

**Programme Guide**  
**For**  
**M.Sc. Zoology**  
**(Programme Code: MSCZOO)**



**School of Sciences**  
**Indira Gandhi National Open University**  
**Maidan Garhi, New Delhi-110068**

## RECOGNITION

*The UGC Notification No. F. 1-1/2020(DEB-I) dated 4th Sept., 2020 regarding recognition of Degrees and Certificates acquired through ODL mode states as under:*

**— 22. Equivalence of qualification acquired through Conventional or Open and Distance Learning and Online modes.— Degrees at undergraduate and postgraduate level in conformity with UGC notification on Specification of Degrees, 2014 and post graduate diplomas awarded through Open and Distance Learning mode and/or Online mode by Higher Educational Institutions, recognised by the Commission under these regulations, shall be treated as equivalent to the corresponding awards of the Degrees at undergraduate and postgraduate level and post graduate diplomas offered through conventional mode.**

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**January, 2024**

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*Further information on Indira Gandhi National Open University courses may be obtained from the University's office at MaidanGarhi, New Delhi-110 068.*

Printed and published on behalf of the Indira Gandhi National Open University, New Delhi by  
Director, School of Sciences, Indira Gandhi National Open University, New Delhi.



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## ABOUT THE UNIVERSITY

The Indira Gandhi National Open University came into being on September 20, 1985, by an Act of Parliament to achieve the following objectives:

- democratising higher education by taking education to your doorsteps;
- providing access to high quality education to all those who seek it irrespective of age, region or formal qualifications;
- offering need-based academic programmes by giving professional and vocational orientation to the courses;
- Promoting and developing distance education in India.

The Indira Gandhi National Open University has an international jurisdiction, a nationwide student support service network, socially and academically relevant programmes based on students need analysis which are also cost effective, with provision for you to study at your own pace.

The University operates through its 21 Schools of Studies. The methodology of instruction in this university is different from that of the conventional universities. The Open University System is more learner-oriented, and the learner is an active participant in the teaching-learning process. Most of the instruction is imparted through distance mode rather than face-to-face communication. The University follows a multi-media approach for instruction. It consists of: self-instructional printed course material, audio and video programmes, the online repository of course related material – eGyankosh, face-to-face counselling at Learner Support Centres by academic counselors, assignments, laboratory work, teleconference/web conference, interactive radio counseling, WEAS (web enabled academic support) portal and the GyanDhara channel.



## **MESSAGE FROM THE PROGRAMME TEAM**

Dear Learner,

Congratulations on taking admission in M.Sc. (Zoology) programme at IGNOU! We extend you a warm welcome to this newly launched programme in the open and distance learning (ODL) mode. This programme is designed to provide you with a comprehensive and in-depth understanding of the fascinating field of Zoology.

The M.Sc. (Zoology) programme has advanced courses in all the important areas in zoology. As you know, classical Zoology forms an important basis in the study of advanced Zoology courses. Therefore, as a preparation for studying your M.Sc. Courses, it is advised that you should revise the classification i.e., invertebrate and vertebrate phyla, classes and orders and their characteristics that you have studied in your undergraduate programme. A strong foundation in these topics will greatly benefit you in grasping the concepts and applications covered in the courses of the programme.

The study materials for the courses are uploaded on the eGyankosh site (<https://egyankosh.ac.in/>) of IGNOU. The student support services such as counselling sessions for the theory courses and the practical sessions for the laboratory courses will be conducted at the designated Study Centres. The information regarding these activities will be made available on the website of your Regional Centre from time to time. IGNOU faculty will also provide you support through Web Enabled Academic support (WEAS) Portal of IGNOU. **You will be able to appear for your term-end examinations for the first time one year after your admission, for the courses of the first and second semesters, and every six months thereafter.**

This **Programme Guide** contains key information about the programme including the details of courses on offer, the syllabi of courses, how to study the courses, evaluation methods, rules and regulations and links to important forms .It will help you to navigate through the different stages of the programme and progress in it.

At all stages of your journey in IGNOU, please use the **IGNOU website** as your source of all the latest information on different aspects like cut-off dates for submission of different forms and fees for different services. Please check the IGNOU website regularly for announcements on these.

We are excited to have you join our M.Sc. (Zoology) programme and embark on this journey of intellectual growth and exploration. We are committed to providing you with a high-quality learning experience. You may reach out to us at our **dedicated email address** [msczoo@ignou.ac.in](mailto:msczoo@ignou.ac.in) for academic queries on the programme.

Once again, we extend our warmest welcome and wish you all the best in your pursuit of knowledge and excellence in the field of Zoology.

Sincerely,

**Programme Team (M.Sc. Zoology)**



## IGNOU WEBSITE

The IGNOU website is <http://www.ignou.ac.in>. It offers relevant information to the general public and student support facilities to the learners through the Single Window Information and Student Support (SWISS). These include:

- Online registration for fresh admission to various programmes
- Online Re-Registration
- Online submission of Term-End Examination Form
- Results of the Term End Examinations
- Checking status of study material
- Downloads of Assignments/Question papers/Forms
- Catalogue of audio/video programmes
- Schedule of GyanDarshan/GyanVani/ programmes
- Admission announcements
- Addresses of regional and Study Centres
- Updates on the latest happenings at the University
- Checking registration details
- Web Enabled Academic Support (WEAS)
- TEE date-sheet
- Examination Hall Ticket
- Course Completion Status
- Accessing eGyanKosh: using this web site you can download your course material and view videos related to your courses.
- Student Portal (after admission): <https://ignou.samarth.edu.in/>: **All students are advised to register on the Student Portal after confirmation of their admission and create their own Student Account.**



# 1. M.Sc. (ZOOLOGY) PROGRAMME

## Programme Code: MSCZOO

The M. Sc. (Zoology) programme housed in the School of Sciences has been designed by eminent experts and teachers of Zoology from across the country. The courses of this programme strive to cover all the core concepts in different areas of Zoology. It offers an exciting opportunity to people who are interested in Zoology and would like to pursue a career in teaching or research and development in Zoology and allied areas.

## Objectives of the Programme

This programme has the following broad objectives:

- to impart high quality higher education in Zoology;
- to equip the learners with core knowledge in Zoology and provide adequate analytical and laboratory training for pursuing higher education or a career in Zoology research and development;
- to prepare students for higher studies in interdisciplinary areas;
- provide an opportunity to the learners to upgrade their qualifications;
- to provide a focused insight into currently relevant branches of Zoology research through well designed elective courses;
- to foster academic integrity and professional ethics.

## Duration

The **minimum** duration of the programme is **two years**, which is divided into **four semesters**. The **maximum** period allowed for completion of the programme is **four years**.

## Medium of Instruction

The programme is available only in **English**.

## Programme Fee

The programme fee, exclusive of examination fee is Rs. 28,400/-\* for the full programme to be paid year wise @ Rs.14,200/- per year plus additional charges as applicable. As and when it is necessary, the University can revise the programme fee and the revised fee shall be payable by you as per schedule of payment notified by the University.

## Re-Registration

Learners have to submit the Re-Registration (RR) forms for the II<sup>nd</sup> year (comprising 3<sup>rd</sup> and 4<sup>th</sup> semester courses) 'Online' only on <https://ignou.samarth.edu.in/> as per schedule being notified by the University from time to time. Timely payment of fees is the responsibility of the students. Students are expected to remit fee as early as possible without waiting for the last date. In case, you fail to remit the fee as per the schedule, you will have to wait for next cycle of fee payment schedule. Non-payment of fee results in discontinuation of the dispatch of study material. Such students will not be permitted to write the examinations. In case any student willfully appears in the examination without proper registration for a course(s), the result shall not be declared.



Note that you have to re-register in the second year, irrespective of whether you have cleared all the Courses in your first and second semester. While the programme has a semester structure, the fee is to be paid annually. At the time of your admission you have paid the fee for the first year (1<sup>st</sup> and 2<sup>nd</sup> semesters). At the time of re-registration, you need to pay the fee for the second year (3<sup>rd</sup> and 4<sup>th</sup> semesters).

## 2. PROGRAMME STRUCTURE

Studies in this 2 year programme are divided into **4 semesters (2 semesters per year)**. To successfully complete this programme, you will have to earn **80 credits** over a period of 2 to 4 years depending on your convenience. These 80 credits comprise

1.	<b>Core Courses</b>	56 credits
2.	<b>Elective Courses</b>	24 credits
	<b>Total</b>	<b>80credits</b>

The details of these courses are given in Sec.5. After successfully completing the programme you will be awarded the **degree of M.Sc. (Zoology)**.

### Core Courses

The core courses are being offered in all four semesters of the programme. They deal with the fundamental concepts in different branches in Zoology and the allied areas, which will help you to apply the acquired knowledge and skills to emerging areas of fascinating world of Zoology. The detailed syllabi of these courses are given in Sec. 5.

### Elective Courses

Six elective courses are being offered in four currently relevant branches of Zoology research. An attempt is made to update you with the developments in these areas and expose you to the interdisciplinary nature of current research in science.

The **semester-wise details of the courses of M.Sc (Zoology) programme** is as follows: (The Laboratory courses are marked with a \*)

### FIRST SEMESTER

Course Code	Course Title	Type of Course	Credits
MZO-001	Molecular Cell Biology	Theory (Core)	4 Credits
MZO-002	Genetics and Animal Biotechnology	Theory (Core)	4 Credits
MZO-003	Comparative Animal Physiology and Biochemistry	Theory (Core)	4 Credits
MZOE-001	Parasitology	Theory (Elective)	4 Credits
MZOL-001	Lab Course I	Laboratory (Core)	4 Credits





## SECOND SEMESTER

Course Code	Course Title	Type of Course	Credits
MZO-004	Systematics, Biodiversity and Evolution	Theory (Core)	4 Credits
MZO-005	Genomics and Proteomics	Theory (Core)	4 Credits
MZOE-002	Animal Behavior and Animal Welfare Ethics	Theory (Elective)	4 Credits
MZOE-003	Aquaculture	Theory (Elective)	4 Credits
MZOL-002	Lab Course II	Laboratory (Core)	4 Credits

\*These Laboratory Courses (MZOL-001 and MZOL-002) will be conducted over the period of Semesters 1 and 2 and the Study Centres will prepare the schedule accordingly.

## THIRD SEMESTER\*\*

Course Code	Course Title	Type of Course	Credits
MZO-006	Biostatistics and Bioinformatics	Theory (Core)	4 Credits
MZO-007	Principles of Ecology	Theory (Core)	4 Credits
MZO-008	Immunology	Theory (Core)	4 Credits
MZO-009	Research Methodology	Theory (Core)	4 Credits
MZOL-003	Lab Course III	Laboratory (Core)	4 Credits

## FOURTH SEMESTER\$\$

Course Code	Course Title	Type of Course	Credits
MZOE-004	Insect Taxonomy and Morphology	Theory (Elective)	4 Credits
MZOE-005	Insect Physiology and Toxicology	Theory (Elective)	4 Credits
MZOE-006	Applied Entomology	Theory (Elective)	4 Credits
MZOL-004	Lab Course IV	Laboratory (Core)	4 Credits
MZOP-001	Project/Dissertation*	Project (Core)	4 Credits

\*These Laboratory Courses (MZOL-003 and MZOL-004) will be conducted over the period of Semesters 3 and 4 and the Study Centres will prepare the schedule accordingly.

You are advised to start your Project (MZOP-001) work from third semester onwards.



## 3. INSTRUCTIONAL SYSTEM

The M.Sc. (Zoology) programme instructional system includes Self-Learning Material (SLM), assignments, counseling sessions and practical sessions at the Learner Support Centres (LSCs).

### 3.1 Print Material

The study material will be provided in digital form (on eGyankosh, the repository for SLMs of the University) and/or in printed form. The study material is properly planned and are self-instructional in nature.

The **printed study material is sent to you by registered post to the address provided by you in the application form at the time of admission.** The material will be despatched to you **semester wise.** You can check status of dispatch of study materials on the IGNOU website using the web link: [www.ignou.ac.in/ignou/aboutignou/division/mpdd/material](http://www.ignou.ac.in/ignou/aboutignou/division/mpdd/material), provided by MPDD. For non-receipt of study material, students are required to write to the Registrar, Material Production and Distribution Division, IGNOU, Maidan Garhi, New Delhi –110 067 or e-mail to [mpdd@ignou.ac.in](mailto:mpdd@ignou.ac.in).

The soft copy of the learning material can be downloaded from eGyankosh (at <https://egyankosh.ac.in>) and also IGNOU E-Content mobile App ( which can be downloaded from Google Play Store). You can also access your course materials, assignments, and other learning resources through Web Enabled Academic Support (**WEAS**) **Portal of MSCZOO.** To access the WEAS Portal click the link - <https://sites.google.com/ignou.ac.in/weas>.

