



NETAJI SUBHAS OPEN UNIVERSITY

School of Sciences

PROGRAMME GUIDE

for

Bachelor Degree Programmes

And

Post Graduate Degree Programmes

DD-26, Sector-I, Salt Lake, Kolkata-700064
(www.wbnsou.ac.in)



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Programmes under School of Sciences

- ❖ Bachelor Degree in Botany (EBT)
- ❖ Bachelor Degree in Chemistry (ECH)
- ❖ Bachelor Degree in Geography (EGR)
- ❖ Bachelor Degree in Mathematics (EMT)
- ❖ Bachelor Degree in Physics (EPH)
- ❖ Bachelor Degree in Zoology (EZO)
- ❖ Post Graduate Degree in Geography (PGGR)
- ❖ Post Graduate Degree in Mathematics (PGMT)
- ❖ Post Graduate Degree in Zoology (PGZO)



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PREFACE

In the curriculum structure introduced by the University for Bachelor Degree Programme/ Post Graduate Degree Programme/2nd Degree Programmes(in compliance to the concerned regulatory body) in various disciplines is equally available to all learners. Instead of being guided any presumption about ability level, it would perhaps stand to reason if receptivity of a learner is judged in the course of the learning process. That would be entirely in keeping with the objectives of open education which does not deliver in artificial differentiation.

Keeping this in view, Self Learning Materials of the programme in different disciplines are being prepared on the basis of a well laid out syllabus. The course structure combines the best elements in model syllabi of UGC in respective subject. It has been so designed as to be upgradable with addition of new information as well as of fresh thinking and analysis. The University has also taken initiatives to prepare the Programme Guide for the benefit of the learners. The Programme Guide will help the learners in completing the course successfully by well designed plan of entire learning process. It also provides different sources of e-Resources.

The more a learner would seriously follow the Programme Guide the easier it will be for her/him to reach out to longer horizons of a subject. If anything remains still difficult to follow, the learners are advised to attend the counselling sessions arranged at designated Learner Support Centres (LSCs) of the University.

Needless to add, a great part of these efforts is still experimental – in fact, pioneering in certain areas. Naturally, there is every possibility of some lapse or deficiency here and there. With the new initiatives of the University, I hope that the Programme Guide would be beneficial to the learners and as well as to the Academic Counsellors. I also welcome suggestions and feedback from the users for its further improvement.

Professor Subha Sankar Sarkar
Vice-Chancellor
Netaji Subhas Open University

Bachelor Degree in Botany

B.Sc. in Botany (EBT)

Expectation from the learners

Today Botany is a fusion of the traditional components with the modern aspects of Biochemistry, Molecular Biology, Biotechnology, Biodiversity and Conservation etc. Quite for a long time Botany has contributed enormous knowledge and information as inputs to the national developmental planning based on its fundamental and applied aspects of researches. This has led to the emergence of challenging areas in Botany. In fact, study of plant science has become of national importance.

Netaji Subhas Open University is a place where knowledge is served through wide range of courses in the vernacular medium to various disadvantaged groups of aspiring learners. Out of this potpourri of courses, B.Sc. Honours in Botany (EBT) is a unique, interesting and leading course designed by the NSOU to encourage aspiring students to pursue an undergraduate honours and subsidiary course program that will innovate their power of critical thinking, Emotional Quotient/Emotional Intelligence (EQ/EI), provide practical training and prepare them eligible for rewarding professional career.

Course Information

For EBT program, the student must have passed 10+2 examination or equivalent with 40% marks in Biology. The EBT course offered by NSOU is designed by competent Board of Studies to make it as contemporary as possible. It is a three years course with eleven (11) theory papers and three (3) practical papers. The total marks of the course is 1550.

Core Subject	Number of Paper	Full Marks	Total Learning Activity (hr)	Total Credit Value
Elective Botany Subjects	14	800	1920	64
Subsidiary Subjects	3	300	720	24
Foundation Course Subjects	2	200	480	16
Application Oriented Course	1	100	240	8

Language Course Subject	2	100	240	8
Environmental Studies	1	50	120	4
Total	—	1550	3720	124

Course duration is three (3) years. However, the students have the liberty to complete its course within six years. The learners after completion of the course may go for M.Sc. in the field of Botany/Biological Sciences or may even get jobs in various Non-governmental or Governmental sectors.

