology (CGZ-Group)

Admission Criteria

- 1) Merit List
- 2) Entrance Test (written or/and oral) if decided by the University

Observance of Reservation Policy.

Course Code	Course Type	Course (Paper/Subjects)	Credits	Contact Hours Per			EoSE Duration	
				L	T	P	Thy	P
ZOO 101	CCC	Systematics, Biodiversity and Evolution	5	4	2	0	3	0
ZOO 111	CCC	Systematics, Biodiversity and Evolution –Laboratory work	2	0	0	3	0	3
ZOO 102	CCC	Principles of Ecology	5	4	2	0	3	0
ZOO 112	CCC	Principles of Ecology- Laboratory Work	2	0	0	3	0	3
ZOO 103	CCC	Computational Biology, Biostatistics and Bioinformatics	5	4	2	0	3	0
ZOO 113	CCC	Computational Biology, Biostatistics and Bioinformatics -Laboratory Work	2	0	0	3	0	3
ZOO S01	OSC	RESEARCH METHODOLOGY & COMPUTER APPLICATION: BASICS	6	4	3	0	3	0
ZOO A01	ECC/CB	CONSTITUTIONALISM & INDIAN POLITICAL SYSTEM	6	4	3	0	3	0
ZOO A02	ECC/CB	Entomology- Insect Diversity, Society and Evolution Theory						
ZOO A03	ECC/CB	ENTOMOLOGY- Insect Physiology, Toxicology & Vector Biology						
ZOO A04	ECC/CB	ENTOMOLOGY- Pest Ecology & Agricultural Entomology						
			TOTAL=					
			33					

COURSE TITLE: Systematics, Biodiversity and Evolution

CREDIT: 7

THEORY: 5 PRACTICAL:2

HOURS: 135

THEORY: 90 PRACTICAL: 45

MARKS:

THEORY: 100 (80+20)

PRACTICAL: 00

OBJECTIVE: This course is aimed towards generating fundamental knowledge, concepts related to Systematics, Biodiversity and Evolution

Unit-1-18 Hours

An overview of evolutionary biology, concept of organic evolution during pre- and post- Darwin era; evolution and molecular biology- a new synthesis; from molecules to life, life originated from RNA, introns as ancient component of genes.

Unit-2 18 Hours

The universal common ancestor and tree of life, three domain concept of living kingdom; molecular phylogeny- history, terms, definition and limitations, construction of phylogenetic trees using molecular data, construction of phylogenetic trees by using 16S rRNA gene sequences and concept of speciation in bacteria.

Unit-3 18 Hours

Molecular divergence and molecular clocks and molecular drive; complication in inferring phylogenetic trees; origin and diversification of bacteria and archaea; diversification of genomes; the nature of bacterial and archeal genomes; origin of genomes by horizontal gene transfer; role of plasmid, transposons, integrons and genomic islands in DNA transfer.

Unit-4 18 Hours

Origin and diversification of eukaryotes- origin of cells and first organisms; early fossilized cells; evolution of eukaryotic cell from prokaryotes- a case of symbiosis; evolution of eukaryotic genomes; gene duplication and divergence.

Unit-5 15 Hours

Mode of speciation- factors responsible for speciation; tempo of evolution; systematics- definition and role in biology, biological classification- theories and objectives, types of taxonomy, taxonomic diversity- definition and types, origination and extinction, rates of change in origination and extinction, causes of extinction, causes of differential rates of diversification, current status and future of biodiversity; human evolution- human evolutionary history; placing humans on tree of life; genomics and humanness; current issues in human evolution.

LABORATORY WORK

(ZOO111)

1. Isolation of Genomic DNA from a bacterium and its quantification.
2. Designing primers for 16S rRNA gene sequence.
3. Amplification of 16S rRNA gene sequences by using genomic DNA as well as by colony boiling method.
4. Purification of 16S rRNA gene.
5. Sequence of 16S rRNA gene; editing the sequence, multiple alignments, construction of phylogenetic trees and interpretation of results.
6. Dot blot hybridization of different eubacterial species and interpretation of results.

SUGGESTED READINGS

1. *Evolution*, Barton, N. H., Briggs, D. E.G., Eisen, J. A., Goldstein, A. E., Patel, N. H., Cold Spring Harbor Laboratory Press, New York, USA
2. *Evolution*, Hall, B. K. and Hallgrimsson, B., Jones and Bartlett Publisher, Sudbury, USA
3. *Evolution*, Futuyma, D. J., Sinauer Associates, Inc., Sunderland, USA
4. *What Evolution Is*, Mayr, E., (2001), Basic Books, New York,

COURSE TITLE: Principles of Ecology

CREDIT: 7

THEORY: 5 PRACTICAL:2

HOURS: 135

THEORY: 90 PRACTICAL: 45

MARKS:

THEORY: 100 (80+20)

PRACTICAL: 00

OBJECTIVE: The purpose of the course is to make the students to understand various ecological principles and factors that determine the size and number of population that can co-exist within a specific area. This knowledge is crucial for better development and management of natural resources and global environment.

Unit-1 18 Hours

Introduction to ecology, evolutionary ecology, environmental concepts – laws and limiting factors, ecological models. Characteristics of population, population size and exponential growth, limits of population growth, population dynamics, life history pattern, fertility rate and age structure. Competition and coexistence, intra-specific and inter-specific interactions, scramble and contest competition model, mutualism and commensalism, prey-predator interactions.

Unit-2 18 Hours

Nature of ecosystem, production, food webs, energy flow through ecosystem, biogeochemical cycles, resilience of ecosystem, ecosystem management. The biosphere, biomes and impact of climate on biomes.

Unit-3-18 Hours

Environmental Stresses and their management, global climatic pattern, global warming, atmospheric ozone, acid and nitrogen deposition, coping with climatic variations. Major classes of contaminants. Uptake

Unit-4 18 Hours

Biotransformation, detoxification, elimination and accumulation of toxicants. Factors influencing bioaccumulation from food and trophic transfer. Pesticides and other chemical in agriculture, industry and hygiene and their disposal. Impact of chemicals on biodiversity of microbes, animals and plants. Bioindicator and biomarkers of environmental health. Biodegradation and bioremediation of chemicals.

Unit-5 18 Hours

Biodiversity – assessment, conservation and management, biodiversity act and related international conventions. Sustainable development, natural resource management in changing environment. Molecular ecology, genetic analysis of single and multiple population, phylogeography, molecular approach to behavioural ecology, conservation genetics.

LABORATORY WORK

(ZOO112) Habitat studies:

1. Physical and chemical characteristics of soil.
2. Assessing influence of light, temperature and moisture on plant germination and growth/animal behavior and growth.
3. Assessing influence of soil nutrient status on plant germination and growth.

Community/ecosystem studies:

1. Assessment of density, frequency and abundance of plants/animal in a community using various techniques i.e. transect, quadrat etc.
2. Comparison of stands/communities and ordination.
3. Profile diagrams.
4. Biomass and reproductive allocation under various environments.
5. Nutrient uptake and budget for various communities/Food chain assessment.
6. Decomposition of various organic matters and nutrient release mechanisms/role of arthropods and other micro-, and macrofauna in decomposition.
7. Understanding ecosystem succession by studying various stages of vegetation/community assemblages development.
8. Molecular techniques in laboratory.
9. Insect diversity in soil.

Landscape studies:

1. Principles of GIS, GPS and RS technology.
2. Interpretation (visual and automated) of remote sensing information for landscape differentiation.

SUGGESTED READINGS

1. *Field Sampling: Principles and Practices in Environmental Analysis*, Conklin, A.R. Jr., (2004), CRC Press.
2. *Principles and Standards for Measuring Primary Production*, Fahey, T.J. and Knapp, A.K., (2007), Oxford University Press, UK
3. *Ecological Modeling*, Grant, W.E. and Swannack, T.M., (2008), Blackwell.
4. *Fundamental Processes in Ecology: An Earth system Approach*, Wilkinson, D.M., (2007), Oxford University Press, UK.
5. *Animal Ecology*, Ranga M.M., Agrobios, Jodhpur, India

M.Sc. (ZOOLOGY)
COURSE CODE:ZOO103

1ST SEMESTER
COURSE TYPE: CCC

COURSE TITLE:

Computational Biology, Biostatistics and Bioinformatics

CREDIT: 7

HOURS: 135

THEORY: 5 PRACTICAL:2

THEORY: 90 PRACTICAL: 45

MARKS:

THEORY: 100 (80+20)

PRACTICAL: 00

OBJECTIVE: The Purpose of this course is to make the students to understand computational biology- Bioinformatics & Biostatistics

Unit-1 20 Hours

Basic components of computers- hardware (CPU, input, output, storage devices), Software (operating systems), Application software; Introduction to MSEXCEL- use of worksheet to enter data, edit data, copy data, move data; Use of in- built statistical functions for computations of mean, S. D., correlation, regression coefficients etc., Use of bar diagram, histogram, scatter plots, etc., Graphical tools in EXCEL for presentation of data; Introduction to MS- WORD word processor- editing, copying, moving, formatting, table insertion, drawing flow charts etc; Introduction to Power Point, image and data handling.

Unit-2.....15 Hours

Biostatistics- population, sample, variable, parameter, primary and secondary data, screening and representation of data, frequency distribution, tabulation, bar diagram, histograms, pie diagram, mean, median, mode, quartiles and percentiles, variance, standard deviation, coefficient of variation; Probability and distributions- definition of probability (frequency approach), independent events. Addition and multiplication rules,

Unit-3 15 Hours

Conditional probability, examples- bernoulli, binomial, poisson and normal distributions; bivariate data- scatter plot, correlation coefficient (r), properties (without proof), interpretation of r , linear regression: Fitting of lines of regression, regression coefficient,

Conditional probability, examples- bernoulli, binomial, poisson and normal distributions; bivariate data- scatter plot, correlation coefficient (r), properties (without proof), interpretation of r , linear regression: Fitting of lines of regression, regression coefficient, coefficient of determination; hypothesis, critical region, and error probabilities, tests for proportion, equality of proportions, equality of means of normal

Unit-4 20 Hours

The era of computerized biology information, review of relevant definitions in molecular biology, overview of challenges of molecular biology computing, proteins, secondary structure and folding, RNA secondary structures, introduction to phylogenetic analysis; introduction to bioinformatics; introduction to genomics and proteomics databases- nucleic acid sequence database: Genbank, UCSC, ENSEMBL, EMBL, DDBJ, protein sequence databases: Swiss-prot, PDB, BLAST, PSI- BLAST (steps involved in use and interpretation of results) and HMMER, BLAST vs FASTA, file formats- FASTA, GCG and ClustalW.

Unit-5 20 Hours

Databank search- data mining, data management and interpretation, multiple sequence alignment, genes, primer designing; Protein modeling, protein structure analysis, docking, ligplot interactions, phylogenetic analysis with the program PHYLIP, DISTANCES, GROWTREE etc.; introduction to computational genomics and proteomics- basics of designing a microarray, image analysis and normalization, annotations, protein prediction tools- protein secondary structure, molecular modeling, identification and characterization of protein mass fingerprint, world- wide biological databases, Introduction to programming languages such as "C"

LABORATORY WORK (ZOO 113)

1. Use of excel sheet for data processing.
2. Use of search engines like Scopus, Science direct for reference material collection and management.
3. Nucleic acid and protein sequence databases.
4. Data mining for sequence analysis.
5. Web- based tools for sequence searches and homology screening.
6. Primer designing for gene amplification and gene cloning.
7. Annotations: ORF finder, Use of ARTEMIS or any other suitable software.
8. Construction of phylogenetic trees for DNA and proteins.
9. Introduction to microarray technology.
10. Identification of peptide finger print by nano LC- MS/MS and database search using MASCOT and OMSSA.