### 3.2 How To Study A Course

- **SLM based Courses**

The learners joining open and distance learning institutions like IGNOU are expected to be self-learners. As there is no regular and face-to-face classroom teaching in such institutions, you are provided **self-learning materials (SLM)** for the courses of the programme which are developed in self-instructional style and completely cover the course contents. An effort is made to make SLMs self-contained so that you do not need any additional help to understand it. Since SLMs for the courses are the primary learning resource, you should know how these SLMs are structured and how you can make best out of it.

SLM of the courses in IGNOU are offered in the form of booklets called **Blocks**. Each block is divided into several units so that the learning material is presented in smaller portions, which are easier to absorb at a time. The units in a block have the thematic unity and are structured in a standard way.

Each **unit** contains expected learning outcomes which tell you what you are expected to know after studying the unit. These goals state what conceptual understanding you should have, what kind of ability to reason and problem-solving skills you should develop.

We give the **summary** at the end of the conceptual discussion followed by a section called **terminal questions**. The last section gives the answers/ solutions to (SAQs and TQs) problems.

Zoology, as you know, cannot be learnt passively. Learning Zoology is not like listening to a story and memorizing it. You have to not only understand concepts but acquire the abilities to comprehend the morphological, anatomical and histological characteristics of cells and correlate with the molecular organization of the cell.



The first thing you must understand while studying the courses in Zoology is that Zoology is to appreciate the fascinating world of animals and to love and care about the innocent animals and their feelings. As you are getting training in Zoology, so in addition to laboratory work, you have to go to field also for studying the nature, animals and their interactions with plants. We give below some advise regarding how to study SLMs for the courses of the programme:

- ✚ Always keep a pen/pencil and paper with you while studying as Zoology is all about diagrams.
- ✚ Work through all steps in the derivations given in the text **yourself**. Also, **work each step** in the solved examples given in the text on your own.
- ✚ You may use the Blocks of the course as your notebook. **Make notes in the text as well as in the margin**. You can simplify things by making points.
- ✚ You will have to draw figures, solve SAQs, Terminal Questions on separate papers, as no space has been provided in the text for this purpose.
- ✚ We advise you to make an honest attempt at solving the Self Assessment Questions (SAQs) and the Terminal Questions. Do not immediately turn to the answers given at the end of each unit if you cannot solve a problem in the first instance. You should go through the unit once more and then attempt the questions again.

The programme is built in such a way that you get the flavor of core Zoology courses and interdisciplinary courses in each semester. The programme will equip you with the knowledge and skills of various Zoology courses (viz. Animal Physiology Parasitology, Aquaculture, and Animal Behaviour) and interdisciplinary courses (Genetics, Molecular Cell Biology, genomics and Proteomics). This will help you to remain in the forefront for competitive examinations and interviews.

You have studied cell Biology Genetics and Ecology at undergraduate level, but as this is Post Graduate Programme so these courses are explained here in an advanced level. Elective courses of Zoology like Parasitology, Aquaculture and Animal Behaviour are explained in simple language with interesting examples and activities. Fourth semester courses are devoted to Entomology (Study of Insects) as this programme provides specialization in Entomology. All theory courses of fourth semester are elective courses.

### **3.3 Practical Work**

Four out of the twenty courses of this programme are Laboratory courses. The practical sessions for these courses will be conducted at the LSCs, in the Zoology Laboratories. **The laboratory session for each laboratory course will run for 14 days. On 14<sup>th</sup> day the examination for Laboratory course will be held.** Attending practical sessions is **compulsory** for all the learners. Completing minimum 70% of each laboratory session is mandatory. It qualifies you to appear for the term-end practical examination for the course which is held on the last day of the session. Schedule for practical sessions will be made available to you by your LSC/RC.

### **3.4 Teleconference**

Teleconference/web conference, using one-way video and two-way audio transmission via satellite, is another medium used by the University to impart instruction to and facilitate learning for a distance learner. The schedule for the teleconferencing sessions would be available on the website of the University or the Regional Centres.



### **3.5 Interactive Radio Counselling**

Interactive phone-in radio counselling sessions conducted by the University are available on and GyanVani FM station. The radio counselling sessions are broadcast ‘live’ and are relayed by stations across the country. Now, there is a synchronized weekly transmission “IGNOU HOUR” on Sundays from 4.00 p.m. to 5.00 p.m. with coverage of almost all over the country. IRC sessions can be accessed through radio at the frequency 105.6 MHz, through DTH and also through Internet at the link [gd.ignouonline.ac.in/gyandhara](http://gd.ignouonline.ac.in/gyandhara). The phone numbers for interaction are: 01129533581, 01129536131, 29533103 and 1800112347.

### **3.6 GyanDarshan**

GyanDarshan, the 24 hours educational TV channel is a joint venture of IGNOU with Doordarshan. It is available through the Cable TV network. The telecast schedule of GyanDarshan is made available on IGNOU web site: <http://www.ignou.ac.in>.

**Please ask your cable operator to provide this channel.**

### **3.7 IGNOU e-Content Mobile App**

IGNOU-e-Content Mobile App is an official mobile app of Indira Gandhi National Open University (IGNOU), New Delhi. This app is an ICT initiative of IGNOU to provide Digital Learning Environment to IGNOU learners and extending Technology Enhanced Learner Support Services to them. The aim of this initiative is to disseminate the digitised course material to IGNOU Learners. IGNOU learners can use this app to access their course material through their hand held devices such as Mobile Phones and Tablets.

### **3.8 Scheme of Study**

In order to enable you to complete your M.Sc. (Zoology) programme within the minimum period of two years, you will have to complete 80 credits worth of courses in four semesters. Registration to the programme is annual, so you register for the first and second semester in Year 1 and for the third and fourth semester in Year 2. In the second year irrespective of whether you pass or not in all the courses of the first year, you must re-register for the third and fourth semester by submitting the Re-registration Form with the requisite programme fee.

It is quite possible that you may not find sufficient time to prepare for the Term End Examinations of all the courses you have registered for. You can focus only on those courses in which you intend to take the examination. You can give the examination of the remaining courses later. You may appear for the term-end examinations for the first time after one year of admission to the programme, at that time, you are eligible to appear for the exams of the first and second semesters. Thereafter you can appear for your exams every six months till the completion of the validity of your admission. Examinations are held in the month of June/December of each year. In this way, you can plan your courses within two to four years. By a proper planning every year, you can complete this programme according to your convenience.

### **3.9 Learner Support Centres (LSCs)**

To provide effective students support, we have set up LSCs for this programme. You will be allotted one of these study centres. The particulars of the LSC to which you are assigned will be communicated to you at the time of admission.



**Each Learner Support Centre will have:**

- A **Coordinator/Assistant Coordinator** who will coordinate all the activities, academic as well as administrative, related to the programme and will be a guide/support to you at the centre.
- **Counsellors** in different courses, core as well as electives, to provide you counselling and guidance in that subject.
- Zoology laboratories where you will do the practicals of the laboratory courses of the programme.

In the LSC you will also have an opportunity to interact with fellow students. This may lead to the formation of self-help groups.

## 4. EVALUATION

The system of evaluation, both for theory courses and laboratory courses have two components i) continuous evaluation, and ii) term-end examination. For the theory courses the continuous assessment is through the tutor marked assignments (TMAs). The weightage of continuous evaluation and term-end examination of various courses of the programme are shown in the table below:

Type of Course	Weightage of	
	Continuous Assessment	Term End Examination
Theory Courses	30% (Assignment)	70%
Laboratory Courses	70% (Guided Experiments)	30%

For every course, you are required to score at least 40% marks in both the continuous assessment as well as the term-end examination separately. In the overall computation also, you must get at least 40% marks in each course to be eligible for the M.Sc. degree.

If you do not clear the term-end examination of all the courses taken in a particular semester, you can appear for the term-end examination of those courses again after 6 months, as per the University rules. The overall percentage wise division of the results is

Division	Percentage of Marks
Distinction	75% and Above
I <sup>st</sup> Division	60% and Above
II <sup>nd</sup> Division	50% and Above; but below 60%
III <sup>rd</sup> Division	40% and Above; but below 50%
Fail	Below 40%



## **4.1 Assignments**

Tutor Marked Assignments (TMA) are **compulsory** component of the course. You will need to do one tutor marked assignment for each theory course. There are no assignments for the laboratory courses of the programme. **Each assignment is valid for the dates printed on the assignment. If you fail in an assignment or are not able to submit the assignment before the validity date, you have to submit the assignment for the next year.**

**The TMA for each semester can be downloaded from the Student Zone of the University website at <https://webservices.ignou.ac.in/assignments/>.**

The main purpose of the assignments is to test your comprehension of the learning material you receive from us and also to identify the gaps in your understanding of the course by providing feedback to you. These assignments will be checked by your counsellors, who will also explain to you where and how you can improve your understanding. The information given in the course material should be sufficient for answering the assignments. However, to take you a little further, you can always refer to other books accessible to you. **You will not be allowed to appear for the term-end examination for a course if you have not submitted the assignments stipulated in time for that course. If you appear in term-end examination without submitting the assignments, then the result of term-end examination is liable to be cancelled.**

These assignments are to be submitted at the LSC according to the submission schedule provided in the assignments booklets. Before submission, you should ensure that you have answered all the questions in all assignments. Incomplete answer sheets bring you poor grades.

### **SPECIFIC INSTRUCTIONS FOR TUTOR MARKED ASSIGNMENTS**

1. Write your Enrolment Number, Name, Full Address, Signature and Date on the top right hand corner of the first page of your response sheet.
2. Write the Programme Title, Course Code, Course Title, Assignment Code and Name of your Study Centre on the left hand corner of the first page of your response sheet.  
Course Code and Assignment Code may be reproduced from the Assignment.
3. Read the assignments carefully and follow the specific instructions, if any, given on the assignment itself.
4. Use only foolscap size for your responses and tie all the pages carefully. Avoid using very thin paper. Allow a 4 cm. margin on the left and at least 4 lines in between each answer. This may facilitate the evaluator to write useful comments on the margins at appropriate places.
5. Write the response in your own hand writing. Do not print or type the answers. Write answers in your own words; do not reproduce your answers from the units sent to you by the University. If you reproduce from units, you will get poor marks for the respective question.
6. Do not copy from the response sheets of other students. If copying is noticed, the assignments of such students will be rejected.
7. Write each assignment separately. Write the question number with each answer.
8. **The completed assignments should be sent to the Coordinator of the LSC allotted to you. Under no circumstances you should sent the tutor marked response sheets to the Headquarters for evaluation. Please retain a copy of the assignment.**



9. After submitting the assignment at the LSC, get the acknowledgment from the Coordinator on the prescribed assignment remittance-cum-acknowledgment card.
10. Provision for online submission of assignments is also available. You will get more details about this on the website of your Regional Centre.

## **4.2 Term End Examination**

As stated earlier, Term End examination is another component of the evaluation system. For non-laboratory courses, Term End Examination carries 70% weightage in the final result. For laboratory courses, assigned unguided experiments similar to term-end examination carry 30% weightage. **You are eligible to appear for the Term End examinations for the theory courses one year after admission and every six months thereafter.**

If you get a pass score in a course in the Term End Examination, you will not be allowed to reappear in the subsequent examinations in that course for improvement of marks. In case, you fail to get a pass score in the Term-end Examination, you will be eligible to reappear in the next Term End Examination for that course as and when it is held, within the total span of the programme.

### **General Guidelines Regarding the Term-End Examination**

1. To be eligible to appear the Term-end Examination in any course, the students are required to fulfill the following conditions:
  - a) registration for the courses, in which they wish to appear is valid,
  - b) they should have opted and pursued the prescribed courses
  - c) they have also submitted the required number of assignment(s), if any.
  - d) they have submitted the online examination form of IGNOU and have paid the requisite examination fees.
2. The University conducts term-end examination twice a year, in June and December. You are eligible to appear for the Term End examinations for the theory courses one year after admission and every six months thereafter. You can also appear for these exams in later cycles as per the validity of your program
3. Examination schedule is also notified through the website of IGNOU [www.ignou.ac.in](http://www.ignou.ac.in). You are advised to see whether there is any clash in the examination dates of the courses you wish to take i.e. examination of any two courses you wish to take are scheduled on the same day at the same time. If there is any clash, you are advised to choose one of them in that examination and appear for the other course in the next examination (i.e. June or December as the case may be).
4. The online examination form is to be filled up from IGNOU website at <http://exam.ignou.ac.in/>, in general, as per the schedule given on the IGNOU website (**You MUST visit IGNOU website for actual cutoff dates**). The details of fee and late fee are displayed on the website.
5. You can pay examination fee online using Credit Card / Debit Card /Net Banking while filling up the form. It may also be noted that in case, examination fee needs to be returned to student due to technical reasons, the fee will be refunded to the same account (Credit card/ Debit card/ Net Banking) from which the payment was made.