Recommended Approach

The EBT course is conducted through Personal Contact Programme (PCP) in its various study centers. Besides these PCP sessions the University also conducts special lectures in its Regional Centers from time to time. The learners are expected to read the Self Learning Materials (SLM) before coming to the PCP sessions and clarify their doubts. They supposed to ask questions and check their progress in these sessions.

There is a strong liaison between the coordinators of the study centers and the concerned authorities of the universitys othatan effective mode of communication is established and relevant information are timely disseminated amongst the learners about the various curriculum like submission of assignments, notice related to Laboratory Counseling Cum Evaluation Session (LCES) programme or matters related to examination. The university has its own e-repositories along with a strong ICT support which enables the learners to access the e-learning materials whenever they require. The learners are welcome to meet the concerned faculty on the Regional Centre whenever they feel the need. The learners and the concerned faculties are in regular contact through different social networking sites. The University therefore adopts a very democratic and flexible approach where the learners are encouraged for blended learning from anywhere on round the clock.

Programme Objectives

The objective of the programme is to help the learners develop competency in the field of Botany. The Programme consists of foundation course, elective courses and application oriented course. The Bachelor Degree in Science is designed for the workforce of bioscience and industry who wants work in a research organization or to develop his/her own business. The fresher and existing workforce can take the advantage of ODL system to increase their skills and competency in this particular field without disturbing their work schedule.

Course/Paper Objectives

All theory and practical papers nourish the grass root knowledge of the learners in the field of Bioscience and help to enhance their overall graduate attributes.

Expected Learning Outcomes

After successful completion the students may increase their knowledge in the domain of Science and Management which intern increase their employability.

Programme Outcomes:

Course-wise Learning Outcomes:

EBT 01

At the end of the course the learning outcomes will be to:

- Write down in details with application of Classification of bacteria
- Understand in details with application of Microbial ecology
- Specify the details of Algal Reproduction

EBT 02

At the end of the course the learning outcomes will be to:

- Identify in details with examples Basidiomycetes
- Deliberate in depth the concept of Control of plant diseases
- Deliberate in details with application of Diagnosis of some diseases affecting Indian crops

EBT 03

At the end of the course the learning outcomes will be to:

- Learn in depth the concept of Plant Tissues
- Write down the characteristics of Cambium primary and secondary structure, nature and function
- Identify in details with examples Cultivation of paddy, wheat and jute

EBT 04

At the end of the course the learning outcomes will be to:

- Identify in details with examples Preparation and identification : *Rhizopus*, *Ascobolus*

- Specify in depth the concept of Sterilization, inoculation techniques, preparation of slant and stabs
- Write down the classification and characteristics of Sampling and identification of *Lycopodium and Pteris*

EBT 05

At the end of the course the learning outcomes will be to:

- Identify the characteristics of Bryophyta : Introduction, characteristics, life cycle, classification
- Identify the details of Heterospory and seed habit
- Learn the characteristics of Characteristics of Gymnosperm and their classification

EBT 06

At the end of the course the learning outcomes will be to:

- Identify the characteristics of Inflorescence different types
- Write down the details of Fertilization
- Understand the details of Taxonomy, systematics, classification, identification and nomenclature

EBT 07

At the end of the course the learning outcomes will be to:

- Identify the characteristics of Cell Physiology
- Learn in details about the different aspects of plant physiology.