SUGGESTED READING

1. *Principles of Biostatistics*, Pagano M., Gauvreau, K, (2000), Duxbury Press, USA
2. *Bioinformatics for Dummies*, Claverie J. M., Notredame C., (2nd Ed., 2007), Wiley Publishing, Inc., New York, USA
3. *Bioinformatics: Sequence and Genome Analysis*, Mount, D. W. (2nd Ed., 2001), Cold Spring Harbor Laboratory Press, New York, USA.
4. *Animal Ecology*, Ranga M.M., Agrobios, Jodhpur, India

**COURSE TITLE: RESEARCH METHODOLOGY &
COMPUTER APPLICATION: BASICS**

CREDIT: 06
THEORY: 06 PRACTICAL:00

HOURS: 90
THEORY: 90

MARKS: 100

THEORY: 80

CCA: 20

OBJECTIVE:

- Understands the concept and place of research in concerned subject
- Gets acquainted with various resources for research
- Becomes familiar with various tools of research
- Gets conversant with sampling techniques, methods of research and techniques of analysis of data
- Achieves skills in various research writings
- Gets acquainted with computer Fundamentals and Office Software Package .

Unit-1- 15 Hours

CONCEPT OF RESEARCH :

Meaning and characteristics of research , Steps in research process ,Types of research -

i) Basic, applied and action research ii) Quantitative and qualitative research ,Areas of research in concern discipline

SELECTION OF PROBLEM FOR RESEARCH :

Sources of the selection of the problem , Criteria of the selection of the problem ,Drafting a research proposal , Meaning and types of variables ,Meaning and types of hypotheses.

Unit-1- 15 Hours

TOOLS OF RESEARCH :

Meaning and general information about construction procedure of (i) Questionnaire, (ii) Interview, (iii) Psychological test, (iv) observation (v) Rating scale (vi) Attitude scale and (vii) check list , Advantages and disadvantages of above tools

CONCEPT OF RESEARCH :

Meaning and characteristics of research , Steps in research process ,Types of research -

i) Basic, applied and action research ii) Quantitative and qualitative research ,Areas of research in concern discipline

SELECTION OF PROBLEM FOR RESEARCH :

Sources of the selection of the problem , Criteria of the selection of the problem ,Drafting a research proposal , Meaning and types of variables ,Meaning and types of hypotheses.

Unit-1- 15 Hours

TOOLS OF RESEARCH :

Meaning and general information about construction procedure of (i) Questionnaire, (ii) Interview, (iii) Psychological test, (iv) observation (v) Rating scale (vi) Attitude scale and (vii) check list , Advantages and disadvantages of above tools

SAMPLING :

Meaning of population and sample , Importance and characteristics of sample , Sampling techniques - i) Probability sampling : random sampling, stratified random sampling, systematic sampling, cluster sampling ii) Non-probability sampling: incidental sampling, purposive sampling, quota sampling

Unit-3 15 Hours

METHODS OF RESEARCH

Meaning and conducting procedure of following methods of research Historical method, Survey method , Case study , Causal omparative method , Developmental methods, Experimental methods

UNIT - 4 15 Hrs

TREATMENT OF DATA :

Level of measurements of data , Steps in treatment of data: editing, coding, classification, tabulation, analysis and interpretation of results

WRITING RESEARCH REPORT :

Sections of report : Preliminary section , Content section : various chapters , Supplementary section : appendices, references, abstract , Format and style

UNIT-5 15Hrs

Computer Fundamentals

Computer System : Features, Basic Applications of Computer, Generations of computers.

Parts of Computer System : Block Diagram of Computer System ; Central Processing Unit (CPU) ; Concepts and types of Hardware and Software, Input Devices - Mouse, Keyboard, Scanner, Bar Code Reader, track ball ; Output Devices - Monitor, Printer, Plotter, Speaker ; Computer Memory - primary and secondary memory, magnetic and optical storage devices.

Operating Systems - MS Windows : Basics of Windows OS ; Components of Windows - icons, taskbar, activating windows, using desktop, title bar, running applications, exploring computer, managing files and folders, copying and moving files and folders ;

Control panel : display properties, adding and removing software and hardware, setting date and time, screensaver and appearance ;

Windows Accessories : Calculator, Notepad, WordPad, Paint Brush, Command Prompt, Windows Explorer.

UNIT- 6 15 Hrs

Office Software Package

Word Processing - MS Word : Creating, Saving, Opening, Editing, Formatting, Page Setup and printing Documents ; Using tables, pictures, and charts in Documents ; Using Mail Merge sending a document to a group of people and creating form, letters and label.

Spreadsheet - MS Excel : Opening a Blank or New Workbook, entering data/Function/ Formula into worksheet cell, Saving, Editing, Formatting, Page Setup and printing Workbooks.

Presentation Software - MS Power Point : Creating and enhancing a presentation, modifying a presentation, working with visual elements, adding Animations & Transitions and delivering a presentation.

SUGGESTED READINGS

Agrawal, Y. P. (1988). *Better sampling : Concepts, Techniques and Evaluation*. New Delhi : sterling Publishers Private Ltd. Best J. W. (1993).

Research in Education (6th ed.) New Delhi : Prentice-Hall of India Pvt. Ltd.

Broota, K. D. (1992) *Experimental design in Behavioral Research* (2nd ed.)

New Delhi : Wiley Eastern Limited.

Dasgupta, A. K. (1968). *Methodology of Economic Research*.

Bombay: Asia Publishing House. Edwards, A. L. (1957).

Techniques of Attitude Scale construction. New York : Appleton-Contury

Gall, M. D., Gall, J. P. and Borg, W. R. (2007). *Educational Research : An introduction*

(8th ed.) Coston : Allyn and Bacon.

Garrett, H. E. & Woodworth, R. S. (1969). *Statistics in Psychology and Education*. Bombay : Vakils, Fecffer & Simons Pvt. Ltd.

Goode, W. J. & Hatt, Paul K. (1952). *Methods in Social Research*. New York : McGraw-Hill.

Gopal, M. H. (1964). *An Introduction to research Procedure in Social Sciences*. Bombay : Asia Publishing House.

Hillway, T. (1964) *Introduction to Research* (2nd ed.) Noston : Houghton Mifflin.

Hyman, H. H., et al. (1975). *Interviewing in Social Research*.

**COURSE TITLE: CONSTITUTIONALISM &
INDIAN POLITICAL SYSTEM**

CREDIT: 06
THEORY: 06 PRACTICAL:00

HOURS: 90
THEORY: 90

MARKS: 100

THEORY: 80

CCA: 20

OBJECTIVE:

- Understands the concept of Constitutionalism
- Gets acquainted with various Indian Political System
- Becomes familiar with various Union Executive
- Gets conversant with Legislatures, Legislative Bills
- Achieves skills in various writings

UNIT - 1 12 Hrs

Meaning: Constitution, Constitutional government & constitutionalism; Difference between Constitution & Constitutionalism; Constitutionalism: Basis, Elements, Features & future. Forms of Government: Democracy & Dictatorship, Unitary & Federal, Parliamentary & Presidential form. Ideals of the Indian Constitution incorporated in the Preamble. Special Features of the Indian Constitution.

UNIT - 2 24 Hrs

Concept of State and Citizenship, Judicial Review and Fundamental Rights, Directive Principles of the State Policy, Fundamental Duties, Procedure to Amend the Indian Constitution, Judiciary: Supreme Court and High Court, Judicial Activism and Public Interest Litigation and Provisions relating to Emergency.

UNIT - 3 10 Hrs

Union Executive- President, Prime Minister, Council of Ministers. State Executive- Governor, Chief Minister and Council of Ministers. Local Bodies & Panchayati Raj.

UNIT - 4 24 Hrs

Parliament of India, State Legislatures, Legislative Bills: Ordinary, Money and Financial, Union State Relations, Principles of the 'Separation of Power and the 'Principles of Check & Balance'. Political Parties and Pressure Groups. Challenges before Indian Democracy: Terrorism, Regionalism, Communalism, *Linguistics* and National Integration.

UNIT - 5 20 Hrs

Controller & Accountant General of India, Solicitor General, Advocate General, Election Commission, Union and State(s) Public Service Commission, Finance Commission.

SUGGESTED READINGS

- HOBBS, Thomas, The Leviathan, Chapters XIII & XVII [entry]
LOCKE, John, The Second Treatise of Civil Government, Chapter IX [entry]
ROUSSEAU, Jean-Jacques, The Social Contract or Principles of Political Right
MONTESQUIEU, The spirit of the laws,
RAZ, Joseph, "The rule of law and its virtue", in The authority of law, Oxford University Press, 1979
Dicey on British constitution
P. Ishwara Bhat Inter-relationship between Fundamental Rights
M P Jain Indian Constitutional Law
H M Seervai Constitutional Law of India
V N Shukla Constitution of India
D DBasu Shorter Constitution of India
B Sivarao Constitutional Assembly Debates
J. V R Krishna Iyer Fundamental Rights and Directive Principles
Paras Diwan Human Rights and the Law
P K Tripathi Some Insight into Fundamental Rights
S P Sathe Fundamental Rights and Amendment to the Constitution
P B Gajendragadkar Law, Liberty and Social Justice
David Karrys Politics of Law.

**COURSE TITLE: Entomology- Insect Diversity, Society
and Evolution Theory**

CREDIT: 06

THEORY: 06 PRACTICAL:00

HOURS: 90

THEORY: 90 PRACTICAL:00

MARKS: 100

THEORY: 100 (80+20)

PRACTICAL:0

OBJECTIVE: This course is aimed towards generating fundamental knowledge of insects diversity society and evolution theory.

UNIT-1- 18-Hours

Morphology: external features and their articulation. Comparative study of head-antennae, mouth parts; thorax – legs, wings; abdominal appendages, genitalia

UNIT-2- 18 Hours

Taxonomy- historical development of classification of insect, basis of insect classification; classification of insects up to sub orders and up to super families in economical important groups; fossil history, origin and evolution of insects.

UNIT-3- 18 Hours

Insect Society: group of social insects and their social life; evolution of sociality; social organization and social behaviour in honey bee, ants, termites and wasps.

UNIT-4- 18-Hours

Insect Plant Interaction - Theory of co-evolution, role of allelochemicals in host plant mediation, tritrophic interaction, host-plant selection by phytophagous insects, establishment of insect population on a plant surface.

UNIT-5- 18 Hours

Forensic Entomology: Introduction, forensically important insects, collection of data from cadaver site, interpretation of data for predicting time and cause of death.