## 6. Hall Ticket for Term-End Examination

- Hall Ticket will be uploaded on the University Website approximately 10 days before the commencement of the Term-end examinations. Please take print out of Hall Ticket from University website ([www.ignou.ac.in](http://www.ignou.ac.in)) and report at the Examination Centre along with the Identity Card issued by the Regional Centre/University.
- You will be allowed to appear in Term-end Examination for the course(s) for which registration is valid and not time-barred and assignment(s) is/are submitted. Examination Fee once submitted will not be refunded.
- You must carry IGNOU Identity-Card in the Examination Hall for writing Examination. A digital copy of the student Identity Card is available in the student account (<https://ignou.samarth.edu.in>). It can be downloaded and printed whenever required.
- **Contact Details**

In case of non-receipt of Control number or any query pertaining to Examination Form please contact **Phone No.(s) : 011-29572209** or send us an email at [termendexam@ignou.ac.in](mailto:termendexam@ignou.ac.in)

7. **Early Declaration of Results:** In order to facilitate the students who have got an offer of admission to further courses of study or have been selected for employment etc. and are required to produce marks sheet/grade card by a specified given date provision of early declaration of result is made. Student may apply for early processing of their answer-scripts and declaration of the results for this purpose along with supporting documents and requisite fee. **The students must submit their requests for early declaration before the commencement of the Term-end Examination i.e., before 1st June and 1<sup>st</sup> December respectively.** In such cases, the University will make arrangements for processing the answer-scripts and early declaration of the results as a special case.
8. **Obtaining Photocopy of Answer Scripts:** After the declaration of result, if the students are not satisfied with the marks awarded, they can request the University for Photocopy of Answer Scripts. The request for obtaining Photocopy of Answer Scripts by the student must be made within 30 days from the date of declaration of result (i.e.) to the Evaluation Centre concerned in the prescribed format along with the requisite fee. The form is available on the IGNOU website.
9. **Re-evaluation of Answer-script(s):** In case the student is not satisfied with the marks obtained, a request for reevaluation can be made then. The answer-scripts will be re-evaluated by another Evaluator. Students can apply for re-evaluation within one month from the date declaration of results i.e. the date on which the results are made available on the University Website using the prescribed application form available on the University Website along with the requisite fee. The better of the two scores among the original marks/grades and re-evaluated marks/grades will be considered and the revised marks/grades shall be incorporated in the students' record and the revised grade card/marks sheet will be sent to the students. Re-evaluation is not permissible for Assignments and Laboratory courses.

## 4.3 Examination for Laboratory Courses

Evaluation of laboratory courses is carried out at the time of conducting the laboratory courses at the study centre. Each and every experiment, which you perform, is evaluated. Evaluation of experiments, which you perform under the guidance of your counsellor, constitutes continuous evaluation and carries 70% weightage. On the other hand, the evaluation of unguided assigned experiment(s), which you perform during the last session of your lab course, carries 30% weightage and constitutes Term End evaluation.





## 5. DETAILS OF COURSES

### **MZO-001: Molecular Cell Biology**

**4 Credits**

Molecular cell biology is a unified discipline that explores cell structure and function in biological, biochemical, and developmental context. The course aims to provide fundamental knowledge about the structure and function of cells and cellular components. The course focuses on the cytoskeleton and cell dynamics, the cell cycle and control, membrane traffic and protein sorting, cellular communications and signal transduction. This course provides a solid foundation for more advanced biological sciences like cancer biology, microbiology, virology, immunology, and developmental biology. The course also provides a variety of molecular cell biology methods commonly used in academic and industrial research laboratories. The detailed unitized syllabus is given below.

### **Syllabus**

**Eukaryotic Cytoskeleton:** Eukaryotic Cell Structure, and Functions: The basic unit of life, structure-function of eukaryotic cell: Subcellular organelles, cell morphology, and shape. Actin Filaments: Structure and dynamics of microfilaments; Organization of the cortical cytoskeleton. Actin cytoskeleton in cell shape, intracellular motility, and cell locomotion, the biological significance of actin cytoskeleton and myosin. Microtubules: Microtubule structure, organization, and dynamics; Role of microtubules in cell shape and mitosis. Intermediate Filaments: Structure, organization, and function of intermediate filaments.

**Cell transport:** The Cell: The basic unit of life, structure-function of eukaryotic cell: Subcellular organelles, cell morphology, and shape. Transepithelial Transport: Transepithelial transport; Maintenance of cellular pH; Cell excitation; Acidification of cell organelles and stomach. Bulk Transport: Receptor-mediated endocytosis; Protein sorting and targeting to organelles; Targeting of proteins to lysosomes for degradation; Molecular mechanism of the secretory pathway. Neurotransmitters Secretion: Secretory gland of Brain, the pathway of neurotransmitter and function; Secretion of neurotransmitters.

**The Cell Cycle and Cell Culture:** Cell Cycle: Overview of Cell cycle, interphase, Mitosis, Meiosis, and their differences. Cell Cycle Regulation: Regulation of Cell cycle; Commitment to cell division; Entry into and exit from the cell cycle; Checkpoints in the mammalian cell cycle. Intracellular Protein Turnover: Turnover of cellular components; Degradation of cytosolic proteins. Animal Cell Culture: Basics of cell culture, Types of cell culture, growth media, cell lines, maintenance and storage of cell lines, and cytotoxicity.

**Tissue Organization and Communication:** Extracellular Matrix and Cell Junction: Extracellular matrix; Cell-cell and cell-matrix adhesion; cell junctions. Signal Transduction: Intercellular communication, Key concepts in cellular signaling mechanisms; Second messenger systems. Cellular G-protein Receptor: G-protein coupled receptors; Receptor tyrosine kinases; MAP kinase cascade; Desensitization of receptors. Cell Death and Renewal: Cell Survival and apoptosis.

### **MZO-002: Genetics and Animal Biotechnology**

**4 Credits**

Genes are specific nucleotide sequences that are passed down from one generation to the next and code for unique proteins. The course on genetics and Animal Biotechnology focuses on the inheritance of traits, or the features that characterize an organism. Recent scientific discoveries have made it possible for scientists to find the gene that either synthesises the desired protein or encodes any RNA molecule with a purpose other than directly coding for a protein. This has led to the development of genetic engineering, the basis of modern biotechnology. The thorough information on



gene cloning, clone screening methods and disease diagnosis is provided through this course. Additionally, utilizing various molecular biology techniques, you will learn about the concept of genetic engineering for the creation of genetically modified organisms. The detailed unitized syllabus is given below:

## **Syllabus**

**Gene Interaction and Mapping:** Mendel's Laws: Mendel's laws and their chromosomal basis; extension of Mendel's principles: allelic variation and gene function- incomplete dominance and co-dominance. Gene Action and Interactions: Gene action- from genotype to phenotype- penetrance and expressivity, gene interaction, epistasis, pleiotropy. Gene Structure and Function: Nature of the gene and its functions: evolution of the concept of the gene, fine structure of gene (*rII* locus). Linkage, Crossing Over and Mapping in Eukaryotes: Methods of gene mapping: 3- point test cross in *Drosophila*, gene mapping in humans by linkage analysis in pedigrees.

**Gene Mutation, Repair and Expression:** Mutation and Repair: Gene mutation and DNA repair: types of gene mutations, P- element insertional mutagenesis in *Drosophila*, DNA damage and repair. Organization of Gene: Organization of a typical eukaryotic gene, transcription factors, enhancers and silencers, non-coding genes, Epigenetic modifications. Gene Regulation in Prokaryotes: Regulation of gene activity in lac and trp operons of *E. coli*. Gene Regulation in Eukaryotes: General introduction to gene regulation in eukaryotes at transcriptional and posttranscriptional levels.

**Human Genes and Inheritance: Sex Linked Inheritance:** Sex determination and dosage compensation: sex determination (*C. elegans*, *Drosophila*, mammals), dosage compensation of X-linked genes- hyperactivation of X-linked gene in male *Drosophila*, inactivation of X-linked genes in female mammals. Human genetics and chromosomal anomalies: Human genetics- Karyotyping; chromosome anomalies and diseases- chromosomal anomalies in malignancy (chronic myeloid leukemia, Burkitt's lymphoma). Genetic Analysis of Complex Traits: Genetic analysis of complex traits - complex pattern of inheritance, quantitative traits, threshold traits.

**Animal Biotechnology: Gene Cloning-I:** Restriction enzymes and other enzymes for DNA manipulation in animals, Vector types: cloning and expression. Gene Cloning-II: Probes, cDNA and genomic libraries, Positional cloning. Screening of Clones and Disease Detection: Hybridization: Southern, Northern (colony/plaque), immuno-screening, Characterization of clones: Sequencing, Microarray, Developmental sex disorders (DSD), Detection of genetic disorders, Teratogenesis. Genetic Engineering-I: Application: transgenic organisms and genetically modified organisms (GMOs). Genetic Engineering-II: Site-directed mutagenesis, generation of knock-out animals, Gene Therapy and Tissue Engineering: Gene therapy, Stem cells, and tissue engineering.

### **MZO-003: Comparative Animal Physiology and Biochemistry**

**4 Credits**

'Animal Physiology' course consists of two blocks and will introduce you to the various life supporting properties, functions and processes of animals. These processes can be studied at various levels of organization from membranes through to organelles, cells, organs, organ systems and to the whole animal. You will study about transport of nutrients, waste products and respiratory gases between the blood and tissue in cardiovascular and Respiratory Physiology. Renal Physiology, and Physiology of movement, the characteristic property of animals will be discussed in Muscle Physiology. Energy metabolism in animals in relation to oxygen consumption will be dealt in Digestive System. Conceptual view of organisation of nervous system and integrated function of the same are also discussed in this course.

Biochemistry is the application of chemistry to study biological processes at the cellular and molecular level. The course aims to provide an advanced understanding of the core principles of enzymes, their kinetics, inhibition, and regulation, as well as the study of the energetics and the design of living systems, metabolic networks, and integration of metabolism.



The students can apply this knowledge gained from the course to solve the analytical problem and enhance the interest in the field of biochemistry to pursue research. The detailed unitized syllabus is given below.

## **Syllabus**

**Fundamentals of Animal Physiology:** Circulatory System: Systems of circulation, Peripheral circulation, Regulation of heartbeat and blood pressure. Respiratory System: Transport and exchange of gases, Neural and chemical regulation of respiration. Excretion and Osmoregulation: Osmoregulation- Osmoregulation in aquatic and terrestrial environments, Extra-renal osmoregulatory organs, Patterns of nitrogen excretion. Muscle Physiology: Types of muscle, structure, properties, function & control; Muscle Energetics. Feeding: Feeding patterns, Behaviour, mechanisms, and their control, the effect of starvation.

**Sensing the Environment and Coordination:** Nervous System: Neuroanatomy and integrated function of the nervous system. Environment Stress and Thermoregulation: Basic concept of environmental stress, acclimation, acclimatization, avoidance and tolerance, stress and hormones. Thermoregulation- Heat balance in animals, Adaptations to temperature extremes, torpor, Aestivation and hibernation, Counter current heat exchangers. Environment Sensing Organs: Photoreception, Chemoreception, Mechanoreception; Echolocation, Endogenous and exogenous biological rhythms; Chromatophores- Types and Functional Modifications vis-a-vis different animals (Invertebrates & Vertebrates) & control; Behavioural significance and its application. Bioluminescence: Bioluminescence- Phenomenon dynamics (Luciferin-Luciferase reaction); Occurrence in different groups of the animal kingdom, Types (Blue & Red), functional significance, and its application in mankind. Electric Organs: Electric organs (myogenic lineage)- Electroplaxes, Electric discharge, Organogenesis, Electroreception, functional significance in animals.