EBT 08

At the end of the course the learning outcomes will be to:

- Deliberate the classification and characteristics of Taxonomic study of angiosperm
- Deliberate in details with examples Identification of anatomical structures with reasons
- Identify in depth the concept of Ecological anatomy

EBT 09

At the end of the course the learning outcomes will be to:

- Write down in details with examples Chromosomal theory of inheritance
- Specify in depth the concept of Numerical changes in chromosome : different types of euploidy
- Learn in details with examples Gene regulation

EBT 10

At the end of the course the learning outcomes will be to:

- Write down the characteristics of Plant ecology relevance to human civilization, sub-divisions, development
- Understand in details with examples Atmosphere and plant responses
- Identify in depth the concept of Soil and plant interrelationship

EBT 11

At the end of the course the learning outcomes will be to:

- Write down the characteristics of Water, pH, buffer solutions
- Specify in details with examples DNA structure and types
- Learn in details with application of RNA structure and types

EBT 12

At the end of the course the learning outcomes will be to:

- Understand in details with application of Determination of Goodness of fit in normal and modified mono and dihybrid ratios (3:1, 1:1, 9:3:3:1, 9:7, 15:1 and 13:3)
- Identify the classification and characteristics of Detection of organic acids : Citric, Tartaric, Oxalic and Malic. Detection of titrable acidity from plant sample
- Learn in details of Estimation of catalase activity and amino nitrogen by tritometric method

EBT 13 & 14

At the end of the course the learning outcomes will be to:

- Write down in details with application of Microscopy light, phase contrast,

fluorescence and electron microscopy

- Deliberate in details with examples Cell cycle and its control

Examination System

There are eleven theoretical papers and three practical papers i.e. LCES in the BDP EBT course. The total marks allotted for the course is 1550. The learner have to submit assignment for all the papers except practical papers, followed by the term end examination each year. The total weight age of 30% for assignment while 70% is given for the term end examination. LCES programmes are conducted in the Regional Centers of the University by the selected Board of Examiners. The names of the Paper Setter, Moderator, and Examiner are selected by the BoS (Board of Studies) members.

- **Semester wise Examination system** (Subject to Change)

1st Semester - FBG, FEG, E-1 & E-4*

2nd Semester - FHS, E-2, E-3 & E-5

3rd Semester - FST, E-6 & E-8*

4th Semester - E-7, E-9, E-10 & S-1

5th Semester - E-11, E-12* & S-2

6th Semester- E-(13 & 14), S-3, AOC & ENVS

- * **Practical Courses**

Detailed Syllabus:

http://www.wbnsou.ac.in/student_zone/courses/science/syllabus/BDP-Elective_Subjects/EBT_Syllabus.pdf

Bachelor Degree in Chemistry (ECH)

B.Sc. in Chemistry (ECH)

Expectation from Learners

The primary goal of the Chemistry undergraduate program is to equip students with the fundamental knowledge in the diverse fields of Chemistry i.e. Analytical, Inorganic, Organic and Physical Chemistry. Moreover, the Bachelor's Degree Programme in chemistry at Netaji Subhas Open University is designed not only to provide knowledge to students but also to grow appreciation for the vast subject of chemistry and to prepare them for their future endeavours. Upon graduation, the bachelor degree holders will have developed a set of fundamental competencies such as:

i) Knowledge and Comprehension:

The course is designed to give the students a holistic understanding of the basic knowledge fundamental to the field of Chemistry in accordance with the expectations set forth by the University Grants Commission through course work in general, organic, inorganic, analytical, physical and biological Chemistry.

ii) Application and Analysis:

At the end of the course a student will be able to employ and extend knowledge gained to analyze issues of Chemistry. design a rational scientific scheme to generate data and collect reliable information and utilize the knowledge, information and data gathered to formulate a scientifically sound strategy in order to solve a chemical problem or challenge.

iii) Evaluation and Judgment:

The course will enable individuals to design a rational criterion and a scientifically sound strategy to evaluate the effectiveness of solutions developed.