SUGGESTED READINGS

1. *A general text book of entomology*, Imms , A. D., Chapman & Hall, UK
2. *Introduction to the study of insects*, Borror, D. J., Triplehorn, C. A., and Johnson, N. F., M Saunders College Publication, USA
3. *Principles of Insect Morphology*, Snodgrass, R. E., Cornell Univ. Press, USA
4. *The Insect Societies*, Wilson, E. O., Harward Univ. Press, UK
5. *Host Selection by Phytophagous insects*, Bernays, E. A., and Chapman, R. F., Chapman and Hall, New York, USA
6. *Insect Plant Biology*, Schoonhoven, L. M., van Loop, J. A., & Dicke. M. Pub. Oxford Univ. Press. USA

M.Sc. (ZOOLOGY)
COURSE CODE:ZOOA03

1ST SEMESTER
COURSE TYPE: ECC/CB

**COURSE TITLE: EMTOMOLOGY- Insect Physiology,
Toxicology & Vector Biology**

CREDIT: 06

THEORY: 06 PRACTICAL:00

HOURS: 90

THEORY: 90 PRACTICAL:00

MARKS: 100

THEORY: 100 (80+20)

PRACTICAL:0

OBJECTIVE: This course is aimed towards generating fundamental knowledge concepts related to insect physiology toxicology and vector biology

UNIT-1- 20-Hours

Structure and physiology of integumentary, digestive, excretory, circulatory, respiratory, endocrine, reproductive, and nervous system. Sensory receptors. Growth, metamorphosis and diapause in insect.

UNIT-2 20-Hours

Definition of pesticides, brief history, pesticides registration, pesticide industries and markets. Dose-response relationship; mode of action of insecticide, carcinogenic, mutagenic and teratogenic effects, and evaluation of toxicity.

UNIT-3 15-Hours

Group characteristics of insecticide, structure and function of organochlorine, organophosphorus, carbamate, pyrethrod, other plant origin as well as bio-insecticides, neonicotinoids and nitrogenous insecticides, fumigants, IGRs. Metabolism or degradation of pesticides - phase I and phase II reactions. Insecticide resistance and health hazards.

UNIT-4 15 Hours

Introduction to vector biology, economic importance and control of fleas, lice, bugs, mosquitoes, flies and parasitoids.

UNIT-5 20 Hours

Vector-parasite interaction; host-pathogen interaction, Insect transmitting bacteria and viruses of medical, veterinary and agricultural importance; control of insect vector.

SUGGESTED READINGS

1. *The Insects: Structure and function*, Chapman, R. F., Cambridge University Press, UK.
2. *Physiological system in Insects*, Klowden, M. J., Academic Press, USA
3. *The Insects, An outline of Entomology*, Gullan, P. J., and Cranston, P. S., Wiley Blackwell, UK
4. *Insect Physiology and Biochemistry*, Nation, J. L., CRC Press, USA
5. *Toxicology and Risk Assessment: A Comprehensive Introduction*, Greim H., and Snyder, R. (ed), John Wiley and Sons, UK
6. *The Complete Book of pesticide management*, Whitford, F., Wiley Interscience, John Wiley and Sons, UK
7. *Safer Insecticides*, Hodgson, E., and Kuhr, R. J., (ed), Marcel Dekker Inc., New York, USA
8. *Pesticide Application Methods*, Matthews, G. A., Blackwell Science, London, UK
9. *Pesticide Biochemistry and Physiology*, Wilkinson, C. F., Plenum Press, New York, UK
10. *Metabolic pathways of agrochemicals Part II*, Roberts, T. R., and Hutson, D. H. The Royal Society of Chemistry, UK
11. *Medical and Veterinary Entomology* Mullen, G. , Durden, L., Academic Press, USA
12. *Medical and Veterinary Entomology*, Kettle, D. S., Cabi Press, USA
13. *Medical Entomology for students, Service*, M. Cambridge University Press, UK

**COURSE TITLE: ENTOMOLOGY- Pest
Ecology & Agricultural Entomology**

CREDIT: 06

THEORY: 06 PRACTICAL:00

HOURS: 90

THEORY: 90 PRACTICAL:00

MARKS: 100

THEORY: 100 (80+20)

PRACTICAL:0

OBJECTIVE: This course is aimed towards generating fundamental knowledge concepts related to pest ecology and agricultural entomology

UNIT-1.....25-Hours

Pest - definition and its ecology, pest status, features responsible for evolutionary success of insect species, factors responsible for achieving the status of pest, Economic injury level, economic threshold, action threshold, pest spectrum, pest complex, carrying capacity, secondary pest out break, pest surveillance and sampling.

UNIT-2.....15-Hours

Population dynamics of pests - agro-ecosystem, phases of population fluctuation, models of population growth, factors for population fluctuation, population size and regulatory mechanisms.

UNIT-3.....20-Hours

Identification, seasonal history, biology, nature of damage and control measures of pests, of cereals, pulse crops, cotton, vegetables (summer vegetable and winter vegetable), oil seeds, fruit crops, sugarcane and stored grains. Locust- different species and phases, phase transition, periodicity, migration, biology and control measures

UNIT-4.....15 Hours

Integrated Pest Management: history, different phases of pest control, Quarantine, Physical, Cultural, Chemical, Biological control and genetic and biotechnological methods of control. Pheromones- production, and their use in pest surveillance and management

UNIT-5.....15 Hours

Plant resistance to insects: types of resistance, mechanism of resistance-antibiosis, antixenosis, tolerance, factors mediating resistance, JH Mimics & MH-agonist. Transgenic plants: history, *Bacillus thuringiensis* and its mode of action on insect, different sub species of *Bt*, development of *Bt* plant by recombinant DNA technology, resistance management of *Bt* crop, prospective and controversies of *Bt* crop.

SUGGESTED READINGS

1. *Ecology of insects*, Speight, M. R., Hunter, M. D., & Watt, A. D., Wiley-Blackwell, UK
2. *Insect Plant Biology*, Schöonhoven, L. M., van Loon, J.A., & Dicke, M., Publisher Oxford University Press, USA
3. *Interrelationship between insects and Plants*, Jolivet, P., CRC Press, USA
4. *Chemical Ecology of Insects*, Carde, R. T., and Bell, W. J., Chapman & Hall, New York, USA
5. *Entomology & Pest Management*, Pedigo, L. P., Prentice Hall, New Jersey, USA
6. *Concepts of IPM*, Norris, Caswell-Chen and Kogan, Prentice-Hall, USA
7. *Agricultural insects pests of the tropics and their control*, Hill, D. S., Cambridge University Press, UK.

Course Code	Course Type	Course (Paper/Subjects)	Credits	Contact Hours Per Week			EoSE Duration (Hrs.)	
				L	T	P	Thy	P
ZOO201	CCC	Genetics and Cytogenetics	5	4	2	0	3	0
ZOO211	CCC	Genetics and Cytogenetics- LABORATORY WORK	2	0	0	3	0	3
ZOO202	CCC	Principles of Gene Manipulation	5	4	2	0	3	0
ZOO212	CCC	Principles of Gene Manipulation -LABORATORY WORK	2	0	0	3	0	3
ZOO203	CCC	Structure and Function of Genes	5	4	2	0	3	0
ZOO213	CCC	Structure and Function of Genes -LABORATORY WORK	2	0	0	3	0	3
ZOO221	PRJ/ST EST	SOCIAL OUTREACH AND SKILL DEVELOPMENT	6	0	0	9	0	4
ZOO B01	ECC/CB	ENVIRONMENTAL AND FOREST LAWS						
ZOO B02	ECC/CB	Fish Biology - Evolution and Functional Anatomy of Fish						
ZOO B03	ECC/CB	Fish Biology - Aquatic Resources and Their Conservation-	6	4	3	0	3	0
ZOO B04	ECC/CB	Fish Biology -Aquaculture						
			TOTAL=					
			32					

COURSE TITLE:
Genetics and Cytogenetics

CREDIT: 07

THEORY: 5 PRACTICAL: 2

HOURS: 135

THEORY: 90 PRACTICAL: 45

MARKS: 100

THEORY: 100 (80+20)

PRACTICAL: 00

OBJECTIVE: This course is aimed towards generating fundamental knowledge, concepts related to genetics and cytogenetics.

UNIT-1..... 15 Hours

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

UNIT-2..... 25 Hours

Nature of the gene and its functions: evolution of the concept of the gene, fine structure of gene (rII locus); methods of gene mapping: 3- point test cross in *Drosophila*, gene mapping in humans by linkage analysis in pedigrees.

UNIT-3..... 15 Hours

Gene mutation and DNA repair: types of gene mutations, methods for detection of induced mutations, P- element insertional mutagenesis in *Drosophila*, DNA damage and repair; regulation of gene activity in *lac* and *trp* operons of *E. coli*, general introduction to gene regulation in eukaryotes at transcriptional and posttranscriptional levels, organization of a typical eukaryotic gene, transcription factors, enhancers and silencers, non coding genes.

UNIT-4.....15 Hours

Sex determination and dosage compensation: sex determination- in humans, *Drosophila* and other animals; dosage compensation of X-linked genes- hyperactivation of X-linked gene in male *Drosophila*, inactivation of X-linked genes in female mammals; human genetics- karyotype and nomenclature of metaphase chromosome bands; chromosome anomalies and diseases- chromosomal anomalies in malignancy (chronic myeloid leukemia, Burkitt's lymphoma, retinoblastoma and Wilms' tumor); genetic analysis of complex traits - complex pattern of inheritance, quantitative traits, threshold traits; human genome and mapping.

UNIT-5.....20 Hours

Genetics and cancer: oncogenes- tumor inducing retroviruses and viral oncogenes; chromosome rearrangement and cancer; tumor suppressor genes- cellular roles of tumor suppressor genes, pRB, p53, APC, genetic pathways to cancer.

LABORATORY WORK (ZOO-211)

1. Study of mutant phenotypes of *Drosophila*.
2. Demonstration of law of segregation using *Drosophila* mutants.
3. Study of law of independent assortment.
4. Demonstration of sex- linkage by using *white* mutation of *Drosophila*.
5. Demonstration of dosage compensation in *Drosophila* males and females.
6. Demonstration of Green Fluorescence and Red Fluorescence protein for monitoring gene expression.
7. Targeted tissue specific expression of a gene using UAS-Gal4 System in *Drosophila*.

8. Preparation and study of metaphase chromosomes from mouse bone marrow:
 - a. Chromosome banding (C, G, H banding).
 - b. Study the differences in number, shape and size of chromosomes in normal vs. tumor cells, or normal vs. irradiated cells.
 - c. Preparation of human karyotype and study of chromosomal aberrations with respect to number, translocation, deletion etc. from the pictures provided.
9. Study of transcriptional activity in polytene chromosome upon heat shock induction by uridine incorporation.
10. Study of sex chromatin in buccal smear and hair bud cells (Human).
11. Study of Hardy- Weinberg equilibrium in human population by taking the example of blood group system (ABO).

SUGGESTED READINGS

1. *Principles of Genetics*, Snustad and Simmons, (4th Ed. 2005), John Wiley & Sons, USA
2. *Modern Genetic Analysis: Integrating Genes and Genomes*, Griffiths, J.F., Gelbart, M., Lewontin, C. and Miller, W. H. Freeman and Company, New York, USA
3. *Genetics*, J. Russell, Benjamin-Cummings Publishing Company, San Francisco, California, USA

COURSE TITLE:
Principles of Gene Manipulation

CREDIT: 07

THEORY: 05 PRACTICAL:02

HOURS:135

THEORY: 90 PRACTICAL:45

MARKS:

THEORY: 100 (80+20)

PRACTICAL:00

OBJECTIVE: This course is aimed towards generating fundamental knowledge, concepts related to principle of gene manipulation.

UNIT-1.....18 Hours

Basic recombinant DNA techniques, cutting and joining DNA molecules, restriction modification systems, various enzymes used in recombinant DNA technology, restriction maps and mapping techniques;

UNIT-2.....18 Hours

Nucleic acid probes, blotting techniques, DNA fingerprinting, footprinting, methyl interference assay. Polymerase chain reaction-methods and applications.