**Enzyme Catalysis and Regulation:** Nature of Enzymes: Contents: Basic characteristic of enzymes, Concept of activation energy, Properties of enzymes, Factors affecting enzyme activity. Enzyme Kinetics: Overview of Enzyme Kinetics, Michaelis - Menten equation, the importance of  $V_{max}$ ,  $K_m$ , MM equation, and turnover number; Lineweaver - Burk plot, Eadie - Hofstee plot, Hanes - Woolf plot, and Essential and Cornish - Bowden plot. Kinetics of multi-substrate enzyme-catalyzed reactions - Ping-pong bi-bi, random order, and compulsory order mechanism. Kinetics of Allosteric enzymes - MWC and KNF model Hill's equation coefficient. Enzyme Inhibition: Contents: Reversible inhibition - competitive, uncompetitive, non-competitive, mixed, substrate, and allosteric inhibition. Irreversible inhibition. Feedback inhibition. Regulation of Enzyme Activity: Contents: Mechanism of action and regulation of pyruvate dehydrogenase and fatty acid synthase. Isoenzymes-LDH.

**Energy production and Network of metabolic pathways:** Energetics and Design of Living System I: The living state, metabolism as the defining characteristic of living organisms, molecular approach to understanding life forms and living processes, Energetics (second law of thermodynamics. Energetics and Design of Living Systems II: Free Energy and standard free energy change), Reducing power and Redox potential, Nernst equation, synthesis of ATP, structure, and function of electron transport chain and synthesis of ATP through Fo-F1 ATP synthase. Metabolic Network: A general overview of the major metabolic pathways, linkage of metabolic pathways. Metabolic flux and study state models. Integration of Metabolism-I: Fasting state, well-fed state, caloric Homeostasis, energy requirements, five-phase of glucose homeostasis, metabolic adaptation in special physiological state. **Integration of Metabolism-II:** Introduction, Organ-specific metabolic, profile, Brain Muscle, Adipose tissue, liver, kidney.

### **MZOE-001: Parasitology**

**4 Credits**

Parasitology is a broad and multi-disciplinary approach to the complex and dynamic relationships between parasites and their hosts. Although parasitology had its origins in the zoological sciences, it is today an interdisciplinary field, greatly influenced by microbiology, immunology, biochemistry, and



other life sciences. This course offers an overview of the biological and epidemiological bases of important parasitic diseases and an understanding of the impact of parasitic diseases on endemic communities. Parasitic diseases can be blood borne, gastro-intestinal, and somatic. Blood borne diseases include African trypanosomiasis, babesiosis, chagas disease, leishmaniasis, malaria and toxoplasmosis. Parasitic infections, caused by intestinal helminths and protozoan parasites are among the most prevalent infections in humans in developing countries. Parasites harbour not only humans but animals and plants also. Ectoparasites of animals and nematode parasites of plants are also discussed.

## **Syllabus**

**Introduction to Parasitology:** Animal Associations and Evolution of Host–Parasite Relationship: Parasites and its types; types of host; host-parasite relationships; Life cycle of parasites and its Pathogenesis. Distribution of Diseases and Zoonosis caused by Animal Parasites: Source of infection- Soil, Water, Food, Animal (Zoonosis), Insects; Modes of infection; Course of infection; Symptoms; Diagnosis and Prevention. Adaptations in Parasites: General immune response-Antibodies, Cell-mediated immunity, Hypersensitivity; Regulation of the immuneresponse; Self-defence mechanisms; Immune evasion in parasites (Immunological adaptations, Morphological adaptations, Nutritional adaptations, Life cycle adaptations, Biochemical adaptations).

**Blood Parasites:** Malarial Parasite: Epidemiology, mode of infection, detection, immunity, and immune evasion mechanisms. Coordinated switching for antigenic variation by malaria parasites, drug targets, mechanism of drug resistance, malaria vaccine strategies. Leishmaniasis Parasite: Sandfly biology in the life cycle of *Leishmania* parasites; a critical role for sand fly midgut microbiota in *Leishmania* development and transmission, epidemiology, detection, protective and pathologic immune responses in leishmaniasis, immune evasion mechanisms, drug targets, mechanism of drug resistance, vaccine strategies. Sleeping Sickness Parasite: Epidemiology, mode of infection, serum resistance in zoonotic trypanosomes, immunity and immune evasion mechanisms, dynamics of antigenic variation and VSG diversification, drug targets, mechanism of drug resistance, vaccine strategies. Blood Fluke Parasite- *Schistosoma*: Epidemiology, mode of infection, detection, immunity and immune evasion mechanisms, drug targets, mechanism of drug resistance, vaccine strategies.

**Gastro-intestinal Parasites:** *Ancylostoma*: Epidemiology, detection, immunity and immune evasion mechanisms, drug targets, mechanism of drug resistance, vaccine strategies. *Trichinella*: Epidemiology, detection, immunity and immune evasion mechanisms, drug targets, mechanism of drug resistance, vaccine strategies. *Entamoeba histolytica*: Epidemiology, detection, immunity and immune evasion mechanisms, drug targets, mechanism of drug resistance, vaccine strategies.

**Somatic Nematodes of Importance:** Parasites of Lymphatic System: *Wuchereria*, and *Brugia*: Epidemiology, mode of infection, detection, immunity and immune evasion mechanisms, drug targets, mechanism of drug resistance, vaccine strategies. Parasites of Subcutaneous Tissue: *Dracanculus*: Epidemiology, detection, immunity and immune evasion mechanisms, drug targets, mechanism of drug resistance, vaccine strategies.

**Parasites of Plants and Veterinary Animals:** Parasites of Veterinary Importance: General parasites of domestic animals and diseases caused by them-Flies, mosquitoes, ticks, mites, lice, and fleas; Symptoms and Diagnostic techniques. Nematode Parasites of Plants: Morphology, biology, lifecycle, reproduction, nematode feeding, infection in crop plants and host-parasite interactions; Diagnosis of nematode parasitism in plants; Management and control of nematode parasitism.

### **MZOL-001: Lab Course-I**

**4 Credits**

The course encompasses the concepts learnt in your four theory courses. You will learn to make chromosome preparations, along with some basic experiments of biochemistry including buffer preparation, amino acid titration, characterization of enzyme kinetics and spectrophotometric assay to



estimate the level of certain biomolecules. You will learn to prepare blood smears and determine the total and differential leukocyte count. You will be introduced to some basic molecular biology and biotechnology techniques, including plasmid DNA isolation and spectrophotometric estimation of DNA content, agarose gel electrophoresis, restriction enzyme digestion of DNA, ligation and transformation to get recombinant clones. You will get an idea about the aseptic techniques and steps of animal cell culture, including the different forms of culture media, in addition to cell viability and DNA damage analysis. In the experiments related to parasitology, you will observe specimens of arthropod vectors, learn about the life cycle of different parasites, identify the different species of *Plasmodium* and study the different stages of life cycle of mosquito as a vector.

You will perform the experiments at the study centre assigned to you and it is mandatory to attend the laboratory sessions.

## **Syllabus**

### **List of Experiments:**

1. Study of Meiosis from Chromosomes of Grasshopper Testis
2. Study of Polytene Chromosomes from Salivary Glands of *Drosophila*
3. Preparation of Buffer
4. Titration of Amino Acid and Organic Acid to Determine the pKa Value
5. Kinetic Characterization of an Enzyme
6. Estimation of Amino Acids, Nucleic Acids, Sugars and Ascorbic Acid
7. Estimation of Glucose and Cholesterol in the Given Blood Sample
8. Preparation of Human Blood Smears to Demonstrate Different Types of Cells
9. Estimation of Total Leukocyte Count and Differential Leukocyte Count in Human Blood
10. Isolation of Plasmid DNA
11. Analysis of DNA by Agarose Gel Electrophoresis
12. Quantification and Purity Estimation of Nucleic Acids
13. Restriction Enzyme Digestion of Plasmid DNA
14. Ligation of Insert DNA in Vector
15. Preparation of Competent Cells and Bacterial Transformation
16. Aseptic Techniques for Cell Culture
17. Culture of Mammalian Cells
18. Assessment of Proliferation/Cytotoxicity in Cultured Cells by MTT Assay
19. Trypan Blue Dye Exclusion Assay
20. Detection of DNA Damage by Comet Assay
21. Study of Selected Arthropod Vectors from Microscopic Slides/Museum Specimens
22. Study of Life Stages of Selected Parasites Through Permanent Slides/Museum Specimens
23. Identification of Different Species of *Plasmodium* through Blood-Stage Morphologies in Human Blood
24. Study of Mosquito Vectors

### **MZO-004: Systematics, Biodiversity and Evolution**

**4 Credits**

The study of systematic focuses on the links between living organisms over time and the historical and contemporary diversification of living forms. The variety and variability of life on Earth is known as biodiversity. Evolution is the shift over multiple generations in the heritable traits of biological



populations. The evolutionary biology of bacteria and eukaryotes is explained in the course on systematic, biodiversity, and evolution. The concepts of speciation and human evolution are also covered in the course. The detailed unitized syllabus is given below:

### **Syllabus**

**Evolutionary Biology-I: Concept of Organic Evolution:** An overview of evolutionary biology, the concept of organic evolution during pre-andpost-Darwin era. The RNA World and Origin of Life: Evolution and molecular biology- a new synthesis; from molecules to life, life originated from RNA, introns as ancient component of genes.

**Evolutionary Biology-II: The Three-domain System:** The universal common ancestor and tree of life, three-domain concept of the living kingdom. Molecular Phylogeny: 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. Molecular Clocks: Molecular divergence and molecular clocks and molecular drive; complication in inferring phylogenetic trees. Divergence of Bacterial and Archaeal Genomes: Origin and diversification of bacteria and archaea; diversification of genomes; the nature of bacterial and archaeal genomes. Bacterial Genome Evolution: Origin of genomes by horizontal gene transfer; role of plasmid, transposons, integrons and genomic islands in DNA transfer.

**Origin and Evolution of Eukaryotes:** Eukaryotic Origin: Origin and diversification of eukaryotes– origin of cells and first organisms; early fossilized cells. Endosymbiosis and Eukaryotic Cell Evolution: Evolution of eukaryotic cell from prokaryotes- a case of symbiosis; evolution of eukaryotic genomes; gene duplication and divergence.

**Speciation and Human Evolution:** Speciation: Mode of speciation- factors responsible for speciation; tempo of evolution. Biological Systematics: Systematics definition and role in biology, biological classification- theories and objectives. Biodiversity and Extinction: 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 evolution- human evolutionary history; placing humans on tree of life; genomics and humanness; current issues in human evolution.

### **MZO-005: Genomics and Proteomics**

**4 Credits**

While the proteomics chiefly deal with the deciphering of protein structure and function of an organism, genomics provide an overview of the complete set of genetic instructions found in DNA. The discovery and cataloging of each sequence found throughout the whole genome of an organism is the focus of the course on genomics and proteomics, a rapidly evolving and expanding area of biology. The course covers the role, function, complexity, and expression profiling of genes and structure-function correlations of proteins. Proteomics also provides information regarding the roles that individual proteins play within cells. A whole collection of proteins from a cell is referred to as its proteome, which is highly dynamic. The course on Genomics and Proteomics covers all of the specific methods used in genome and proteome analysis. The information about the applications of genome and proteome analysis is also thoroughly covered in this course. The detailed unitized syllabus is given below:

### **Syllabus**

**Introduction to Genomics and Proteomics:** Introduction to Genomics: Organization and structure of viral, prokaryotic, and eukaryotic genomes, Genome size, Sequence complexity, Introns and Exons, protein evolution by exon shuffling; Comparative genomics - orthologs and paralogs. Genome Diversity and Molecular Dynamics of DNA Repeats in Eukaryotes: Diversity of genome and C-value paradox, Model nuclear genomes (*Drosophila*, Mammalian), transposable elements, retro-



transposons, SINE, LINE, Alu and other repeat elements. Genes: Gene duplication: gene families, pseudogenes, segmental duplications, Horizontal gene transfer. Functional Genomics: Concept of transcriptome and proteome, Approaches to transcriptome analysis (sequence-based and hybridization-based), Applications and outcomes of transcriptomic studies, Applications of OMICS to human disease. Introduction to Proteomics: Introduction to Proteomics – The proteome, mining proteomes, bridging genomics and proteomics, Proteomics and the new biology.

**Techniques for Genome and Proteome Analysis:** Techniques for Gene Identification and Function: Sequencing of genomes and annotation, detecting open-reading frames, Fluorescence In Situ Hybridization (FISH). Gene Function: Protein structural genomics, determining gene function by sequence comparison and through conserved protein structure. Gene Expression Profiling: Global expression profiling – Introduction, traditional approaches to expression profiling. Application of Gene Expression: Analysis of RNA expression, applications of genome analysis and genomics.