Course Information

The Elective Chemistry Honours (ECH) course under School of Sciences, NSOU has been designed by an eminent Board of Studies. The course follows UGC recommended guidelines and is at par with any other undergraduate programmes in the country. The overall Bachelor's Degree Programme involves four compulsory

subjects, thirteen papers of elective chemistry honours (ECH) subjects, one application-oriented course and one environmental science paper. The undergraduate students also have to take a subsidiary subject consisting of three paper from the list of available subjects offered by the university. For completing B.Sc. programme as major in Chemistry (ECH) from NSOU, learner has to study 124 credits or 1550 marks worth of courses. Among 124 credits, 64 credits are solely based on the chemistry elective courses which contains 10 theory courses and 3 laboratory courses. One credit is equivalent to thirty hours of study time (which includes all the learning activities) from the learners' point of view.

The ECH course incorporates all the fundamentals of chemistry as well as exposure to latest developments. Chemistry students need to undergo mandatory laboratory training to learn and apply the subject in future. Therefore, the ECH course has been divided into ten theory papers and three practical chemistry papers. Evaluation for theory papers are based on internal assessment and term end examinations while the same for the practical papers are completely done through term end examinations. The course incorporating both the theory and practical papers runs through personal contact programmes in the study centres of the university. However, from 2016, NSOU has established its own chemistry laboratory facility with modern instruments facilities to cater to the needs of students in the Kalyani regional campus with plans of further expansion.

Recommended Approach

The University adopts various democratic and flexible approach where the learners are encouraged to learn from any where and in anytime. Besides these PCP sessions the University also conducts special lectures in its Regional Centers from time to time. The university has its own e-repositories along with a strong ICT support which enables the learners to access the e-learning materials, video lectures, online classes whenever they require. The learners are welcome to meet the concerned faculty on the Regional Centre whenever they feel the need. The learners and the concerned faculties are in regular contact through social networking sites.

There is need for two laboratories namely Inorganic and Physical laboratory at University's own campus for better laboratory support to the learners. The faculty members of the Department of Chemistry are highly enthusiastic and they have already submitted a detailed proposal with approximate budget for the establishment of these laboratories to the higher authority of the university seeking financial support. The University wants to introduce PG course in Chemistry under this

Department in coming days and the faculties are engaged to take all required initiatives for this purpose. The proposal to introduce PG course in Chemistry under the School of Sciences has already been approved by the members of Executive Council and preparation of syllabus is under process. Faculty members are eager to carry out the research activities in the Department of Chemistry with some experimental as well as theoretical facilities. Furthermore, the Department is preparing topic-wise online video lectures by eminent experts on various topics within the syllabus and wants to cater to the students through University's IT department.

Programme Objective

The objective of the programme is to provide facility for lifelong education in Chemistry to intending learners. The Bachelor's Degree in Chemistry is designed accordingly so that the students at the end are able to secure key fundamental knowledge and practical training skills required for a profession with chemistry background or industry. The main objective of the programme is to equip individuals with the necessary skills and competencies to enable them to seek jobs and progress in their academic career. The programme intends to introduce students to foundation and advance level knowledge of the subject and provide them with exposure to the ongoing research in the field. The programme is designed in such a way that a fresher as well as an existing employee in an organisation can take the advantage of ODL system to increase their skills and competency in this particular field without disturbing their work schedule.

Course/Paper objectives

As mentioned before the bachelor's degree programme in chemistry can be divided into five set of courses. These courses were designed keeping in mind individual objectives. The honours level chemistry courses which is the main objective of the programme consists of both theory and laboratory-based papers. In the following points, individual course objectives have been discussed.

i) Foundation Courses:

This course consists of compulsory papers which every undergraduate student of the university has to take. By design, the foundation courses prepare a student for

undergraduate studies. The foundation courses at NSOU include a humanities and social science paper (FSH), a science and technology paper (FST). These two papers act as a bridge between school level education and college/university level education. Along with them, one English language paper (FEG) and one Bengali language paper (FBG) paper is being taught. These two language papers prepare the students for communication, writing and helps them uplift their language skills.