UNIT-3.....18 Hours

Basic biology of cloning vectors: plasmids, phages, single stranded DNA vectors, high capacity vectors, retroviral vectors, expression vectors and other advanced vectors in use. Gene cloning strategies: methods of transforming *E. coli* and other cells with rDNA; methods of selection and screening of transformed cells; construction of genomic and cDNA libraries; strategies of expressing cloned genes; phage display.

UNIT-4-18 Hours

Principles of DNA sequencing, automated sequencing methods; synthesis of oligo- nucleotides, primer design; micro-arrays; confocal microscopy; changing genes- directed evolution, protein engineering in microbes.

UNIT-5.....18 Hours

Manipulating genes in animals: gene transfer to animal cells, genetic

manipulation of animals, transgenic technology, application of recombinant DNA technology; genetically modified organisms: gene knockouts, mouse-disease models, gene silencing, gene therapy, somatic and germ- line therapy.

LABORATORYWORK (ZOO-212)

1. Plasmid DNA isolation;minipreps.
2. Agarose gel electrophoresis of isolated plasmid.
3. DNA quantization and purity of DNA.
4. Restriction enzyme digestion of plasmid DNA.
5. Purification of DNA from an agarose gel.
6. Vector and insert ligation.
7. Preparation of competent cells and storage.
8. Transformation of *E. coli* with standard plasmids, calculation of transformation efficiency.
9. Polymerase Chain Reaction, using standard 16S rRNA eubacterial primers.

SUGGESTED READINGS

1. Recombinant DNA: Genes and Genomics – a short course, Watson et al., W. H. Freeman and Company, New York, USA.
2. Principles of Gene Manipulation and Genomics, Primrose, S. B. and Twyman, R. M., (7th Ed. 2006), Blackwell Publishing, West Sussex, UK.
3. Molecular Biotechnology: Principles and application of recombinant DNA, Bernard R. and Jack, ASM Press, Hemdon, USA.

COURSE TITLE:
Structure and Function of Genes

CREDIT: 06

HOURS: 135

THEORY: 05 PRACTICAL:02

THEORY: 90 PRACTICAL:45

MARKS

THEORY: 100 (80+20)

PRACTICAL:00

OBJECTIVE: This course is aimed towards generating fundamental knowledge, concepts related to structure and function of genes.

UNIT-1.....20 Hours

Structure of nucleic acids- structure of nucleic acids, folding motifs, conformation flexibilities, denaturation, renaturation, kinetics of hybridization, super-coiling of DNA, packaging of DNA in the nucleus, structure of chromatin, chromatin territories. Genetic material and its evolution- structure and function relationships, evolution of genetic material, genes and genomes.

UNIT-2.....20 Hours

DNA replication, recombination and repair- energetics of nucleic acid polymerization, accuracy during flow of genetic information, DNA polymerases, proof-reading activity, errors and damage in the DNA, mechanism of DNA repair; genome instability;

UNIT-3.....10 Hours

Transcriptional control of gene expression- positive and negative regulations, RNA polymerases, promoters and regulatory sequences, activators and repressors of transcription, transcription initiation by RNA polymerases, regulation of transcription-factor activity, elongation and termination of transcription.

UNIT-4.....20 Hours

Post-transcriptional gene control and nuclear transport- types of introns

and their splicing, evolution of introns, catalytic RNA, alternative splicing and proteome diversity, regulation of Pre-mRNA Processing, micro RNA and other non-coding RNAs, degradation of RNA.

UNIT-5.....20 Hours

Transport across the nuclear envelope and stability of RNA- structure of nuclear membrane and nuclear pore complexes, processes of nuclear import and export and their regulation, degradation of RNA. Translational machinery and translational control -energetics of amino acid polymerization, tRNAs and their modifications, aminoacyl tRNA synthetases, accuracy during aminoacylation of tRNA, regulation of initiation of translation in eukaryotes, elongation and its control, inhibitors of translations.

LABORATORY WORK (ZOO-213)

1. Studies on structure of Gene

- Familiarization with sterile-handling techniques for growth of bacteria, such as sterilization, growth media, types of culture etc.
- Isolations of genomic DNA from bacteria and mouse/rat liver.
- Measurement of absorption-spectrum of DNA, RNA, and nucleotides.
- Studies on denaturation of DNA and determination of T_m and calculation of G:C content.
- Studies on stability of DNA and RNA towards alkali.

2 Studies on regulation of gene-expression in bacteria

- Studies on growth curve of *E.coli* in synthetic medium and calculation of log-phase for metabolic experiments.
- Studies on induction of *lac*-operon.
- Studies on catabolite repression of *lac*-operon and role of cAMP.

3. Generation and selection of mutants for *lac*-operon, calculation of mutation-frequency.

SUGGESTED READINGS

- Molecular Biology of the Gene*, Watson *et al.*, (5th Ed. 2004), Pearson Education, Delhi, INDIA
- Genes IX*, Lewin, (9TH Edition 2008), Jones and Bartlett Publishers, Boston, USA

COURSE TITLE:
FOREST AND ENVIRONMENTAL LAWS

CREDIT: 06
THEORY: 06

HOURS: 90
THEORY: 90

MARKS : 100

THEORY: 80

CCA : 20

OBJECTIVE:

- Understands the concept and place of research in concerned subject
- Gets acquainted with various resources for research
- Becomes familiar with various tools of research
- Gets conversant with sampling techniques, methods of research and techniques of analysis of data
- Achieves skills in various research writings
- Gets acquainted with computer Fundamentals and Office Software Package.

UNIT - 1 18 Hrs

EVOLUTION OF FOREST AND WILD LIFE LAWS

- a) Importance of Forest and Wildlife
- b) Evolution of Forest and Wild Life Laws
- c) Forest Policy during British Regime
- d) Forest Policies after Independence.
- e) Methods of Forest and Wildlife Conservation.

UNIT - 2 18 Hrs

FOREST PROTECTION AND LAW

- a) Indian Forest Act, 1927
- b) Forest Conservation Act, 1980 & Rules therein
- c) Rights of Forest Dwellers and Tribal
- c) The Forest Rights Act, 2006
- d) National Forest Policy 1988.

UNIT - 3 18 Hrs

WILDLIFE PROTECTION AND LAW

- a) Wild Life Protection Act, 1972
- b) Wild Life Conservation strategy and Projects
- c) The National Zoo Policy

UNIT - 4 18 Hrs

CHAPTER – BASIC CONCEPTS

- a. Meaning and definition of environment.
- b. Multidisciplinary nature of environment
- c. Concept of ecology and ecosystem
- d. Importance of environment
- e. Meaning and types of environmental pollution.
- f. Factors responsible for environmental degradation.

CHAPTER – INTRODUCTION TO LEGAL SYSTEM

- a. Acts, Rules, Policies, Notification, circulars etc
- b. Constitutional provisions on Environment Protection
- c. Judicial review, precedents
- d. Writ petitions, PIL and Judicial Activism

CHAPTER – LEGISLATIVE FRAMEWORK FOR POLLUTION CONTROL LAWS

- a) Air Pollution and Law.
- b) Water Pollution and Law.
- c) Noise Pollution and Law.

UNIT - 5 18 Hrs

CHAPTER- LEGISLATIVE FRAMEWORK FOR ENVIRONMENT PROTECTION

- a) Environment Protection Act & rules there under
- b) Hazardous Waste and Law
- c) Principles of Strict and absolute Liability
- d) Public Liability Insurance Act
- e) Environment Impact Assessment Regulations in India

CHAPTER – ENVIRONMENTAL CONSTITUTIONALISM

- a. Fundamental Rights and Environment
 - i) Right to EqualityArticle 14

- ii) Right to InformationArticle 19
- iii) Right to LifeArticle 21
- iv) Freedom of Trade vis-à-vis Environment Protection
- b. The Forty-Second Amendment Act
- c. Directive Principles of State Policy & Fundamental Duties
- d. Judicial Activism and PIL.

SUGGESTED READINGS

- Bharucha, Erach. Text Book of Environmental Studies. Hyderabad: University Press (India) Private limited, 2005.
- Doabia, T. S. Environmental and Pollution Laws in India. New Delhi: Wadhwa and Company, 2005.
- Joseph, Benny. Environmental Studies, New Delhi: Tata McGraw-Hill Publishing Company Limited, 2006.
- Khan, I. A. Text Book of Environmental Laws, Allahabad: Central Law Agency, 2002.
- Leelakrishnan, P. Environmental Law Case Book. 2nd Edition. New Delhi: LexisNexis Butterworths, 2006.
- Shastri, S. C (ed). Human Rights, Development and Environmental Law, An Anthology. Jaipur: Bharat law Publications, 2006.
- Environmental Pollution by Asthana and Asthana, S, Chand Publication
- Environmental Science by Dr. S.R.Myneni, Asia law House
- Gurdip Singh, Environmental Law in India (2005) Macmillan.
- Shyam Diwan and Armin Rosencranz, Environmental Law and Policy in India –
- Cases, Materials and Statutes (2nd ed., 2001) Oxford University Press.

JOURNALS :-

- Journal of Indian Law Institute, ILI New Delhi.
- Journal of Environmental Law, NLSIU, Bangalore.

MAGAZINES :-

- Economical and Political Weekly
- Down to Earth.

COURSE TITLE:	
Evolution and Functional Anatomy of Fish Theory	
CREDIT: 06	HOURS: 90
THEORY: 06 PRACTICAL:00	THEORY: 90 PRACTICAL:0

MARKS

THEORY: 100 (80+20)

PRACTICAL:0

OBJECTIVE: The main objective is to furnish the process of evolution, its importance and let the students know the functional anatomy of fish.

UNIT-1.....20 Hours

Origin, diversity and distribution- origin and evolution of major groups of fishes, evolutionary strategies and morphological innovations, gene and genome duplication, evolutionary genetics, biogeographical distribution, methods employed in phylogenetic studies and fish identification, fish barcoding.

UNIT-215Hours

Fish as a research model. Body form, swimming mechanisms and buoyancy regulation- propulsive systems, hydrodynamic analyses, swimming modes, fish biomodelling, bioenergetics, strategies for buoyancy regulation. Gas exchange, internal transport and homeostasis- aquatic and aerial respiration, cardiovascular physiology, hematology, fish leucocytes, phagocytes, lymphoid organs, gas transport, osmoionic regulation, acid- base balance, nitrogen excretion and metabolism.

UNIT-320 Hours

Sensory systems- photoreception, chemoreception, mechanoreception, electroreception. Adaptations to environmental extremes- temperature, pressure, stressors. Growth and metabolism- regulation of food intake by neuropeptides and hormones, environmental factors and feed intake, digestive physiology and nutrient digestibility in fishes, nutritional energetic, growth.

UNIT-4-20 Hours

Defense mechanism- integument and Immune system, development of immune system, cells and tissues of the fish immune system, modulators of fish immune responses, humoral and cell-mediated immune defense, fish antibody molecules and their effector functions. Reproduction- reproductive strategies, environmental and endocrine factors regulating reproductive cycles, hormonal and molecular mechanisms of oogenesis, spermatogenesis, oocyte maturation and spermiation, fertilization, mechanism of sex determination, maternal factors in early development.

OBJECTIVE: The main objective is to furnish the process of evolution, its importance and let the

UNIT-5-15Hours

Endocrines- piscine endocrine glands, hormones and their role in appetite, osmoregulation, calcium metabolism, cardiovascular regulation and behaviour, hormone receptors, in fish, endocrine disruption, behaviour and cognition, patterns of migration, orientation and homing, schooling, feeding, background adaptations, parental care.