**Techniques for Proteome Analysis:** Techniques for Proteome Analysis-I: Peptide sequencing, Western Blotting, Separation and detection of proteins by Polyacrylamide gel electrophoresis (PAGE); Gene-protein and protein-protein interactions. Techniques for Proteome Analysis-II: Mass spectrometry, mass spectrometry-based methods for protein identification. Techniques for Proteome Analysis-III: Two-dimensional polyacrylamide gel electrophoresis; Resolution and Reproducibility of 2-D, Image analysis of 2-DE gels, De novo sequencing using mass spectrometric data- Correlative mass spectrometric based identification strategies, 2-D gel electrophoresis coupled with mass spectrometry. Techniques for Proteome Analysis-IV: Micro-array techniques: types of microarrays, microarray technology in treating disease, protein structure analysis, Prediction, diversity and multiplicity of protein functions, Hap-map type project.

**Genome-proteome Analysis and Application of Genomics and Proteomics:** Analysis of the Genome: Analysis of Genomes – Human, *Plasmodium falciparum*, *Mycobacterium tuberculosis*. Manipulation of genomes: Site-specific mutagenesis. Manipulation of the Genome: Targeted mutagenesis: reporter genes and gene knock-out and knock- in methods, transgenesis. Expression Analysis of Genome: Reporter genes and temporal/site-specific expression, RNAi and gene silencing. Proteome Analysis and Application of Proteomics: Application of proteome analysis: drug development and toxicology, Pharmaceutical Applications, Proteomics in drug discovery in humans, phage antibodies as tools.

## **MZOE-002: Animal Behavior and Animal Welfare Ethics**

**4 Credits**

Animal behavior deals with the response of animals to various stimuli and factors operating in the environment. It is also called as ethology. Human fascination with animal behavior probably extends back millions of years. The most significant way to study the function of behavior is to see how natural selection operates on it under current conditions. The course encompasses two components. First on Animal Behaviour which comprises evolutionary approach to Animal Behaviour, various types of complex behavior i.e., fixed action Pattern and Mimicry. Mechanisms of different types of orientation learning, and motivation are also discussed in the course. Parental care, altruism and social organization are also described. Second component of the course is an Animal Welfare which is the application of animal behavior. It will tell you about animal welfare theories, and overview of five freedoms. Animal Welfare auditing and assessment are also dealt with. Scientific view of animal sentience and ethical theories are also explained.

### **Syllabus**

**Introduction to Animal Behavior: Concept and Evolution:** An Evolutionary Approach to Animal Behaviour: History of the study of animal behavior, objectives of behaviour, proximate cause & ultimate cause of behaviour. Mechanism of Behaviour: Neural control of behavior, sensory processes and perception, ecology of senses, mechanism of orientation: primary and secondary orientation; kinesis and taxis. Complex Behaviour and Patterns: Instincts and innate behaviours, innate releasing



mechanisms: key stimuli, open and closed IRM, stimulus filtering, supernormal stimuli, fixed action pattern- characteristics and evolutionary features, code breakers. mimicry, mimetic releaser. Learning and Cognitive Behaviours: Learning and cognition: Imprinting, habituation, Associated learning: classical conditioning and operant conditioning, cognitive learning, latent learning, social learning. Homeostasis and Behaviour: Behavioral homeostasis, motivational system and their physiological basis, motivational conflict and decision making, displacement activity, Hormonal regulation of behaviours.

**Systematic Approach to Understand Important Animal and Human Behaviours:** Social Behaviors and Altruism: An overview of Sociality in animal systems, Cooperation and conflict in animals, Social organization in honey bees. Altruism: Group selection, kin selection and inclusive fitness, reciprocal altruism. Mating Behaviour: Sexual selection: Asymmetry of sexes, reproductive fitness, sexual dimorphism, mating systems (monogamy, polyandry, polygyny & polygamy), intra sexual selection (male rivalry), inter-sexual selection (female choice). Parental Care: Types of parental cares, parental manipulation, evolutionarily stable strategy, cost benefit analysis of parental care. Human Behavior and its Regulating Factors: An introduction to human behavior, human non-verbal communication, mate selection and sexual strategy, family relationships and altruism, Linking behaviours to the brain, genes, hormones and environment.

**Animal Welfare-I:** Scientific Understanding of Animal Welfare: Different Views of Animal Welfare, Scientific Basis of Animal Welfare, Evidence Based Approaches to Animal Welfare. Concepts of Animal Welfare-An Overview: Environmental Coping, Animal Sentience, Meeting Animal Needs, Comprehensive Frameworks of Animal Welfare. Overview of the Five Freedoms: Origin and Evolution of the Five Freedoms, The Five Freedoms, Advantages, Limitations of the Five Freedoms and Further Development. Animal Welfare Assessment Methods: Animal Welfare Assessment Process, Animal Welfare Assessment Frameworks, Welfare Based Measures, Characteristics of Measures or Indicator, Uses of Animal Welfare Assessment. Animal Welfare Auditing: Why Conduct Welfare Assessment/Audit? Implementing Animal Welfare Assessment, Animal Welfare Assessment Schemes or Protocols, Training and Certification of Animal Welfare Auditors.

**Animal welfare-II:** Improving Animal Welfare through Social Conditions: The Social Environment and its Relation to Welfare Improvement, Solving Socially Induced Welfare Problems. Improving Animal Welfare through Human Contact: Influence of Human Contact on Animal Welfare, The Effect of Negative Contact and Neglect, The Effect of Positive Contact, Opportunities to Improve Human-Animal Relationships, Methods for Improving Human-Animal Relationships, Methods for Improving Human-Animal Relationships, Animal Signals, Human-Animal Conflict. Improving Animal Welfare through Genetic Selection: The Power of Animal Breeding, Genetic Versus Non-Genetic Determination, Undesirable Effects for Welfare of Past Breeding Strategies, Using Breeding to Improve Welfare. Animal Ethics and Sentience: What is Ethics?, Ethical Views or Theories, Ethical Decision Making, Overview of Animal Sentience, Scientific Evidence for Animal Sentience. Animal Welfare Ethical Theories: Consequentialism, Contractarian Ethical Approaches, Utilitarian Ethical Approaches, Respect for Nature Views, Ethical Dilemmas for Animal Welfare, Deontological Approaches, Virtue Ethics, Practical Ethical Decision-Making.

### **MZOE-003: Aquaculture**

**4 Credits**

Aquaculture includes culture of fishes, crustaceans, molluscs and other aquatic organisms and plants as well, for their commercial production. As air is environment for us, water is environment for aquatic organisms. In every one's views aquaculture is a wise use of aquatic resources. Owing to its location in tropical and subtropical belt of the earth, India has vast and varied water resource potential including major riverine systems, reservoirs, floodplains lakes, ponds, tanks, brakishwaters, paddy fields, inland saline water areas and a long coastline offering tremendous scope for the development of different forms of aquaculture practices. These vast aquatic resources can be well exploited by culturing different aquatic species, for which culture technology and its economical viability studies are available. The candidate species suitable for aquaculture include fishes, crustaceans, molluscs and





seaweeds. Most of the aquaculture is practiced on land or near shore portions of water bodies. Mariculture in open ocean is not well exploited.

During last few decades although, conventional methods of aquaculture i.e. ponds, pens cages and integrated aquaculture are being practiced, slowly non-conventional methods of aquaculture viz. aquaculture in running water, in recirculatory system, greenhouse aquaculture, waste water aquaculture, recreational aquaculture and aquaculture using raft, pole, rope and tray are not uncommon. Aquaculture is practiced at different levels i.e., extensive, semi-intensive and intensive and occasionally industrial aquaculture.

A guiding principle for aquaculturists is that their job is not complete until the product is consumed. Aquacrops are sold fresh as well as in different processed forms viz. freezing, canning sausages, freeze drying, smoking etc. Maintaining high quality in the final product is possible if that product of excellent quality reality reaches the processing plant. Aquaculture is a bright spot with great potential. Its future depends on those who chose aquaculture as a vocation. The detailed syllabus of the course is given here:

## **Syllabus**

**Aquatic Environment for Aquaculture:** Introduction to Aquaculture: Scope of Aquaculture, General Considerations of aquaculture, Trends in global & Indian aquaculture industry. Environment for Aquatic Organisms: Types of aquatic environment, advantages of water as medium for life, physical and chemical properties of water. Water resources for Aquaculture: Freshwater (Inland, Reservoir, Cold water) and Saline water (Coastal, Brackish Water and Marine) Resources. Candidate Species for Aquaculture: Species for Freshwater, Brackish Water and Seafarming.

**Aquaculture Methods and Practices:** Conventional Methods of Aquaculture: Pond Aquaculture, Aquaculture in pens and cages, Integrated Aquaculture. Non-conventional Methods of Aquaculture: Running Water Aquaculture, Design of Raceways for Aquaculture, Aquaculture in Recirculation Water, Greenhouse Aquaculture, Biofloc farming, Wastewater Aquaculture, Use of Sewage Water for Aquaculture. Fish Seed Technology and Transport: Natural collection, Bundh breeding, Induced breeding, Global survey of fish breeding practices, Cryopreservation of gametes, Transport of eggs, fry, fingerlings and adults. Role of Genetics in Aquaculture: Chromosome manipulation (Gynogenesis, Androgenesis, Triploidy, Tetraploidy), Hybridization, Sex Reversal & Breeding, Molecular Markers & Tools, Production of Transgenic Fish, Genetic Resource of India.

**Fish Health and Nutrition:** Fish as Food: Nutritive Value of Fish; Proteins, Lipids, Non-protein Nitrogenous Compounds, Vitamins, Minerals; Changes after Death of Fish; Rigor Mortis, Autolysis; Bacterial Spoilage. Nutrition of Aquatic Animals: Nutritional requirements of commercially important finfish and shellfish, energy budget, formulation of fish feed, feeding techniques, role of probiotics and prebiotics in fish nutrition. Fish Health: Infection and diseases in fish, common fish pathogens, and routes of pathogen entry in fish, Disease control & management, Fish vaccines strategy and use in aquaculture.

**Economic and Social Aspects of Aquaculture:** Aquaculture Economics, Marketing and Co-operatives: Economics of Aquaculture, Marketing of Fish, Fisheries Co-operatives, Characteristics of a Co-operative, Fisheries Co-operatives in India. Aquaculture and Environment: Aquaculture vs Environment, Environmental Impact Assessment, Environmental Monitoring and Management Plans, Environmental Management for Sustainable Aquaculture, Aquaculture Authority Bill, Coastal Zone Regulation Act. Aquaculture Extension: Aquaculture Extension System in India, Present Network of Extension Services in Aquaculture, Methods of Extension Services in Aquaculture, Extension Education in Fisheries, Linkages and Coordination, Extension Services Network. Prospects of Aquaculture for future Development: Challenges in Aquaculture, Technical Challenges, Role of Government, Inter-regional Cooperation, Culture-Based Fisheries, Education, Training and Extension, Marketing Issues, Future Development, Resorting to Effective Mechanisms for Transfer of Technology.



The course encompasses the concepts learnt in your four theory courses. You will learn about some of the techniques used in molecular biology and biochemistry like genomic DNA isolation, metagenomic DNA isolation, polymerase chain reaction, protein isolation and running of sodium dodecyl sulfate-polyacrylamide gel electrophoresis (SDS-PAGE), and thin layer chromatography. You will also be introduced to the basic techniques of genomics and proteomics like primer designing, restriction mapping and visualizing protein structures using Rasmol. There will be experiments and/or field visits on fishery and aquaculture as well studying animal behavioral patterns using few model systems.

You will perform the experiments at the study centre assigned to you and it is mandatory to attend the laboratory sessions.