Education methods differ from school to college and university. A bachelor's degree student is expected to gain expertise in subject-specific modules which is completely different from school level studies. While the core modules will allow a student to gain an understanding of the wider context of his/her chosen focus area, the foundations courses prepare them for the method of teaching and impart necessary language/communication skills.

ii) Elective Chemistry Honours (ECH):

These papers are the main focus of the course. There are 13 papers comprising of both theory and practical courses. The detailed information are as follows:

Title of the Papers	Theory Based Papers
<p>ECH – 01 General Chemistry</p>	<p style="text-align: center;">Objectives</p> <ol style="list-style-type: none"> 1. To become familiar with the scope, methodology, and application of modern chemistry and to learn to appreciate its ability to explain the physical world. 2. To understand that all matter consists of atoms, and that the limitless variety observed around us stems from the ways that these atoms bond with one another. 3. To get the concept of structure of atoms and molecules and develop the concept of chemical bonds with theoretical background. 4. To familiarise with the concepts of optical rotation, refractivity etc. and apply them in future. 5. To get a primary concept about dipole moment, rotational, vibrational and molecular spectroscopy
<p>ECH-02 Inorganic Chemistry-I</p>	<ol style="list-style-type: none"> 1. This paper provides to the learners about the detailed study on Periodic Table, Periodicity of the elements in two different units.

	<p>2. In Inorganic Chemistry -1: A brief study on the oxidation and reduction reactions is presented. The chapter will definitely improve the knowledge about the topics.</p> <p>3. In this paper learners will learn about the acids and bases, aqueous and non-aqueous solvents systems also.</p> <p>4. To get the details about the structural nature mainly shape of inorganic compounds, this paper is very much useful to the learners.</p> <p>5. To get a comprehensive idea on radioactivity and isotopes and their applications.</p>
ECH-03 Inorganic Chemistry - II	<p>1. In this paper Block -I & Block –II elements are discussed. Learners must get the basic idea about these block elements.</p> <p>2. To get the basic detailed idea of the S-Block elements like hydrogen, alkali metals and alkaline earth metals, this volume is very much effective to the learners.</p> <p>3. To get the fundamental about the P-Block elements mainly elements of Group-13, 14 and 15.</p>
ECH -05 Inorganic Chemistry - III	<p>1. To get the fundamental knowledge on P-block elements mainly on Group -16, 17 and 18 elements of the periodic table.</p> <p>2. A detailed discussion on d-and f-Block elements (Transition elements, Inner-Transition elements) are presented in this paper which definitely an excellent tool for the learners to get the fundamental concepts.</p> <p>3. To get a brief knowledge on the lanthanides and actinides chemistry.</p> <p>4. To get the knowledge on fundamental chemistry on coordination compounds.</p> <p>5. To become familiar with the scope, methodology on separation and purification of the metals and their applications on modern society.</p>

<p>ECH – 06 Physical Chemistry - I</p>	<ol style="list-style-type: none"> 1. To know the basic empirical equation of states and to get the concept of ideal and real gases. 2. To understand the significance of the kinetic molecular theory of gases. 3. To understand the molecular nature of gases and to derive the laws from kinetic theory. 4. To know the different properties of liquids and how they behave under different conditions. 5. To get the idea of crystals, symmetry elements, determination of crystals structure of solids. 6. To identify the thermodynamic systems and processes, understand the basic principles of thermodynamics. 7. To Explain the processes taking place in solution and at interfaces. 8. To grasp the concept of entropy, free energy and third law of thermodynamics.
<p>ECH – 07 Physical Chemistry - II</p>	<ol style="list-style-type: none"> 1. To understand that the property of solutions is different from either of its constituents i.e. solvent and solute and know the reason behind it. 2. To understand how to quantify the properties of solutions and development of laws based on those properties. 3. To get the concept of phase and phase diagrams 4. To learn different aspect of solid, liquid and gas phases along with mixtures and phase transformations. 5. To learn about chemical equilibrium and its energy aspects 6. To understand the driving forces behind a chemical transformation and how changing those factors changes the outcome of a reaction.
<p>ECH – 09 Physical Chemistry - III</p>	<ol style="list-style-type: none"> 1. To recognize oxidation reduction (redox) reactions and be able to write the oxidation and reduction half reactions. 2. To describe the functions of the various components of simple voltaic and electrolytic cells