SUGGESTED READINGS

1. *Biology of Fishes*, Bone, Q. and Moore, R., Talyor and Francis Group, CRC Press, U.K.
2. *The Physiology of Fishes*, Evans, D. H. and Claiborne, J. D., Taylor and Francis Group, CRC Press, UK
3. *The Senses of Fish Adaptations for the Reception of Natural Stimuli*, von der Emde, R., Mogdans, J. and Kapoor, B. G., Narosa Publishing House, New Delhi, INDIA

COURSE TITLE:	
Aquatic Resources and Their Conservation	
CREDIT: 06	HOURS: 90
THEORY: 06 PRACTICAL:00	THEORY: 90 PRACTICAL:0
MARKS	
THEORY: 100 (80+20)	PRACTICAL:0

OBJECTIVE: This course is aimed towards generating fundamental knowledge, concepts related to aquatic resources and their conservation

UNIT-1- 18 Hours

Riverine fisheries- important river systems and their hydrological conditions, flora and fauna with special reference to fisheries, dams and their impact on riverine fisheries, fish ladders, interlinking of rivers and likely impact on fisheries. Cold water fisheries - ecology of hill streams, biology of important cold water fishes of India, recreational fishing. Lacustrine fisheries - origin of lakes and lake morphology, light, temperature and density relationship in the lacustrine ecosystems, heat energy and water movements, oxygen and other dissolved gases in lakes, pH and redox potential, fisheries profile and potential of major Indian lakes.

UNIT-2- 18Hours

Estuarine fisheries- major estuarine systems of India, hydrography, flora and fauna with special reference to fisheries. Marine fisheries – coastal and deep sea fisheries, permanent and seasonal stratification, upwelling, the photic zone, control of primary production by light and nutrients availability, chemical properties of sea water, biology of important fishes (sardine, mackerel, tuna), marine protected areas.

UNIT-3- 18 Hours

Integrated resources- coastal wet lands, mangroves, coral reefs, sea grasses and their conservation. Fishing techniques-- technologies for localizing catches- remote sensing, sonar, radar; crafts and gears. Stock assessment and management.

UNIT-4- 18 Hours

Natural markers- morphological analyses, environmental signals, genetic analyses; Applied markers- marking and tagging, Stock identification data analysis - stock composition analysis, age and growth, fecundity estimation, application of statistical methods in fisheries. Fish conservation- fishing laws and regulation, permitting. Post harvest technology-- Fish spoilage, rigor mortis, rancidity, enzymatic spoilage, microbial spoilage; Fish preservation and processing- handling of fish at harvest/onboard, principles of fish preservations, methods of preservation, problems associated with fish preservations, quality control, fishery by-products.

UNIT-5- 18 Hours

Aquatic pollution- types and sources, impact of pollution on aquatic organisms, ecosystem analysis- bio-indicators, biomonitoring, environmental factors and fish health, xenobiotics. Waste management- national and international standards. Extension services - basic principles and emerging issues of extension, role of information and communication technology in fisheries extension.

SUGGESTED READINGS

1. *Computers in Fisheries Research*, Megrey, B. A. and Moksness, E. (2009), Springer, USA
2. *Biological Invasions in Marine Ecosystems Ecological, Management and Geographic Perspectives*. Rilov, G. and Jeffrey, A. C. (2009), Springer-Verlag, GERMANY
3. *Handbook of Fisheries and Aquaculture, Indian Council of Agricultural Research*, ICAR, (2006), DIPA, New Delhi, INDIA

M.Sc. (ZOOLOGY)
COURSE CODE:ZOOB04

IInd SEMESTER
COURSE TYPE: ECC/CB

COURSE TITLE:
Aquaculture

CREDIT: 06
THEORY: 06 PRACTICAL:00

HOURS: 90
THEORY: 90 PRACTICAL:0

MARKS

THEORY: 100 (80+20)

PRACTICAL:0

OBJECTIVE: The purpose of this course is to make students understand Aquaculture. This knowledge is crucial for better development and management of aquaculture.

UNIT-1- 18 Hours

Culture technology- freshwater (carps, catfishes, murels, prawns), brackish water (asian sea-bass, milk fish, mullets, crabs, shrimps), mariculture (mussels, oysters, sea weeds), fish food organisms (algae; *Artemia*; zooplankton).

UNIT-2- 18 Hours

Water Quality Requirements for Aquaculture- Role of temperature, pH, salinity, dissolved oxygen, ammonia, nitrite, nitrate, phosphate, Biological oxygen demand, Chemical oxygen demand. Integrated farming - fish-cum-live stock farming, paddy-cum-fish farming, aquaculture engineering- aquahouse, hatchery, ponds, race ways, recirculating system, cage, pen.

UNIT-3-18 Hours

Fish seed technology - natural collection, bundh breeding, induced breeding, cryopreservation of gametes. Transport of finfish and shellfish- transport of eggs, fry, fingerlings and adults. Nutrition of aquatic animals - nutritional requirements of commercially important finfish and shellfish, dietary requirements of larvae and brooders, feed types, manufacture and ingredients, anti-nutritional factors in fish feed ingredients and their treatments, use of attractants and growth stimulants in fish feeds, alternative protein sources in aquaculture diets, feeding techniques, role of probiotics in nutrition.

UNIT-4-18 Hours

Setting up of display aquarium- freshwater and marine aquaria, selection of compatible species, breeding of aquarium fishes. Role of genetics in aquaculture- gynogenesis, androgenesis, triploidy, tetraploidy, hybridization, sex reversal and breeding, production of transgenic fish, impact of GMOs on aquatic biodiversity.

UNIT-5- 18 Hours

Fish health- infection and diseases in fish, common fish pathogens, routes of pathogen entry in fish, methods of colonization and spread of pathogens, immune - evasion mechanisms of fish pathogens. Environmental impact of aquaculture- aquacultural wastes and future developments in waste minimization, environmental consequences of hypereutrophication. Fish vaccines-strategy and use in aquaculture.

SUGGESTED READINGS

1. *Fishponds in Farming Systems*, Zijpp, V. D., Verreth, J. A. J., Tri, L. Q., van Mensvoort, M. E. F., Bosma, R. H., and Beveridge, M. C. M., Wageningen Academic Publishers, Netherlands.
2. *Aquaculture Principles and Practices*, Pillay, T. V. R., Blackwell Publishing, USA
3. *Aquaculture and Fisheries Biotechnology Genetic Approaches*, Dunham, R. A., CABI Publishing, USA.

THIRD SEMESTER (ODD SEMESTER)

Eligibility Criteria/Qualifying Exams

After appearing in the Second semester examination irrespective of any number of back/ arrears papers

Course Code	Course Type	Course (Paper/Subjects)	Credits	Contact Hours Per			EoSE Duration	
				L	T	P	Thy	P
ZOO301	CCC	Comparative Animal Physiology	5	4	2	0	3	0
ZOO301	CCC	Comparative Animal Physiology-LABORATORY WORK	2	0	0	3	0	3
ZOO302	CCC	Developmental Biology	5	4	2	0	3	0
ZOO312	CCC	Developmental Biology-LABORATORY WORK	2	0	0	3	0	3
ZOO303	CCC	Immunology	5	4	2	0	3	0
ZOO313	CCC	Immunology-LABORATORY WORK	2	0	0	3	0	3
ZOO S02	OSC	INTELLECTUAL PROPERTY, HUMAN RIGHTS & ENVIRONMENT: BASICS	6	4	3	0	3	0
ZOO C 01	ECC/CB	TRIBAL STUDIES						
ZOOC02	ECC/CB	Molecular Endocrinology and Reproduction- Neuroendocrinology						
ZOOC03	ECC/CB	Molecular Endocrinology and Reproduction- Molecular Endocrinology	6	4	0	0	0	0
ZOO C 04	ECC/CB	Molecular Endocrinology and Reproduction- Biology of Reproduction						
		TOTAL	33					

COURSE TITLE:
Comparative Animal Physiology

CREDIT: 07
THEORY: 05 PRACTICAL:02

HOURS: 135
THEORY: 90 PRACTICAL:45

MARKS

THEORY: 100 (80+20) PRACTICAL:00

OBJECTIVE: This course is aimed towards generating fundamental knowledge of comparative animal physiology. This knowledge is crucial for better development and management of comparative animal physiology.

UNIT-1/15 Hours

Internal Transport and Gas Exchange – Systems of circulation, Peripheral circulation, Regulation of heart beat and blood pressure, Transport and exchange of gases, Neural and chemical regulation of respiration, Gas transfer in air and water, Gas exchangers,

UNIT-2/20 Hours

Circulatory and respiratory responses to extreme conditions, Acid-base balance, Regulation of body pH.

UNIT-3/15 Hours

Osmoregulation Osmoregulation in aquatic and terrestrial environments, Kidney functions and diversity, Extra-renal osmoregulatory organs, Patterns of nitrogen excretion. Thermoregulation - Heat balance in animals, Adaptations to temperature extremes, torpor, Aestivation and hibernation, Counter current heat exchangers. Adaptations to Stress- basic concept of environmental stress, acclimation, acclimatization, avoidance and tolerance, stress and hormones.

UNIT-4/25 Hours

Sensing the Environment- photoreception, chemoreception, mechanoreception, echolocation, Endogenous and exogenous biological rhythms, Chromatophores and bioluminescence.

UNIT-5/15 Hours

Feeding mechanisms and their control, effect of starvation. Muscle physiology – striated and smooth muscle, Adaptations of muscles for

various activities, Neuronal control of muscle contraction, Electric organs.

LABORATORY WORK (ENV-311)

1. Observe and compare the inherent rhythmicity of the different parts of the heart.
2. Determine the effects of application of parasympathetic or sympathetic agonists/ antagonists.
3. Assessing physical and chemical modifiers of heart rate in frog.
4. Determine the response of the heart to direct electrical stimulation /vagal stimulation.
5. Effects of drugs and hormones on contraction of smooth muscles.
6. Demonstration of tetany, action current and fatigue in muscle.
7. To study the effect of load on muscle contraction.
8. Concentration / dispersal of pigment in isolated scales of dark / light adapted fish.
9. To examine the relative activity of enzymes in the fore, mid, and hindgut of a typical insect and to correlate the enzyme activity with gut regions.
10. To determine the median threshold concentration of sucrose for housefly population.

SUGGESTED READINGS

1. General and Comparative Animal Physiology, Hoar W. S. (ed), Prentice Hall, India
2. Comparative Physiology (Handbook of Physiology): Vol. 1, 2, Dantzler, W.H. (ed.) Oxford University Press, New York, USA
3. Animal Physiology: Adaptation and Environmental, Nelson K. S. (ed) Cambridge University Press, Cambridge, UK

COURSE TITLE:
Developmental Biology

CREDIT: 07

HOURS: 135

THEORY: 05 PRACTICAL:02

THEORY: 90 PRACTICAL:45

MARKS

THEORY: 100 (80+20)

PRACTICAL:00

OBJECTIVE: The purpose of the course is to make the students to understand developmental biology.

UNIT-1 /18Hours

History and basic concepts: the origin of developmental biology- cell theory, mosaic and regulative development, discovery of induction, genetics and development; basic concepts of developmental biology- cell division, cell differentiation, signaling, patterning; model systems: vertebrates model organism- *Xenopus laevis*, chicken, mammals, zebrafish; invertebrate model organism- *Drosophila melanogaster*, *Caenorhabditis elegans*; identification of developmental genes: spontaneous and induced mutation, mutant screening, developmental mutations in *Drosophila*.