### **Syllabus**

#### **List of Experiments:**

1. Genomic DNA Isolation
2. Transfer of Bacterial DNA to Filters Following Colony Lysis
3. Polymerase Chain Reaction
4. Protein Isolation and Estimation by Lowry's Method
5. Sodium Dodecyl Sulfate-Polyacrylamide Gel Electrophoresis (SDS-PAGE) of Proteins
6. Assay of Extracellular  $\alpha$ -Amylase Through Bacterial Cell Immobilization
7. Thin Layer Chromatography
8. Estimation of Tryptophan
9. Isolation and Analysis of Metagenomic DNA
10. *In Silico* Designing of Oligonucleotide Primers for Polymerase Chain Reaction
11. Identification of Open Reading Frames and *In Silico* Translation Using A Nucleotide Sequence
12. Identification of Restriction Enzyme Sites in Sequences and Performing *In Silico* Restriction Fragment Length Polymorphism (RFLP) Analysis
13. Construction of Phylogenetic Trees Using Different Algorithms
14. Visualisation of Protein Structure Using Rasmol: Basic Analysis
15. Study of Geotaxis, Phototaxis, Chemotaxis and Hydrotaxis in Earthworm
16. Study of The Response of Woodlice to Hygrostimuli
17. Study of the Phototaxis Behavior of Insect Larvae and Effect of Different Light Spectra on Their Movement
18. Behaviour Observations in A Primitive Eusocial Wasp
19. Courtship and Mating Behaviour in *Drosophila*
20. Farming Chicken for Meat
21. Demonstration of Fish Breeding Pools and Hatcheries
22. Identification of EGGS, Spawn, FRY and Fingerlings of Cultivable Fishes of India
23. Study of the Feeding Habits of Fishes by Gut Content Analysis
24. Formulation and Preparation of Artificial Fish Food



25. Molecular Techniques in Fish Health Management
26. Aquarium Design and Maintenance
27. Collection and Identification of Aquatic Insects and Aquatic Weeds

### **MZO-006: Biostatistics and Bioinformatics**

**4 Credits**

Biostatistics is the application of statistical methods to biological systems, mainly humans and their health problems. It plays an essential role in all stages of quantitative healthcare research, from design to statistical analysis and interpretation. This introductory course in biostatistics aims to provide foundational skills and knowledge in biostatistics, and students will gain a deeper understanding of its relevance and application to biological sciences, public health policy, and clinical medicine. The course focuses on introductory statistics, data collection and representation, central tendency and dispersion measures, correlation and regression, probability, hypothesis testing fundamentals, and analysis of variance. While Bioinformatics is a multidisciplinary field of science, bioinformatics combines computer science, statistics, mathematics, and engineering to analyse and interpret biological data. It is a new emerging field that helps collect, link, and manipulate different types of biological information in order to discover new biological insights. This course aims to provide students with theoretical and practical knowledge of bioinformatics. The detailed unitized syllabus is given below.

### **Syllabus**

**Descriptive Statistics:** Introduction to Statistics: Origin and History of Statistics, Meaning of Statistics, Definitions of Statistics, Definitions of Statistics under Modern Approach, Characteristics of Statistics, Statistics as A Science, Statistics as an Art, Scope and division of Statistics, Functions of Statistics, Limitations of Statistics, Importance of Statistics. Data Collection and Representation: Data, Primary and Secondary data, Screening and representation of data, Tabulation, Frequency distribution, Histogram, Bar diagram, Line diagram, pie diagram. Measures of Central Tendency: Mean, Median, Mode, Range, Quartiles, Decile and Percentiles. Measure of Dispersion: Measure of dispersion, Variance, Standard Deviation, Coefficient of variation, Skewness and Kurtosis. Correlation and Regression: Bivariate data- scatter plot, cause and effect relationship, correlation coefficient ( $r$ ), interpretation of  $r$ , rank correlation, linear regression: Fitting of lines of regression, regression coefficient, coefficient of determination.

**Probability and Testing of Hypothesis:** Probability Prerequisites: Definition of probability (frequency approach), Types of events. Addition and multiplication rules, Conditional probability. Probability Distributions: Bernoulli, Binomial, Poisson and Normal distributions. Hypothesis Testing Essentials: Population, Sample, Population parameters, Statistic, Sampling distribution, Standard error, Null and Alternative Hypotheses, Critical and acceptance regions, Type-I and II errors, One and two-tailed tests,  $p$ -value of the statistic. Hypothesis Testing for means, Proportions and Independence: Z and t tests for single mean and equality of two means when variances known and unknown, Z tests for proportion and equality of proportions, Chi-square test for independence, Confidence limits. Analysis of Variance: One way and two-way analysis of variance

**The Era of Computerized Biology Information:** Bioinformatics: An introduction: What is computational biology/ Bioinformatics; Relevant definitions in molecular biology; The cell, and its components; Branches of computational biology / Bioinformatics. Overview of Molecular Phylogenetics: Phylogeny representation, Molecular clocks, Phylogenetics tree analysis, Phylogenetics Tree building Approaches, Maximum parsimony methods - Un-weighted Pair Group Methods using Arithmetic means (UPGMA); Phylogenetic tree validation methods, Phylogeny interface package. Biological Database-I: Biological database; types of database-primary database and secondary database; Nucleic acid sequence database: GenBank, UCSC, ENSEMBL, EMBL, DDBJ; Protein database Swiss- prot, PDB, BLAST, PSI-BLAST. Biological Database-II: Enzyme database; pathways database; Protein interaction database; Database retrieval system-SRS, Entrez and DBGET.



Sequence Alignment and File Formats: Pair Wise sequence; Need for scoring; Aligning HMMER, BLAST vs FASTA, file formats- FASTA, GCG and Clustal-W.

**Data Search and Prediction Tools for Protein:** Databank Search: Data search, data mining, data management and interpretation, multiple sequence alignment, genes. Protein Prediction Analysis: Protein modeling, protein structure analysis, docking, ligplotinteractions, phylogenetic analysis with the program PHYLIP, DISTANCES and GROWTREE. Computational Genomics and Proteomics: Introduction to computational genomics and proteomics- basics of designing a microarray, image analysis and normalization, annotations; primer designing; proteins secondary structure and folding, RNA secondary structures. Characterization of Protein by Mass Spectroscopy: Protein secondary structure, molecular modeling, identification and characterization of protein mass fingerprint, world-wide biological databases, Introduction to programming languages such as “C”.

## **MZO-007: Principles of Ecology**

**2 Credits**

Ecology is the scientific study of how living things interact with their surroundings. Its main goal is to comprehend the interactions that exist between living things and the chemical, physical, and biological elements that affect their survival and distribution. This area of study is essential to comprehend the intricacies of natural systems while developing solutions for management of environmental problems. The course on ‘Principles of Ecology’ discusses about the concept of ecosystem, population ecology, biodiversity and its conservation and major environmental issues. The detailed unitized syllabus is given below:

### **Syllabus**

**Ecosystem and its Functioning:** An Introduction To Ecosystem: Concept of ecosystem, components of the ecosystem, characteristics of ecosystems, food and feeding relationships of organisms, trophic levels and ecological pyramids, Bio accumulation and Bio magnification. Energy in Ecosystems: Introduction to Energy, flow of energy in ecosystem, productivity of ecosystems, energy efficiency in ecosystems, ecosystem control and self regulation. Cycling of Materials in the Ecosystem: Geochemical cycles, Nutrient cycles and their general features, Hydrological cycles, Carbon cycles, Gaseous cycles, sedimentary cycles, nutrient budget and nutrient cycling of a forest. Ecosystem, Biomes and Biosphere: The biosphere, biomes and impact of climate on biomes.

**Population Ecology:** Basic Concept of Population: Characteristics of population, population size and exponential growth, limits of population growth, population dynamics, life history pattern, fertility rate and age structure. Attributes of Population: Natality, mortality, biotic potential, carrying capacity; population dynamics; life history pattern. Population Growth and Factors Affecting Population Growth: Population growth, logistic growth and exponential growth, limits of population growth; survivorship; density dependent and density independent factors. Population Interactions: Intra- and inter-specific interactions, competition and coexistence, scramble and contest competition, mutualism and commensalism, prey-predator interactions; patterns of population distribution, Allee’s principle; aggregation and isolation.

**Biodiversity and its Conservation:** Concept of Biodiversity-I: Biodiversity definition, pattern and levels of biodiversity – genetic diversity, species diversity, ecosystem diversity, landscape diversity. Concept of Biodiversity-II: Ecological importance of biodiversity, Biodiversity and ecosystem services; biodiversity assessment, threats to biodiversity. International Conventions on Biodiversity: Millennium Development Goals (MDG) in biodiversity; Convention on biological diversity (CBD); International Union for Conservation of Nature (IUCN), Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), Biodiversity Act and related international conventions. Conservation and Management of Biodiversity: Biodiversity conservation methods: *In-situ* conservation, *Ex-situ* conservation; Traditional ecological knowledge in biodiversity conservation. Molecular Ecology and its Applications: 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.



**Major Environmental Issues:** Climate Change: Environmental Stresses and their management, global climatic pattern, global warming, atmospheric ozone, acid and nitrogen deposition, coping with climatic variations. Contaminants and Toxicity in Ecosystems: Major classes of contaminants. Uptake, biotransformation, detoxification, elimination and accumulation of toxicants. Factors influencing bioaccumulation from food and trophic transfer. Pesticides in Ecosystems: Pesticides and other chemical in agriculture, industry and hygiene and their disposal. Impact of chemicals on biodiversity of microbes, animals and plants. Impact of chemicals on biodiversity of microbes, animals and plants. Treatment of Wastes: Management of sewage and industrial wastes, management of solid wastes, waste water treatment and recycling. Bioindicator and biomarkers of environmental health. Biodegradation and bioremediation of chemicals.

## **MZO-008: Immunology**

**4 Credits**

Immunology is the branch of biology dealing with the human body's defence mechanisms. It has numerous applications in biological sciences, including virology, bacteriology, parasitology, organ transplantation and oncology. The course aims to provide fundamental knowledge of immunological processes as well as concepts related to human health, disease prevention, development, and treatment. The course focuses on the cellular and non-cellular components, as well as how they work together to provide immunity. This course offers a solid foundation for advanced immunotechniques like radioimmunoassay, ELISA, western blotting, and fluorescence in situ hybridization. The course is well-balanced, covering both fundamentals and more advanced topics of immunology. The detailed unitized syllabus is given below.

### **Syllabus**

**Overview of the Immune System:** Organs of the Immune System: Introduction, Organs of the immune system, primary and secondary lymphoid organs. Components of innate and acquired immunity; innate immune response, phagocytosis; complement and inflammatory responses; mucosal immunity. Cell of Immune System: Haematopoietic stem cells, haematopoiesis, cells of immune system: Cells of the myeloid lineage and Cells of Lymphoid lineage. Antigens: Immunogenicity, antigenicity, factors influencing immunogenicity, epitope, haptens. Antibodies: Basic structure, classes & subclasses of Antibody, antigenic determinants; multigene organization of immunoglobulin genes.

**Antigen-Antibody Interactions:** Immunotechniques: Precipitation, agglutination, Advanced immunological techniques: RIA, ELISA, Immunoelectrophoresis, immunofluorescence, and flow cytometry. Major Histocompatibility Complex: Major Histocompatibility Complex: MHC genes, MHC and immune responsiveness and disease susceptibility, Major histocompatibility complex genes and their role in autoimmune and infectious diseases, HLA typing, Implication for linkage disequilibrium and disease associations. Antigen Processing and Presentation: Antigen processing and presentation- endogenous antigens, exogenous antigens, non-peptide bacterial antigens, and super-antigens; cell-cell co-operation, Hapten-carrier system. T cell responses: T-cell maturation, activation and differentiation, and T-cell receptors; functional T Cell subsets; cell-mediated immune responses, ADCC; Pathogen-associated molecular pattern Pathogen recognition receptors (PRR) and pathogen-associated molecular pattern (PAMP). B cell responses: Introduction, B-cell receptor; Immunoglobulin superfamily; principles of cell signaling; the basis of self & non-self discrimination; kinetics of immune response, memory; B cell maturation, activation, and differentiation; generation of antibody diversity. Cytokines: Cytokines: properties, receptors, Important lymphokines, and their biological activities and therapeutic uses.

**Complement and Autoimmunity:** Complement System: Salient features of complement, Biosynthesis of Complements, Complement Activation, Classical pathway and Alternative pathway biological functions of complement. Complement fixation test. Complement genes of the human major histocompatibility complex: implication for linkage disequilibrium and disease associations. Hypersensitivity I: Hypersensitivity: Type I-II. Hypersensitivity II: Hypersensitivity: Type III-IV. Autoimmunity: Autoimmunity; types of autoimmune diseases; mechanism and role of CD4+ T cells;



MHC and TCR in autoimmunity; treatment of autoimmune diseases; anaphylactic shock. Immunodeficiency: Immunodeficiency: primary immunodeficiencies, acquired or secondary immunodeficiencies, Genetic studies of rheumatoid arthritis, systemic lupus erythematosus and multiple sclerosis, genetics of human immunoglobulin, immunogenetics of spontaneous control of HIV, KIR complex.

**Applications of Immunology:** Transplantation and Tumor Immunology: Transplantation: the immunological basis of graft rejection; clinical transplantation and immunosuppressive therapy, tumor antigens; immune response to tumors and tumor evasion of the immune system, cancer immunotherapy. Vaccines: History of vaccine and vaccination, Active and passive immunization; live, killed, attenuated, subunit vaccines; recombinant DNA and protein-based vaccines, peptide vaccines, Plant-based vaccines, reverse vaccinology; conjugate vaccines; idiotypic vaccines and marker vaccines, viral-like particles (VLPs), dendritic cell-based vaccines, T cell-based vaccine, edible vaccine, and therapeutic vaccine. Antibody Engineering: Chimeric, generation of monoclonal antibodies, hybrid monoclonal antibodies; catalytic antibodies and generation of immunoglobulin gene libraries.