	<p>along with labelling the anode, cathode, and directions of ion and electron movement.</p> <p>3. Understand the relationship between E° cell, ΔG°, and K for oxidation-reduction reactions and use the Nernst equation to calculate the cell potential or the concentration of a substance.</p> <p>4. Understand the concept of reaction rates and be able to use the coefficients of a balanced chemical equation to express the rate of reaction in terms of the change in concentration of a reactant or product over time.</p> <p>5. To recognize the integrated rate laws and be able to use integrated first-order and second-order rate laws to find the value of one variable, given values of the other variables.</p> <p>6. To explain the concept of reaction half-life and describe the relationship between half-life and rate-constant for first-order and second-order reactions.</p> <p>7. To understand the concept of collision theory and transition state theory.</p>
<p>ECH – 10 Organic Chemistry - I</p>	<p>1. Understand the fundamental concepts, properties and nature of Chemical Bonds in Organic Chemistry.</p> <p>2. A detailed discussion on the physical and chemical properties, synthesis, and types of reaction for Aliphatic, Alicyclic, Aromatic Hydrocarbons and Polynuclear Hydrocarbons]</p> <p>3. Understand the concept of Stereoisomerism and nature of Organic Reactions</p>
<p>ECH – 11 Organic Chemistry - II</p>	<p>1. A detailed discussion on the physical and chemical properties, synthesis, and types of reaction of Substituted Aliphatic and Aromatic Compounds, carbonyl compounds and nitrogenous compounds</p> <p>2. To explain the reactions of Dicarboxylic Acids</p> <p>3. Understand the basic concept of Tautomerism in organic compounds</p> <p>4. To describe the reactions with Active Methylene</p>

	Group and reaction of Organic Compounds of Metals 5. Study of properties, synthesis, and types of reaction with Heterocyclic Compounds
ECH – 13 & 14 Organic Chemistry-III & Biochemistry	<ol style="list-style-type: none"> 1. Understand the basic concept of Reactive Intermediates; Molecular Rearrangements, Pericyclic Reactions 2. Study of Macromolecules like Carbohydrates, Amino Acids and Proteins 3. To understand the basic knowledge of Spectroscopy and Practical applications of it in Organic compounds. 4. Discussion about synthesis, properties and use of dyes, Colour Constitution of Organic Compounds. 5. To explain the concept of Biogenetics and Metabolism, Catabolism of Carbohydrate, Amino Acid, lipid 6. Understand the concept of Citric Acid Cycle and Special Oxidation Unit
Laboratory Based Papers	
Title of the Papers	Objectives
ECH – 04 Practical Chemistry – I ECH – 08 Practical Chemistry – II ECH – 12 Practical Chemistry – III	<ol style="list-style-type: none"> 1. To develop firm foundation in the fundamentals and application of current chemical and scientific theories including those in Analytical, Inorganic, Organic and Physical Chemistry. 2. To design and carry out scientific experiments as well as accurately record and analyse the results of such experiments. 3. To develop skills in problem solving, critical thinking and analytical reasoning as applied to scientific problems. 4. To convert raw data obtained in the experiments using instruments to physically meaningful form. 5. To use the scientific method to create, test, and evaluate a hypothesis.

	<p>6. To engage in safe laboratory practices handling laboratory glassware, equipment, and chemical reagents.</p> <p>7. To learn basic experimental skills such as titrations, synthesis and purification of organic and inorganic compounds. To perform common laboratory techniques, including reflux, distillation, steam distillation, recrystallization, vacuum filtration, aqueous extraction, pH measurement, acid/base titrations, UV/Visible spectroscopy, conductometry, colorimetry, potentiometry etc and use the techniques to solve chemical problem</p> <p>8. To clearly communicate the results of scientific work in oral, written and electronic formats to both scientists and the public at large.</p> <p>9. To appreciate the central role of chemistry in our society and use this as a basis for ethical behaviour in issues facing chemists including an understanding of safe handling of chemicals, environmental issues and key issues facing our society in energy, health and medicine.</p>
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iii) Application Oriented Course (AOC):

This is a compulsory course for all undergraduate students of NSOU with the aim to gain knowledge about science and technology in everyday life.

iv) Environmental Studies:

The main objective of compulsory environmental studies course is to understand the environmental knowledge and awareness among the students.

v) Subsidiary Papers:

The objective of a subsidiary paper is to expand the knowledge of a subject learned in school other than the main subject. This subsidiary subject will accompany the student in studying the main subject during undergraduate course and in future academic study.