UNIT-2 / 15 Hours

Early embryonic development of vertebrates and invertebrates: structure of the gametes- the sperm, the egg; cleavage and gastrulation; axes and germ layers; morphogenesis- cell adhesion, cleavage and formation of blastula, gastrulation, neural tube formation, cell migration; Axis specification in *Drosophila*; origin of anterior- posterior and dorsal- ventral patterning- role of maternal genes, patterning of early embryo by zygotic genes; segmentation genes- the gap genes, the pair rule genes, the segment polarity genes; the homeotic selector genes- bithorax and antennapedia complex.

UNIT-3/ 18 Hours

General concepts of organogenesis: development of chick limb- development and patterning of vertebrate limb, proximal- distal and dorso- ventral axis formation, homeobox genes in patterning, signaling in patterning of the limb; insect imaginal disc- determination of wing and leg imaginal discs, organizing center in patterning of the wing, butterfly wing development, the homeotic selector genes for segmental identity; insect compound eye- morphogenetic furrow, ommatidia, signaling, eyeless gene; kidney development- development of ureteric bud and mesenchymal tubules.

UNIT-4/ 18 Hours

Postembryonic development: growth- cell proliferation, growth hormones; aging- genes involved in alteration in timing of senescence; regeneration- epimorphic regeneration of reptile (salamander) limb, requirement of nerves for the proliferation of blastema cells;

UNIT-5/ 18 Hours

Embryonic stem cells and their applications; medical implications of developmental biology: genetic errors of human development- the nature of human syndromes- pleiotropy, genetic heterogeneity, phenotypic variability, mechanism of dominance; gene expression and human disease- inborn errors of nuclear RNA processing, inborn errors of translation; teratogenesis- environmental assaults on human development- teratogenic agents like alcohol, retinoic acid etc.

LABORATORY WORK (ENV-312)

1. Study of life cycle of *Drosophila melanogaster*.
2. Study of embryogenesis in *Drosophila* and pattern of gene expression in embryogenesis by *in situ* hybridization technique.
3. Immunohistochemical staining to study the expression pattern of gap and pair- rule gene proteins.
4. Dissection and study of larval and prepupal wing, leg and eye antennal

imaginal discs of *Drosophila*.

5. Patterning of the adult wing and demonstration of the effect of cell death on the patterning of the adult wing.
6. Study of Homeotic gene mutations.
7. Influence of temperature and teratogenes on animal development.
8. Study of regeneration in *Hydra*.

SUGGESTED READINGS

1. *Developmental Biology*, Gilbert, (8th Ed., 2006) Sinauer Associates Inc., Massachusetts, USA.
2. *Principles of Development*, Wolpert, Beddington, Brockes, Jessell, Lawrence, Meyerowitz, (3rd Ed., 2006), Oxford University Press, New Delhi, INDIA.
3. *Analysis of Biological Development*, Kalthoff, (2nd Ed., 2000), McGraw-Hill Science, New Delhi, INDIA.

M.Sc. (ZOOLOGY)
COURSE CODE:ZOO303

IIIrd SEMESTER
COURSE TYPE: CCC

COURSE TITLE:
Immunology

CREDIT: 07

HOURS: 135

THEORY: 05 PRACTICAL:02

THEORY: 90 PRACTICAL:45

MARKS

THEORY: 100 (80+20)

PRACTICAL:00

OBJECTIVE: This course is aimed towards generating fundamental knowledge concept related to immunology.

UNIT-1/ 30 Hours

Overview of the immune system: components of the immune system, principles of innate and adaptive immunity, the recognition and effector mechanisms of the adaptive immunity- antigen and immunogenicity, clonal selection theory.

UNIT-2/.. 10 Hours

Antigen recognition by immune cells: Adaptive immunity- antibody structure, antigen recognition by B lymphocytes, TCR, antigen recognition by T- cells, co- receptors, structure and function of MHC complex; generation of lymphocyte antigen receptors- generation of diversity in immunoglobulins, T- cell receptor gene rearrangement, structural variations in immunoglobulin constant regions; antigen processing and presentation to T lymphocytes- antigen presenting cells, generation of T- cell receptor ligand, and MHC restriction, role of CD1 in antigen presentation;

UNIT-3/ 15 Hours

Innate Immunity- pattern recognition in the innate immune system, role of TLRs in innate immune response, complement and innate immunity, induced innate response to infection.

UNIT-4/ 20 Hours

Effector mechanisms and regulation of immune responses: Signaling through immune system receptors- antigen receptor structure and signaling pathways, other signaling pathways that contribute to lymphocyte behavior; development and survival of lymphocytes- B lymphocyte development and survival, humoral immune response, T lymphocyte development and survival, production of effector T- cells,

cytotoxic T- cell effector mechanisms; NK and NKT cell functions; mucosal immunity; immunological memory; regulation of immune response: cytokines and chemokines, complement system, leukocyte activation and migration, APC regulation of the immune response, T-cell mediated regulation of immune response, Immunological tolerance and allergy.

UNIT-5/ 15 Hours

Immunity in health and disease: introduction to infectious disease, innate immunity to infection, adaptive immunity to infection, evasion of the immune response by pathogens; immunodeficiency diseases- inherited immunodeficiency diseases, acquired immune deficiency syndrome; allergy and hypersensitivity- IgE and allergic reactions, hypersensitivity diseases; autoimmunity- responses to self antigens, transplant rejection- responses to alloantigens; manipulation of immune responses, vaccines; evolution of immune system- evolution of innate immune system, evolution of adaptive immune system.

LABORATORY WORK (ENV-313)

Dissection of primary and secondary immune organs from mice:

- a. Preparation of single cell suspension from bone marrow and spleen (spleenocytes) of mice.
- b. Cell counting and viability testing of the spleenocytes prepared.
2. Preparation and study of phagocytosis by splenic/peritoneal macrophages.
3. Raising polyclonal antibody in mice, serum collection and estimating antibody titre in serum by following methods:
 - a. Ouchterlony (double diffusion) assay for Antigen -antibody specificity and titre.
 - b. ELISA
4. Antibody purification from the serum collected from immunized mice: affinity purification/chromatography.
5. Immunoelectrophoresis.
6. Demonstration of Western blotting;
- a. Protein estimation by Lowry's method/Bradford's method

- b. SDS-PAGE.
- c. Immunoblot analysis.

SUGGESTED READINGS

1. Kuby Immunology, Richard, Thomas, Barbara, Janis, (5th Ed., 2003), W. H. Freeman and company, New York, USA.
2. Immuno Biology- The immune system in health and disease, Janeway, Travers, Walport and Shlomchik, (6th Ed., 2005), Garland Science Publishing, New York, USA.
3. Immunology, David, Brostoff and Roitt, (7th Ed., 2006), Mosby & Elsevier Publishing, Canada, USA.

**COURSE TITLE: INTELLECTUAL PROPERTY RIGHTS,
HUMAN RIGHTS & ENVIRONMENT: BASICS**

CREDIT: 06
THEORY: 06

HOURS: 90
THEORY: 90

MARKS : 100
THEORY: 80

CCA: 20

OBJECTIVE:

- Understands the concept and place of research in concerned subject
- Gets acquainted with various resources for research
- Becomes familiar with various tools of research
- Gets conversant with sampling techniques, methods of research and techniques of analysis of data.

UNIT-1 12 Hrs

- Patents :- Introduction & concepts, Historical Overview.
- Subject matter of patent.
- Kinds of Patents.
- Development of Law of Patents through international treaties and conventions including TRIPS Agreement.
- Procedure for grant of patents & term of Patent.
- Surrender, revocation and restoration of patent.
- Rights and obligations of Patentee
- Grant of compulsory licenses
- Infringement of Patent and legal remedies
- Offences and penalties
- Discussion on leading cases.

UNIT-2 24 Hrs

- Meaning of Copyright, Historical Evolution,
- Subject matter of copyright.
- Literary works
- Dramatic Works & Musical Works
- Computer Programme

- Cinematographic films
- Registration of Copyrights
- Term of Copyright and Ownership of Copyrights
- Neighboring Rights
- Rights of Performers & Broadcasters
- Assignment of Copyright.
- Author's Special Rights (Moral Rights)
- Infringement of Copyrights and defenses
- Remedies against infringement (Jurisdiction of Courts and penalties)
- International Conventions including TRIPS Agreement WIPO, UCC, Paris Union, Berne Convention, UNESCO.
- Discussion on leading cases.

UNIT-3 10 Hrs

- Rights: Meaning
- Human Rights- Meaning & Essentials
- Human Rights Kinds
- Rights related to Life, Liberty, Equals & Disable

UNIT-4 24 Hrs

- National Human Rights Commission
- State Human Rights Commission
- High Court
- Regional Court
- Procedure & Functions of High & Regional Court.

UNIT-5 20 Hrs

- Right to Environment as Human Right
- International Humanitarian Law and Environment
- Environment and Conflict Management
- Nature and Origin of International Environmental Organisations (IEOs)
- Introduction to Sustainable Development and Environment
- Sustainable Development and Environmental Governance

SUGGESTED READINGS

1. G.B.Reddy, *Intellectual Property Rights and Law*, Gogia Law Agency, Hyderabad-
2. S.R.Myneni, *Intellectual Property Law*, Eastern Law House, Calcutta

3. P Narayanan *Intellectual Property Rights and Law (1999)*, Eastern Law House, Calcutta, India
4. Vikas Vashistha, *Law and Practice of Intellectual Property*, (1999) Bharat Law House, New Delhi
5. Comish W.R *Intellectual Property, 3rd ed. (1996)*, Sweet and Maxwell
6. P.S. Sangal and Kishor Singh, *Indian Patent System and Paris Convention*,
7. Comish W.R *Intellectual Property, Patents, Copyrights and Allied Rights, (2005)*
8. Bibek Debroy, *Intellectual Property Rights, (1998)*, Rajiv Gandhi Foundation.

SUGGESTED READINGS

1. G.H. Reddy, *Intellectual Property Rights and Law*, Gupta Law Agency, Hyderabad.
2. S.R. Mysore, *Intellectual Property Law*, Eastern Law House, Calcutta.

M.Sc. (ZOOLOGY)
COURSE CODE: ZOOC01

IIIrd SEMESTER
COURSE TYPE: ECC/CB

COURSE TITLE: TRIBAL STUDIES

CREDIT: 06
THEORY: 06 PRACTICAL: 0

HOURS: 90
THEORY: 90 PRACTICAL: 00

MARKS :100

THEORY: 80

CCA : 20

OBJECTIVE:

- Understands the concept and place of research in concerned subject
- Gets acquainted with various resources for research
- Becomes familiar with various tools of research
- Gets conversant with sampling techniques, methods of research and techniques of analysis of data
- Achieves skills in various research writings
- Gets acquainted with computer Fundamentals and Office Software Package.

UNIT - 1 12 Hrs

Tribal Studies : Meaning, Nature, Scope, Need & importance of tribal studies. Meaning, Definition & characteristics of Tribe, Caste & Race.

UNIT - 2 24 Hrs

Scheduled Tribe in India : Population Composition of tribal, classification of Indian Tribe – Racial, Lingual, Geographical, Cultural.

Some Major Tribes in India : Santhal, Khasi, Munda, Bhils.

Some Major Tribes in Central India : Gond, Baiga, Bhabha, Korkus.