### **MZO-009: Research Methodology**

### **4 Credits**

This course is designed to help the learners to understand the fundamentals of the research process, use the gained knowledge to conduct their own research as well as process, analyze and interpret the data to make it verifiable and draw necessary conclusions. This course will be especially useful to those who wish to undertake or pursue research as career in future. You will learn to formulate a research problem, design strategies, use research tools, collect data and organize and analyze your research data.

### **Syllabus**

**Introduction to Research:** Research: Meaning, concept and need: Definition of research, need and purpose, conceptual framework of research, basic and applied research, concepts of attributes, general characteristics of modern research, scientific method. Process of conducting research: Research and scientific approach, conceptual foundation of scientific research, purpose and developing a theory, scope of research, research process. Types of research: Survey research, how to conduct a survey, instrument of survey research, experimental research, research procedure, fundamental, applied and action research, approaches to research. Research methods: Observation method, questionnaire method, interview method, experimental method, steps in planning an experiment, case study

**Strategies in research designing:** Formulation of research problem: Selection of a suitable problem, formulation of problem, objectives of research, formulating hypothesis, forms and types of hypothesis, sample size considerations. Design strategies in research: descriptive studies: Design strategies in research, descriptive studies, correlational studies, report, cross sectional study. Design strategies in research: analytic studies: Analytic studies, observational study, cohort study, case control study, analytic cross sectional study, experimental or intervention study, issues in design and conduct of clinical trials. Research plan: Definition, need and purpose, function, types, structure, funding, monitoring, ethics

**Managing research data and result:** Issues in the design and conduct of research design: Issues in the Design of Case-Control Studies, issues in correlation studies, issues in the design of cohort studies, experimental research, three characteristics of experimental research, steps involved in experimental research, designs of experimental study. Methods of sampling: Concepts and methods, probability sampling, non probability sampling, choice of the sampling method, characteristics of a good sample. Presentation of results: Research reports and their types, importance and significance of research reports, preparation of a research proposal, research reports: plan outline, format and contents, Preparation and Organisation of Research Notes, Drafting of Research Reports, Language and Grammar, Physical Production, Preparation of Manuscripts, Final Phase of Physical Production.



Reference values, indicators and validity: Reference Values: Basic Concept, Probability: A Measure of Uncertainty, Indicators: Measures of Mortality and Morbidity, Indicators of Mortality, Indicators of Morbidity, Measure for Validity of Diagnostic Tests.

**Tools for research:** Research Tools-1: Scales of Data Measurement, Characteristics of a Good Research Tool, Validity, Reliability, Usability, Types of Tools and their Uses, Questionnaire and Schedules, Rating Scale, Attitude Scale, Tests. Research Tools-2: Types of tools and their uses, interview, observation, documents, types of documents. Data presentation: Preparation of a Table, Tabular Presentation, Nominal and Ordinal Data, Numerical Data, Graphical Presentation, Line Graph, Histogram, Frequency Polygon, Frequency Curve, Bar Diagrams, Pie Chart. Statistical packages for research; Definition, Data Measurement, Functions of Statistics, Features of Some Statistical Packages, Microsoft-Excel, SPSS, Other Softwares for Statistical Analysis.

### **MZOL-003: Lab Course III**

**4 Credits**

The course encompasses the concepts learnt in your three theory courses. This course will make you familiar with the basic techniques of antigen-antibody interaction in immunology. You will learn about the common bioinformatic tools and *in silico* approaches employed in molecular biology work. There will be several experiments on ecology that will help you to gain insights regarding quality assessment of soil and water and studying community structure in any ecosystem.

You will perform the experiments at the study centre assigned to you and it is mandatory to attend the laboratory sessions.

## **Syllabus**

### **List of Experiments:**

1. Estimation of Hydrobiological Parameters of Fishery Based Pond Ecosystem
2. Understanding Ecosystem Succession by Studying Various Stages of Vegetation/Community Assemblage Development
3. Application of Molecular Techniques in Ecological Study
4. Identification of Aquatic Organisms of Different Trophic Levels and Construction of Food Chain and Food Web
5. Physicochemical Characteristics of the Soil
6. Physicochemical Properties of Water
7. Assessment of Density, Frequency and Abundance of Plants/Animals in a Community Using Quadrat Technique
8. Role of Arthropods and other Micro-and Macro-Fauna in Decomposition
9. Study of Soil Insect and Microarthropod Diversity
10. Dissection of Primary and Secondary Immune Organs from Mice
11. Preparation of Single-Cell Suspension from Spleen (Splenocytes) of Mice
12. Preparation and Study of Phagocytosis by Splenic/Peritoneal Macrophages
13. Annotation of unknown protein/ nucleotide sequence using suitable annotation tools - ARTEMIS and PROKSEE
14. Basics of R and SPSS, Data visualization using GRAPHPAD PRISM
15. Sequence similarity search using BLAST and its variants



16. Analysis of sequence associated features in amino acid sequences- phosphorylation sites, protein motifs, conserved domains and protein superfamilies
17. Quality Control of NGS data using FASTQC pipeline
18. Comparative modelling of protein structure from sequence using the SWISS- MODEL work bench and evaluation of structure using QMEAN
19. Construction and analysis of RNA secondary structures using UNAFOLD and VIENNA RNA suite
20. Western Blotting
21. Immunodiffusion
22. Demonstrate the Gradual Change of Abundance and Frequency of Different Species in a Transitional Zone following the Belt Transect Method
23. Determine the Relative Frequency of Different Herbaceous Species Growing in an Area
24. Determine the Basal Area of Trees in a Forest
25. Determine the Relative Density of Different Herbaceous Plants Growing in a Community
26. Determine the Importance Value Index for Different Species Growing in a Herbaceous Plant Community

#### **MZOE-004: Insect Taxonomy and Morphology**

**4 Credits**

This is the first elective course of Entomology specialization package. Insects are the largest group of animals. They are the most successful animals inhabiting every conceivable ecological condition. Class insecta is divided into two subclasses namely Apterygota and Pterygota based on the absence or presence of wings and incomplete/complete metamorphosis. These subclasses are further divided into 30 orders. In insect morphology, you will study about insect body segmentation (head, thorax, abdomen), structure of antennae, legs and their modifications, wings and their venation. This course forms the basis for further three elective courses of this package.

#### **Syllabus**

**Insect Taxonomy-I:** Historical Development of the Classification of Insects: Basis of insect classification; classification of insects up to sub-orders and up to superfamilies in economically important groups; fossil history, origin and evolution of insects. Apterygote Insects: Characteristic features and classification of Orders - Thysanura, Diplura, Protura, Collembola. Exopterygote Insects-I: Characteristic features and classification of Orders - Ephemeroptera, Odonata, Plecoptera, Grylloblattodea, Orthoptera, Phasmida, Dermaptera, Embioptera. Exopterygote Insects-II: Characteristic features and classification of Orders - Dictyoptera, Isoptera, Zoraptera, Psocoptera, Mallophaga, Siphunculata, Hemiptera, Thysanoptera.

**Insect Taxonomy-II:** Endopterygote Insects: Characteristic features and classification of Orders - Neuroptera, Coleoptera, Strepsiptera, Mecoptera, Siphonaptera, Diptera, Lepidoptera, Trichoptera, Hymenoptera. Insect Society: Group of social insects and their social life. Evolution of sociality; Social organization and social behaviour in honey bee, ants, termites, aphids and wasps.

**Insect Morphology-I:** Insect Cuticle: Structure of insect cuticle; cuticular outgrowths; tagmata, sclerites and segmentation; Moulting. Head: Head, Neck, Compound eyes, Ocelli, Tentorium, Antennae; Ectognathous mouthparts; Mechanics, Control and Regulation of Feeding; Head Glands. Thorax: Segmentation of the Thorax, Morphology of the Thorax, Muscles of the Thorax. Legs and Locomotion: Structure of a typical Leg; Adaptive structures based on habitats; Different gaits of insects; Terrestrial and Aquatic Locomotion; Other uses of Legs. Wings and Flight: Structure and form of the Wings, Venation, Wing coupling, Movement and Kinematics, Aerodynamic Mechanism, Power for Flight, Sensory Systems for flight Control.





**Insect Morphology-II:** Abdomen: Segmentation, Abdominal Appendages and Outgrowths, External genitalia. Sense Organs: Mechanoreceptors, Photoreceptors, Chemoreceptors. Reproductive System: Male: Anatomy of the Internal Reproductive Organs, Spermatogenesis, Spermatozoa, Transfer of Sperm in the Female, Other Effects of Mating. Reproductive System: Female: Anatomy of the Internal Reproductive Organs, Oogenesis, Ovulation, Fertilization of the Egg, Oviposition. Postembryonic Development: Hatching, Larval Development, Metamorphosis, Control of Postembryonic Development, Polyphenism, Diapause.

## **MZOE-005: Insect Physiology and Toxicology**

**4 Credits**

Insect physiology tells how insects live and reproduce. The insect physiology has an economical importance which makes its active development much more imperative than if it were of purely scientific interest alone. Insects, like other forms of life, can be regarded as self-replicating metabolic system.

These systems require energy which is met through the processes of nutrition, digestion, respiratory exchange, excretion and osmoregulation studied largely at the level of organ system such as alimentary canal, tracheal and excretory system. If insecticides are developed that target those system, there is a good chance that insecticides will be non-toxic to other species and they are safe to handle and safe for environment. Insect Toxicology course will introduce students to concepts associated with insecticide formulation, types of insecticides, new generation insecticides, modes of action and metabolism of insecticides. The course in addition will also explore issues affecting environmental impacts associated with pesticide use and management of insecticide resistance.

### **Syllabus**

**Insect Life Processes-I:** Integumentary System: Structure, function & formation, Growth, Moulting and Metamorphic development, hormonal influence, Sclerotization. Endocrine System: Insect hormones- with reference to metamorphosis & reproduction. Digestive & Excretory System: Alimentary tract, digestive and excretory physiology, Malpighian tubules, osmoregulation. Circulatory System: Open circulatory system, hemolymph, hemocytes, Immunity and thermoregulation. Respiratory System: Tracheal system and physiology of gas exchange.

**Insect Life Processes-II:** Nervous System: Components of the nervous system, Sensing the environment - Sensory receptors, vision & acoustics. Endocrine System: Insect hormones- with reference to metamorphosis & reproduction, Regulation and Mode of action of hormones. Reproductive System: Female & Male reproductive systems; Usual and unusual modes of reproduction.

**Insect Toxicology-I:** Introduction to Toxicology: Definition of pesticides, brief history, pesticides registration, pesticide industries and markets in world and India. Toxicology of Pesticides: LD<sub>50</sub> and LC<sub>50</sub>, Dose-response relationship; Carcinogenic, Mutagenic and Teratogenic effects, Method of testing chemicals on insect and evaluation of toxicity. Group Characteristics, Functions and Toxicological Symptoms of Pesticides: Organochlorines, Organophosphates, Carbamates, Pyrethroids, other plant origin bio-insecticides, neonicotinoids and nitrogenous insecticides; fumigants; IGRs, attractants, repellents and antifeedants. Properties of a few individual insecticides i.e. DDT, HCH (BHC), Lindane, Endosulfan, Parathion, Malathion, Carbaryl, Propoxur, Cypermethrin, Permethrin/Deltamethrin, Acetamiprid, Diflubenzuron, etc.

**Insect Toxicology-II:** Mode of Action: Central Nervous system, Acetyl cholinesterase and unknown modes of action. Metabolism of insecticides: Phase I and Phase II reactions and metabolism of other pesticides. Safer Pesticides: Next generation molecules to be used as pesticides for plant protection and their chemistry. Biopesticides, Nano-pesticides: Use of nano-pesticides in plant protection, delivery technology and their behaviour in different ecosystems. Therapy and antidotes: Type and severity of contamination and medical aid.



## **MZOE-006: Applied Entomology**

**4 Credits**

Insects habitat is close to plants so their interaction is very significant and it forms the basis of this course. It covers the study of insects which are either beneficial or harmful to human beings. It deals with the ways in which beneficial insects like predators, parasitoids, pollinators or productive insects like honey bees, silkworm and lac insect can be best exploited for our welfare. It also consists of detailed account on agricultural, medical and stored grain pests and management of pests by adopting various methods. The role of insects in criminal investigation is also discussed in the course.