UNIT - 3 10 Hrs

Illiteracy : Poverty, Indebtedness, Unemployment, migration & Exploitation Environmental & Degradation.

Problem of Health and sanitation :

Prostitution, Culture Decay due to assimilation. Replacement & Rehabilitation of Tribal population.

UNIT - 4 24 Hrs

Welfare-Concept, Characteristics: Tribal Welfare in post independence period. Constitutional provision & safe guard after independence, Legislation & Reservation Policy.

UNIT - 5 20 Hrs

Tribal Development Programs for Scheduled Tribes : Medical, Education, Economy, Employment & Agriculture Evaluation of Programs

Tribal Welfare & Advisory Agencies in India : Role of NGO's in tribal development, Role of Christian missionaries in tribal welfare & development. Tribal Welfare Administration.

SUGGESTED READINGS

Tribal Development In India (Orissa) by Dr. Taradutt

Books on Tribal studies by PK Bhowmik

Books on 'Tribal Studies' by W.G. Archer

M.Sc. (ZOOLOGY)
COURSE CODE:ZOOC02

IIIrd SEMESTER
COURSE TYPE: ECC/CB

COURSE TITLE: Molecular Endocrinology and Reproduction- Neuroendocrinology	
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CREDIT: 06

HOURS: 90

THEORY: 06 PRACTICAL: 0

THEORY: 90 PRACTICAL: 00

MARKS :

THEORY: 100 (80+20)

PRACTICAL: 00

OBJECTIVE: The purpose of the course is to make the students to understand molecular endocrinology and reproduction neuroendocrinology.

UNIT-1/ 18 Hours

General organization of neuroendocrine organs and nervous system. Neuroanatomy: form, varieties and distribution of neurons; Structural characteristics of neurons; Stereotaxic atlas of rat brain and the hypothalamus. Neurophysiology: electrical properties of neurons and propagation of nerve impulses; Synapse: types, structure and function. Neurotransmitter and its release; Neuromodulation:

UNIT-2/ 18 Hours

Neurotransmitter vs neuropeptides, Synaptic transmission: role of G-protein coupled, glutamate and on-channel linked receptors; GABA/glutamate neurons in adult preoptic area: sexual dimorphism and function.

UNIT-3/ 18 Hours

The hypothalamo- hypophyseal axis. Hypothalamo- vascular system. Hormones from hypothalamus: chemistry and physiology of releasing and release inhibiting hormones; Regulation of hypothalamic hormone secretion. Hypothalamo- hypophyseal interactions with the gonads, adrenal and other endocrine organs. Diversity of ovarian steroid signaling in the hypothalamus. Development and cytology of pituitary gland. Regulation of pituitary hormone secretion. Neurohypophysis: synthesis and storage of oxytocin and vasopressin; Regulation of the release of neurohypophyseal hormones. Concepts of feed-back inhibition and feed-forward activation.

UNIT-4/ 18 Hours

Regulation of the expression of POMC-related peptides and their differential expression in brain and pituitary. Environment and reproduction. Endocrine disruptors; Embryonic diapause and other adaptive mechanisms. Biological clock and the pineal: synthesis and regulation of melatonin, phylogeny of pinealocytes, role of pineal in circadian rhythms, regulation of pineal by SCN and vice versa, physiological actions of melatonin, biological clock and clock gene expression, fluoride and pineal.

UNIT-5/ 18 Hours

Neuroendocrine regulation of immune system; Stress hormones and immune responses; Regulation of systemic homeostasis by nervous and immune system interactions. Melatonin, immune responses and cancer therapy. Neuroendocrine disorders: genetic versus environmental cause. Principles and application of techniques: electrophysiology, immunocytochemistry, *in situ* hybridization, autoradiography, *in vitro* perfusion

SUGGESTED READINGS

1. An Introduction to Neuroendocrinology, Brown R., (1994), Cambridge University Press, Cambridge, UK
2. Psychoneuroimmunology, Ader R, Felten D.L. and edited by Nicholas C. (4th Ed., 2007), Academic Press, UK
3. Endocrinology (3 volumes set), DeGroot L. J. and Jameson J.L., Editors, (5th Ed., 2006), Saunders Elsevier Press, USA.

M.Sc. (ZOOLOGY)
COURSE CODE:ZOOC03

IIIrd SEMESTER
COURSE TYPE: ECC/CB

COURSE TITLE: Molecular Endocrinology and Reproduction-Molecular Endocrinology

CREDIT: 06

HOURS: 90

THEORY: 06 PRACTICAL:0

THEORY: 90 PRACTICAL:00

MARKS :

THEORY: 100 (80+20)

PRACTICAL:00

OBJECTIVE: The purpose of the course is to make the students to understand molecular endocrinology and reproduction neuroendocrinology.

UNIT-1/ 15 Hours

Discovery of hormones as chemical signals for control and regulation of physiological processes. Nature of hormonal actions. Major questions in biology of hormones. Techniques for quantitation of hormones. Design and development of hormonal assays.

UNIT-2/ 20 Hours

Structure of peptide and protein hormones. Purification and characterization of hormones. Structure-Function relationships in different hormones. Phylogenetic analysis of hormonal structures and functions. Biosynthesis of protein hormones. Storage and secretion of hormones: molecular mechanisms of regulation.

UNIT-3/ 20 Hours

Transcriptional and post-transcriptional mechanisms of hormone biosynthesis and secretion. Regulation of biosynthesis and secretion. Inhibitors of hormone biosynthesis and their use.

UNIT-4/ 15 Hours

Nature of hormonal effects and actions. Discovery of receptors in target tissues. Mechanisms of hormone action and signal attenuation.. Signal discrimination, signal transduction and signal amplification in hormone regulated physiological processes. Structural requirements for successful hormone-receptor interactions. Receptor antagonists

and their applications. Metabolism of hormones by target and non-target tissues. Pharmacokinetics of hormones. Hormones and behavior- cellular and molecular actions of semiochemicals.

UNIT-5/ 20 Hours

Hormones as therapeutic agents. Current developments in design and production of hormonal contraceptives. Recombinant protein hormones-production and application in regulation of fertility in farm animals and humans. Evolution of chemical communication in animal systems. Unsolved problems in hormonal biology.

SUGGESTED READINGS

1. Peer reviewed journal articles, monographs and reviews as and when recommended.
2. Molecular Biology of Steroid and Nuclear Hormone receptors, ed. Freedman L. P., (1998), Birkhauser, Boston, USA.
3. Biochemical actions of hormones, ed. Litwack, G. (1985), Academic press, New York, USA

M.Sc. (ZOOLOGY)
COURSE CODE:ZOOC04

IIIrd SEMESTER
COURSE TYPE: ECC/CB

COURSE TITLE: Endocrinology and Reproduction - Biology of Reproduction

CREDIT: 06

THEORY: 06 PRACTICAL:0

HOURS: 90

THEORY: 90 PRACTICAL:00

MARKS :

THEORY: 100 (80+20)

PRACTICAL:00

OBJECTIVE: The purpose of the course is to make the students to understand molecular endocrinology and reproduction neuro-endocrinology.

UNIT-1/ 18 Hours

Sex determination and differentiation: Mechanism of Sex determination, differentiation of gonad and the genital tract.

UNIT-2/ 18 Hours

Stem cell renewal in testis, Spermatogenesis: structural and molecular events, experimental approaches to study spermatogenesis; Seminiferous epithelial cycle; Sertoli cell: structure and function; Leydig cell: generation of Leydig cell, steroidogenesis; Leydig and Sertoli cell proliferation during foetal and postnatal development; Regulation of testicular functions.

UNIT-3/ 18 Hours

Epididymal maturation of spermatozoa; Capacitation, Signal transduction pathway in acrosome reaction; Male sterility: azoospermia, oligozoospermia, asthenozoospermia, varicocele; Genetic basis for male infertility, Mutational analysis in genes for hormones, receptor and gamete development.

UNIT-4/ 18 Hours

Follicular development and selection; Role of extra-and intra-gonadal factors in folliculogenesis; Oocyte maturation and its regulation; Ovulation: factors involved in follicular rupture; Luteinization and luteolysis; Follicular atresia.; Regulation of

reproductive cycle in female: menstrual cycle in human, estrous cycle in rat, estrous behaviour in cycling animals; Female reproductive disorder: amenorrhea, polycystic ovary.

UNIT-5/ 18 Hours

Fertilization: A comparative account on pre-fertilization events in oviparous animals (echinoderms-amphibians-mammals), activation of egg, candidate molecules involved in fertilization; Contraception leading to prevention of polyspermy: surgical, hormonal and immunocontraception.

SUGGESTED READINGS

1. *The Physiology of Reproduction, Vol 1 and 2*, Ernst Knobil and Jimmy D. Neil, (ed), Raven Press.
2. **Male Reproductive Function**, Christina Wang, (ed), Kluwer Academic Publishers.
3. *The ovary, (ed), Solly Zuckerman Zuckerman*, Barbara J. Weir, T. G. Baker. Academic Press.
4. *The ovary, Peter C.K. Leung and Eli Y. Adashi*, (ed), Elsevier (Academic Press), 2004.
5. *Cell and Molecular Biology of Testis, (ed)*, Claude Desjardins and Larry L. Ewing. Oxford University Press, USA
6. *Reproductive Endocrinology: Physiology, Pathophysiology, and Clinical Management*, Samuel S. C. Yen, Robert B. Jaffe, Robert L. Barbieri, (ed), Saunders publisher. USA.

M. Sc. in ZOOLOGY

FACULTY OF LIFE SCIENCE

FORTH SEMESTER (EVEN SEMESTER)

Eligibility Criteria (Qualifying Exams)

After appearing in the Third semester examination irrespective of any number of back/ arrear papers

Course Code	Course Type	Course (Paper/Subjects)	Credits	Contact Hours Per Week			EoSE Duration (Hrs.)	
				L	T	P	Thy	P
ZOO401	CCC	Animal Behavior	5	4	2	0	3	0
ZOO411	CCC	Animal Behavior- laboratory work	2	0	0	3	0	3
ZOO402	CCC	Biology of Parasitism	5	4	2	0	3	0
ZOO412	CCC	Biology of Parasitism- laboratory work	2	0	0	3	0	3
ZOO403	CCC	Comparative Endocrine Physiology	5	4	2	0	3	0
ZOO413	CCC	Comparative Endocrine Physiology- laboratory work	2	0	0	3	0	3
ZOO421	SSC/PRJ	DISSERTATION	6	0	0	9	0	4
ZOOD 01	ECC/CB	Genomics, Metagenomics and Epigenetics- Genomics	6	4	3	0	3	0
ZOOD 02	ECC/CB	Metagenomics - Epigenetics- Chromatin Biology						
			TOTAL-					
			32					

COURSE TITLE:

Animal Behavior

CREDIT: 07

HOURS: 135

THEORY: 05 PRACTICAL: 2

THEORY: 90 PRACTICAL:45

MARKS :

THEORY: 100 (80+20)

PRACTICAL: 0

OBJECTIVE: The purpose of the course is to make the students to understand about the animal behaviour

UNIT-1/ 18 Hours

Introduction - definition, historical out line, patterns of behaviour, objectives of behaviour, mechanism of behaviour, asking questions. Reflexes- reflex action, types of reflexes, reflex arch, characteristics of reflexes and complex behaviour. Orientation primary and secondary orientation; kinesis - orthokinesis, klinokinesis; taxis - different kinds of taxis; sun-compass orientation, dorsal- light reaction.