### **Syllabus**

**Agricultural Entomology-I:** Introduction to Pests: Agricultural pests: Pest status and factors responsible for achieving the pest status, economic injury level, economic threshold, action threshold, pest spectrum, pest complex, carrying capacity, secondary pest outbreak, pest surveillance and sampling, pest forecasting. Insect-Plant Interactions: 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. Crop Pests' Biology & Control-I: Identification, seasonal history, nature of damage and control measures of the pests of - cereals, pulse crops, cotton. Crop Pests' Biology & Control-II: Identification, seasonal history, nature of damage and control measures of pests of Vegetables (summer vegetables and winter vegetables), oil seeds, fruit crops, sugarcane.

**Agricultural Entomology-II:** Stored Grain Pests: Brief introduction of stored grain pests and effects, Control and quarantine. Locusts: Different species and phases, phase transition, periodicity, migration, biology and control measures. Plant Resistance to Insects: Types of resistance, mechanism of resistance-antibiosis, antixenosis, tolerance, factors mediating resistance. Transgenic plants (using genes of *Bacillus thuringiensis*, etc.) by recombinant DNA technology, resistance management of *Bt*-crops.

**Management of Insect Pests and Vectors:** Pest Management Methods-I: Physical, Cultural, Chemical, and Biological methods of pest control. Pest Management Methods-II: Microbial methods, Genetic methods (SIT, F<sub>1</sub> sterility, etc.) and biotechnological methods of pest control. Pest Management Methods-III: Bio-rational methods (Using Pheromones, JH mimics, MH agonists, etc.) in pest management. Control of Insect Vectors of Public Health Importance: Management of medically important insects by Integrated Vector Management.

**Economic Entomology:** Apiculture: Rearing of the honey bee, Methods of production of honey in India, Bee economy. Sericulture: Mulberry and non-mulberry sericulture, Rearing of mulberry silkworms, Methods of production of silk in India, Silk usage and applications. Lac Culture: Rearing of Lac Insect, Methods of production of lac in India, Uses of lac. Forensic Entomology: Forensically important insects, role of insects/arthropods in criminal investigation by predicting time and cause of death.

## **MZOL-004: Lab Course IV**

**4 Credits**

This is the last laboratory course of the fourth semester and M.Sc. Zoology programme. There are 20 experiments/exercises based on the three elective courses of 4<sup>th</sup> semester. Experiments 1-6 are based on course "Insect Morphology and Taxonomy". Experiments 7-13 are based on course "Insect Physiology and Toxicology". Experiments 14-20 are based on course "Applied Entomology". You will be exposed to visits to agricultural fields and field collection of insect as well as laboratory experiments of estimation of LD<sub>50</sub> and LD<sub>90</sub> values of insecticides. You will perform the experiments at the Study centre assigned to you and it is mandatory to attend the laboratory sessions. The laboratory training for this Course will be imparted for 120 hours (two weeks).



## **Syllabus**

### **List of Experiments:**

1. Morphology: Study of head and its sclerites of honeybee and cockroach.
2. Study of mouth parts of cockroach, housefly, honeybee, mosquito and butterfly.
3. Study of wings and their venation, different types of antennae and legs of insects.
4. Study of stinging apparatus of honey bee.
5. Taxonomy: Identification of insects belonging to different groups up to orders and sub orders.
6. Social Insects: Morphological studies of various castes of *Polistes*, *Apis*, *Camponotus*, and *Odontotermes*.
7. Study of various types of social insects and their nests.
8. Insect Toxicology: Estimation of LD<sub>50</sub> and LC<sub>50</sub> of insecticides using insects.
9. Pesticide residue analysis of contaminated soil, vegetable and water using TLC.
10. Studies on dissipation of pesticides from soil and half-life estimation through provided data.
11. Estimation of non-specific hydrolytic esterases' and acetylcholinesterase activity to evaluate the toxicity of xenobiotic compounds.
12. Ecology: Measuring insect microclimate
13. Life tables/population dynamics modeling
14. Agricultural Entomology: Identification of economically important insects and various stages of their life history.
15. Methods of rearing insects in the laboratory.
16. Identification of important insect pests of different crop plants and stored products.
17. Visits to agricultural fields and forests for on-spot study of pests and damage caused by them.
18. Vector Biology: Study of life history stages of medically important arthropods - Diptera, Phthiraptera, Siphonaptera.
19. Identification and anatomical studies of major vector species of *Anopheles*, *Culex* and *Aedes*.
20. Field collection of immature stages of mosquitoes. Study of a few available pathogens of arthropod-borne diseases.

### **Project (MZOP-001) (Will be continued from III to IV Semester) (4 Credits)**

The Project worth 4 credits will equip you with research skills as Project work is mini research. This component is very important as this will expose you to research. You need to collaborate with various institutions/industries to pursue the project. The details of this component will be given in 'Project Guide' which will be sent to you with course materials. The topic of Project should be on a theme of Zoology courses of our M.Sc. Zoology Programme. Detailed Project Report has to be sent to Registrar (SED) for evaluation. Guidelines for writing Project Report will be provided in Project Guide.

## **6. OTHER USEFUL INFORMATION**

### **6.1 Refund of Fee**

Refund of fee is governed by the Fee Refund Policy of the University. The same is available on the University Admission Portal (<https://ignouadmission.samarth.edu.in>). Fee paid for one programme is

not adjustable against any other programme of the University. In case the University denies admission, the programme fee will be refunded after deduction of registration fee, through online mode.

## **6.2 Reservation**

The University provides reservation of seats for Scheduled Castes, Scheduled Tribes, Non-Creamy Layer of OBC, Economically Weaker Sections, War Widows, Kashmiri Migrants and Physically Handicapped learners, as per the Government of India rules, for admission to its various programmes. However, submission of forged certificate under any category shall be liable for not only cancellation of admission but also to be legally implicated as per Government of India rules. Eligible students can apply for Government of India scholarship on the National Scholarship Portal (<https://scholarships.gov.in/>) after confirmation of their admission.

## **6.3 Correction of Address and Study/Regional Centre Change**

Learners can initiate the request for change of address, Learner Support Centre and Regional Centre online from their user account. The user account is to be created at <https://ignou.samarth.edu.in> by clicking 'New Registration. They can also make a request to the Regional Centre.

## **6.4 Correction/Change of Name/Surname of Learner**

Spelling mistakes, if any, committed at the time of data entry stage will be rectified at the Regional Centre. In case there is a change inhumane (other than the emetic one in his/her High School Certificate), then it is mandatory to furnish legal evidence of having changed his/her name/surname while submitting the admission form.

For 'Change of Name/Surname', after confirmation of admission, the learners are required to submit the following document at the Regional Centre:

- a) Original copy of Notification in a daily news paper notifying the change of name;
- b) Affidavit, in original, on non-judicial Stamp Paper of the appropriate values worn in before 1<sup>st</sup> Class Magistrate specifying the change in the name;
- c) Marriage Card/Marriage Certificate in case of women candidates for change in surname;
- d) Gazette Notification, in original, reflecting the change of name/surname; and
- e) The requisite fee.

**Request for correction and/or change of Name / Surname will be entertained only before completion of the programme.**

## **6.5 Dispute on Admission & other University Matters**

The place of jurisdiction of filing of suit, if necessary, will be New Delhi/Delhi ONLY.

## **6.6 Prevention of Malpractice/Notice for General Public**

Learners seeking admission to various academic programmes of Indira Gandhi National Open University are advised to directly contact IGNOU head quarters at New Delhi or Regional Centres of IGNOU only. Learners interacting with intermediaries shall do so at their own risk and cost. However,



in case of any specific complaint regarding fraudulent institutions, fleecing learners etc., please contact the University through:

**Email:** [ignouregistrar@ignou.ac.in](mailto:ignouregistrar@ignou.ac.in)

As per directions of Hon'ble Supreme Court of India ragging is prohibited. If any incident of ragging comes to the notice of the authority the concerned learner shall be given liberty to explain and if his explanation is not found satisfactory, authority would expel him from the University. IGNOU admissions are made strictly on the basis of merit. Only those learners who satisfy the eligibility criteria fixed by the university will be admitted. Learners will not be admitted if they are not eligible as per the eligibility criteria. Therefore, the candidates should not be misled by the false promises of admission made by any private individuals or institution.

## **6.7 Placement Services**

In order to further extend learner support services to its geographically distributed learner population who are pursuing various IT and Non-IT related Degree, Diploma and Masters Programme, the university has established the Campus Placement Cell (CPC). The mission and endeavour of CPC is to enhance and facilitate the process of prospective suitable employment opportunities that are commensurate with the personal profiles of our learners. All learners interested in seeking the assistance of CPC for procuring suitable job opportunities are requested to send their current resume/bio-datato [campusplacement@ignou.ac.in](mailto:campusplacement@ignou.ac.in). They are further advised to visit our home page [www.ignou.ac.in](http://www.ignou.ac.in) for regular updates on placement related activities.

## **6.8 Some Useful Contact Addresses**

1.	Identity Card, Fee Receipt, Bonafide Certificate, Migration Certificate, Scholarship forms, Change of Courses / Electives / Opting of left over electives	Concerned Regional Centre. The demand Draft for the requisite should be drawn in favour of 'IGNOU' payable at city of the Regional Centre.
3.	Schedule/Information regarding Exam-form, Entrance Test, Date-sheet, Hall Ticket	Asst. Registrar (Exam.II), SED, Block-12, Room No. 02, IGNOU, Maidan Garhi, New Delhi-110068. Ph.: 011-29536743, 29572202, 29572209
4.	Result, Re-evaluation, Grade Card. Provisional Certificate, Early Declaration of Result, Transcript	Deputy Registrar (Exam.III), SED, Block-12, Room No. 01, IGNOU, Maidan Garhi, New Delhi-110068. Ph.: 011-29536103,29572201, 29571316
5.	Non-reflection of Assignment Grades/marks	Assistant Registrar (Assignment), SED, Block-03, IGNOU, Maidan Garhi, New Delhi-110068. <a href="mailto:assignment@ignou.ac.in">assignment@ignou.ac.in</a> . Ph.: 011-29571312,29571319, 29571325



7.	Original Degree/Diploma/verification of degree/diploma	Deputy Registrar (Exam.I), SED, Block-9, IGNOU, Maidan Garhi, New Delhi-110068. Ph.: 011-29535438, 29572224, 29572213
8.	Student Grievance (SED)	Asst. Registrar (Student Grievance), SED, Block-3, Room No.13, IGNOU, Maidan Garhi, New Delhi-110068. Ph.: 011-29532294, 29571313
9.	Academic Content	Director, School of Sciences, IGNOU, Maidan Garhi, New Delhi-110068. sos@ignou.ac.in. Ph.:011-29532167;29572832
10.	Student Support Services	Regional Director, Student Service Centre, IGNOU, Maidan Garhi, New Delhi-110068. <a href="mailto:ssc@ignou.ac.in">ssc@ignou.ac.in</a> , Ph.: 011-29535714, 29533869, 2953380, Fax:011-29533129

## 7. LINKS TO FORMS AND ENCLOSURES

In this section, we are listing the IGNOU website links to various forms, which are useful for you. Whenever you have to correspond with the university, please **download the form from the IGNOU website**, fill it carefully and send it as per the instructions in the form. The detailed instructions for all these forms are provided in the form itself. Some of these links may change, in that case please use the search option to find the desired link. An important page for all students is the following:

<http://ignou.ac.in/ignou/studentzone>

You must familiarize yourself with all the links on this page.

*Note: You may download the Forms from the Website*

### 1. Assignment related links

Link to Latest Assignment(s): <https://webservices.ignou.ac.in/assignments/>

### 2. Re-registration

Link to Online Re-Registration <https://onlinerr.ignou.ac.in/>

Last date of Re-Registration is announced on the IGNOU website. In general, the re-registration is to be done 2-3 months prior to the start of Session. For example, the last date of re-registration for the session starting from July cycle is typically the end of May. Similarly, the last date for session starting January cycle may be in the last of November.

**You must verify the cut off dates and fees from the website prior to filling up form.**

### 3. Term-end Examination and Related Links

The link to the **online Term End Examination form** is available on

<https://exam.ignou.ac.in/>



Links to application forms for

- Early Declaration of Result
- Obtaining Photocopy of the Answer Script
- Re-evaluation of Answer script
- Duplicate Grade Card/Mark-sheet
- Issue of Official Transcript

**are all available** on:<http://ignou.ac.in/ignou/studentzone/forms/1>

The form for **the Issue of Migration Certificate** is available at

<http://ignou.ac.in/ignou/studentzone/download/Applicationformc>

Please keep checking the **News and Announcements** section of the IGNOU website for all important announcements regarding admissions, assignment submission dates, term-end examination schedules and re-registration.

#### 4. Other Important Links

Link for Checking Study Material Status

<http://www.ignou.ac.in/ignou/aboutignou/division/mpdd/material>