UNIT-2/ 18 Hours

Eusociality, social organization in honey bee, polyphenism and its neural control, flower recognition, displacement and translocation experiment, various type of communications, production of new queen and hive, swarming, honey bee as super organism.

UNIT-3/ 18 Hours

Fixed action pattern: mechanism, deprivation experiment, controversies. FAP- characteristics and evolutionary features. Learning and instincts: conditioning, habituation, sensitization, reasoning.

UNIT-4/ 18 Hours

Innate releasing mechanisms: key stimuli, stimulus filtering, supernormal stimuli, open and closed IRM, mimetic releaser, code breakers. Homeostasis and behaviour: motivational system, physiological basis of motivation, control of hunger drive in blow fly and thirst drive in goat, role of hormone, motivational conflict and decision making, displacement activity, models of motivation, measuring motivation. Hormones and pheromones influencing

behaviour of animals.

UNIT-5/ 18 Hours

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

LABORATORY WORK (ENV411)

1. To study the responses of woodlice to hygrostimuli.
2. To study the geotaxis behaviour of earthworm.
3. To study the orientational responses of 1st instar noctuid larvae to photo stimuli.
4. To study the median threshold concentration of sucrose solution in eliciting feeding responses of housefly.
5. To study the orientational responses of larvae to volatile and visual stimuli.

SUGGESTED READINGS

1. *Mechanism of Animal Behaviour*, Peter Marler and J. Hamilton; John Wiley & Sons, USA
2. *Animal Behaviour*, David McFarland, Pitman Publishing Limited, London, UK
3. *Animal Behaviour*, John Alcock, Sinauer Associate Inc., USA
4. *Perspective on Animal Behaviour*, Goodenough, McGuire and Wallace, John Wiley & Sons, USA
5. *Exploring Animal Behaviour*, Paul W. Sherman & John Alcock, Sinauer Associate Inc., Massachusetts, USA
6. *An Introduction to Animal Behaviour*, A. Manning and M.S Dawkins, Cambridge University Press, UK
7. *Animal Behaviour* by Ranga M.M. Agrobios, Jodhpur, India.

COURSE TITLE:
Biology of Parasitism

CREDIT: 07

THEORY: 05 PRACTICAL: 2

HOURS: 135

THEORY: 90 PRACTICAL:45

MARKS :

THEORY: 100 (80+20)

PRACTICAL: 0

OBJECTIVE: The purpose of the course is to make the students to understand biology of parasitism

UNIT-1 18 Hours

1 General organization and classification of parasitic protozoa .2 Morphology, Life cycle ,Mode of infection- Endameba. 3 Morphology ,Life cycle mode of infection -Trypanosome . 4 Morphology ,Life cycle in Guardia .6 Life cycle and infection of plasmodium .

UNIT-2 18 Hours

1 Gastro intestinal nematodes-Ascaris.2 Morphology life cycle in Wuchereia. 3 Morphology life cycle in Ancylostoma .4 Life cycle of Enterobius vermicularis .5 Trichinella .6 Dracanculus .

UNIT-3 18 Hours

1 General organigation and classification parasitic Cestodes .2.Life cycle of Parasitic Fasciola hepatica . Viral disease- 3 AIDS.4 Rabbis .4 Plague 5 Small pox .

UNIT-4 18 Hours

Bacterial disease -1 Tuberculosis .2 Leprosy .3 Fungal diseases -Mycosis .4 Reproduction in bacteria (Asexual and Sexual)5 Life cycle and infection -Leismania .

UNIT-5 18 Hours

Diseases transmitted by Insects and Ticks- 1 Sleeping sickness .2 Malaria 3 Rickettesiae .4 Plant parasite nematods .5 Gastro intestinal Helminthes -biology and life cycle Systosoma .

LABORATORY WORK (ZOO-412)

1. Study of prepared slides and museum specimens of selected parasites of representative groups of protozoans, helminths and arthropods.
2. Demonstration of *in vitro* culture of *Plasmodium*, infection of mice with *Plasmodium*, chasing the process of infection by histopathology and immune reactions.
3. Culturing insect parasitic nematode, and chasing the lifecycle of the nematode on the insect host.
4. Culturing an insect parasitoid and studying their infection on an insect host.
5. Studying the infection of tomato plant by root knot nematode.

SUGGESTED READINGS

1. Foundations of Parasitology, Roberts L.S. and Janovy J., McGraw-Hill Publishers, New York, USA.
2. Modern Parasitology: A Textbook of Parasitology, FEG Cox., Wiley-Blackwell, U. K.

COURSE TITLE:
Comparative Endocrine Physiology

CREDIT: 07

HOURS: 135

THEORY: 05 PRACTICAL: 2

THEORY: 90 PRACTICAL:45

MARKS :

THEORY: 100 (80+20)

PRACTICAL: 0

OBJECTIVE: The purpose of the course is to make the students to understand Endocrine physiology

UNIT-1/ 18 Hours

Concept of endocrinology: introduction to the endocrine system, classes of hormones, modes of hormone secretion. Phylogeny of endocrine system. Endocrine control of various physiological mechanisms in nemerteans, annelids, mollusks, arthropods (Insects and crustaceans) and echinodermites.

UNIT-2/ 18 Hours

Comparative aspects of endocrine physiology in vertebrates. Evolution of pituitary gland; Physiological actions of pituitary hormones. Urophysis and action of its hormone(s). Evolution of discrete adrenal gland; Synthesis of corticosteroid, structural diversity of glucocorticoids among vertebrates, role of glucocorticoid in gluconeogenesis;

UNIT-3/ 18 Hours

Evolution of renin-angiotensin system, hormonal control of water and electrolyte balance; Catecholamine biosynthesis, its storage and release mechanism, physiological actions of adrenal medullary hormones; Importance of adrenocortical and adrenomedullary interaction.

UNIT-4/ 18 Hours

Evolution of thyroid gland. Thyroid hormone synthesis and its regulation, paradigms of thyroid hormone action in poikilotherms

and homeotherms. A comparative account of parathyroid gland and ultimobranchial body/C cells, synthesis of parathyroid hormone, calcitonin and of vitamin D₃; benthic organisms and source of vitamin D; hormonal regulation of calcium and phosphate homeostasis.

UNIT-5/ 18 Hours

Hormonal control of feeding behaviour and gastrointestinal tract functioning including acid release, gall bladder contraction and relaxation, pancreatic enzyme secretion, and GI tract motility; Pancreatic hormones and glucose homeostasis; hormones, vitellogenesis and the evolution of viviparity.

SUGGESTED READINGS

1. Comparative Vertebrate Endocrinology, Bentley, P. J., Cambridge University Press, UK
2. Vertebrate Endocrinology, Norris D. O., Elsevier Academic Press,
3. Hand Book of Physiology, American Physiological Society, Oxford University Press, Section 7: Multiple volumes set.
4. The Insects: Structure and Function, Chapman, F.R., The English Language Book Society (ELBS) and The English Universities Press Ltd.
5. The Principles of Insect Physiology Wigglesworth, V. B., ELBS and Chapman and Hall.

COURSE TITLE:
Genomics, Metagenomics and Epigenetics- Genomics

CREDIT: 06	HOURS: 90
THEORY: 06 PRACTICAL: 2	THEORY: 90 PRACTICAL: 0

MARKS :
THEORY: 100 (80+20) PRACTICAL: 0

OBJECTIVE: The purpose of the course is to make the students to understand Genomics, Metagenomics and Epigenetics-Genomics

UNIT-1/ 15 Hours

Organization and structure of genomes - size, complexity, gene-complexity, virus and bacterial genomes, organelle genome, architecture of mitochondrial genome, conserved chloroplast DNA;

UNIT-2/ 15 Hours

organization and nature of nuclear DNA in eukaryotes; transposable elements, retro-teaspoons, SINE, LINE, Alu and other repeat elements, pseudogenes, segmental duplications.

UNIT-3/ 20 Hours

Mapping genomes - physical maps, EST, SNPs as physical markers, radiation hybrids, FISH, optical mapping, gene maps, integration of physical and genetic maps; sequencing genomes: high-throughput sequencing, strategies of sequencing, recognition of coding and non-coding regions and annotation of genes, quality of genome-sequence data, base calling and sequence accuracy.

UNIT-4/ 20 Hours

Bioinformatics - datasets, sequence analysis based on alignment, de novo identification of genes, *in silico* methods. Comparative genomics - orthologs and paralogs, protein evolution by exon shuffling; human genome project, comparative genomics of bacteria, organelles, and eukaryotes

UNIT-5/ 20 Hours

Large scale mutagenesis and interference - genome wide gene targeting; systematic approach, random mutagenesis, insertional

mutagenesis, libraries of knock-down phenocopies created by RNA interference; transcriptome analysis, DNA micro-array profiling, data processing and presentation, expression profiling, proteomics - expression analysis, protein structure analysis, protein-protein interaction.

SUGGESTED READINGS

1. Principle of Genome Analysis and Genomics, Primrose, S. B. and Twyman R. M., (7th Ed., 2006), Blackwell Publishing Company, Malden, USA
2. Genomes 3, Brown, T. A., Garland Science Publishing, London, UK
3. Bioinformatics: Sequence and Genome Analysis, Mount, D. W., Cold Spring Harbor Laboratory Press, New York, USA

COURSE TITLE:

Metagenomics- Epigenetics and Chromatin Biology

CREDIT: 06

HOURS: 90

THEORY: 06 PRACTICAL: 2

THEORY: 90 PRACTICAL:0

MARKS :

THEORY: 100 (80+20)

PRACTICAL: 0

OBJECTIVE: The purpose of the course is to make the students to understand Genomics, Metagenomics and chromatin biology

UNIT-1/ 20 Hours

Chromatin structure - basic organization of a eukaryotic genome; histone - structure and function; nucleosome as the fundamental particle; 30 nm chromatin fibers, higher order structure of chromatin, chromatin-territories; intra-nuclear spatial organization of chromatin: MARs and SARs and their importance

UNIT-2/ 20 Hours

Epigenetics - from phenomenon to field, a brief history of epigenetics - overview and concepts; chromatin modifications and their mechanism of action, concept of 'histone-code' hypothesis, epigenetics in *saccharomyces cerevistae*, position effect variegation, heterochromatin formation, and gene silencing in *Drosophila*

UNIT-3/ 20Hours

fungal models for epigenetic research: *Schizosaccharomyces pombe* and *Neurospora crassa*; epigenetics of ciliates; RNAi and heterochromatin assembly, role of noncoding RNAs; epigenetic regulation in plants.

UNIT-4/ 15 Hours

Chromatin structure and epigenetics marks - transcriptional silencing by polycomb group proteins , transcriptional regulation by trithorax group proteins, histone variants and epigenetics , epigenetic regulation of chromosome inheritance, epigenetic regulation of the X chromosomes in *C.elegans*, dosage compensation in *Drosophila*, dosage compensation in mammals; types mechanism of chromatin remodeling.

UNIT-5/ 15 Hours

Epigenetics and genome imprinting - DNA methylation in mammals, genomic imprinting in mammals, germ line and pluripotent stemcells , epigenetic control of lymphopoiesis , nuclear transplantaion and the reprogramming of the genome. epigenetics and human disease, epigenetic determinants of cancer.

SUGGESTED READINGS

1. *Epigenetics*, C. David Allis and Thomas Jenuwein, (2007) Cold Spring Harbor Laboratory Press, New York, USA
2. *Molecular Biology of Gene*, Watson et al., (5th Ed. 2004), Pearson Education, Delhi, INDIA