Expected Learning Outcome

Chemistry is a diverse scientific field with application in everywhere from material science, energy harvesting to drug discovery. The undergraduate course in chemistry is the first gateway of a student into the realm of chemistry. The Bachelor's degree graduate students of chemistry from our university will have firm foundations in all the fundamental aspects of all areas of chemistry along with training in chemical laboratory which will help them in the progress of their future endeavours. A broader set of program-focused learning outcomes for degree programs is as follows:

1. By the time of graduation, the Bachelor's degree chemistry honours students of NSOU will be able to demonstrate a mastery of factual knowledge comprehensively and be able to analyse and solve problems, understand relationships, and interpret scientific facts and data.
2. The graduated students will have proficiency in basic laboratory techniques and laboratory safety; have experience with modern lab instrumentation and experience working as a member of a team.
3. The students will be able to communicate (written and oral) scientific information to chemists and non-chemists.
4. Students will be able to explain why chemistry is an integral activity for addressing social, economic, and environmental problems.

Programme Outcomes

Course-wise Learning Outcomes:

ECH 01

At the end of the course the learning outcomes will be to:

- Specify in depth the concept of Electric Discharge through Gases, Fundamental Particles, Radioactivity, Rutherford's Atomic Model
- Specify in details with application of Quantum Theory and Atomic Spectra, Bohr's Theory
- Specify the details of Molar Refraction, Optical Activity

ECH 02

At the end of the course the learning outcomes will be to:

- Specify in details with application of Periodic Table
- Learn in details with application of Oxidation and Reduction
- Specify the characteristics of Isotopes and Applications

ECH 03

At the end of the course the learning outcomes will be to:

- Learn in depth the concept of Hydrogen
- Specify the classification and characteristics of Alkaline Earth Metals
- Write down in depth the concept of Elements of Group

ECH 04

At the end of the course the learning outcomes will be to:

- Learn the characteristics of Identification of Anions and Identification of Cations
- Understand in details with application of Identification of Special Elements of Organic Compounds
- Identify the classification and characteristics of Preparation of Organic Compounds

ECH 05

At the end of the course the learning outcomes will be to:

- Learn the details of Elements of Group
- Learn the details of Coordination Compounds
- Deliberate the characteristics of Isolation and Purification of Metals

ECH 06

At the end of the course the learning outcomes will be to:

- Deliberate in details with application of The Kinetic theory of Gases
- Identify in details with application of Thermochemistry

- Understand in details with examples Law of Thermodynamics

ECH 07

At the end of the course the learning outcomes will be to:

- Deliberate in details with examples Colligative Properties of Dilute Solution
- Specify the classification and characteristics of Chemical Equilibria
- Understand the details of Buffers and Neutralization

ECH 08

At the end of the course the learning outcomes will be to:

- Deliberate the classification and characteristics of Acidimetry and Alkalimetry
- Identify the details of Quantitative Analysis of Water
- Identify the characteristics of Polarimeter, Colourimeter / PH Meter Applications

ECH 09

At the end of the course the learning outcomes will be to:

- Write down the details of Electrolytic Conductance of Solutions
- Understand the details of Polarisation, Overvoltage
- Specify in depth the concept of Photochemistry

ECH 10

At the end of the course the learning outcomes will be to:

- Learn in depth the concept of Atomic Orbitals, Molecular Orbitals and Hybridisation
- Understand the details of Stereoisomerism in Acyclic Compounds
- Write down the details of Stereoisomerism in Cyclic Compounds

ECH 11

At the end of the course the learning outcomes will be to:

- Understand the details of Carbonyl Compounds
- Learn in details with application of Nitro & Amino Compounds
- Learn in depth the concept of Tautomerism

ECH 12

At the end of the course the learning outcomes will be to:

- Write down the characteristics of Structure of a Cell and its Functions
- Identify in details with examples Amino Acid and Protein
- Identify in details with application of Estimation of Iron in Cement

ECH 13 & 14

At the end of the course the learning outcomes will be to:

- Deliberate in details with examples Benzynes
- Deliberate in details with application of Carbohydrates
- Learn the characteristics of Metabolism & Carbohydrate Catabolism

Examination System

The examination system adopted by the department of chemistry is the examination system prescribed by the Netaji Subhas Open University. The evaluation in the theory papers are based on internal assessment: 30% and term-end Examinations: 70%. The practical papers are evaluated in term end examinations only. A semester wise paper distribution is given below

1st Semester - FBG, FEG, ECH 01 & ECH 04*

2nd Semester - FHS, ECH 02, ECH 03 & ECH 05

3rd Semester - FST, ECH 06 & ECH 08*

4th Semester - ECH 07, ECH 09, ECH 10 & SMT 1

5th Semester - ECH 11, ECH 12* & SMT 2

6th Semester - ECH 13&14, SMT 3, AOC -03 & ENVS

*** Practical Courses**

Detailed Course Structure & Syllabus:

Semester-wise detailed course curriculum structure at a glance for BDP chemistry:

Paper		Paper Code	Paper Type (Theo/Prac)	Assignment	Term End	Pass Mark	Full Marks	Credits	
1st Year	Semester - I	Foundation Course in Bengali	FBG	Theo	15	35	17.5	50	4
		Foundation Course in English	FEG	Theo	15	35	17.5	50	4
		General Chemistry	ECH 01	Prac	15	35	17.5	50	4
		Practical Chemistry-1	ECH 04	Theo	0	100	35	100	8
	Semester - II	Foundation Course in Humanities & Social Science	FHS	Theo	30	70	35	100	8
		Inorganic Chemistry-I	ECH 02	Theo	15	35	17.5	50	4
		Inorganic Chemistry-II	ECH 03	Theo	15	35	17.5	50	4
		Inorganic Chemistry-III	ECH 05	Theo	15	35	17.5	50	4
Environmental Studies	Environmental Studies	Theo	15	35	17.5	50	4		
2nd Year	Semester - III	Foundation Course in Science & Technology	FST	Theo	30	70	35	100	8
		Physical Chemistry-1	ECH 06	Theo	15	35	17.5	50	4
		Practical Chemistry-2	ECH08	Prac	0	100	35	100	8
	Semester - IV	Physical Chemistry-II	ECH07	Theo	15	35	17.5	50	4
		Physical Chemistry-III	ECH09	Theo	15	35	17.5	50	4
		Organic Chemistry-I	ECH 10	Theo	15	35	17.5	50	4
		Subsidiary Mathematics-Paper 1	SMT 01	Theo	30	70	35	100	8
3rd Year	Semester-V	Organic Chemistry-II	ECH 11	Theo	15	35	17.5	50	4
		Practical Chemistry-3	ECH 12	Prac	0	100	35	100	8
		Subsidiary Mathematics-Paper 2	SMT 02	Theo	30	70	35	100	8
	Semester - VI	Organic Chemistry-III Biochemistry	ECH 13 & 14	Theo	15	35	17.5	50	4
		Subsidiary Mathematics-Paper 3	SMT 03	Theo	30	70	35	100	4
		Application Oriented Course	AOC-3	Theo	30	70	35	100	4

Detailed syllabus

http://www.wbnsou.ac.in/student_zone/courses/science/syllabus/BDP-Elective_Subjects/ECH_Syllabus.pdf

Bachelor Degree in Geography

B.Sc. in Geography (EGR)

EXPECTATION FROM THE LEARNERS

Geography discourse is a practical based science discipline which has a huge demand for its knowledge base of the real world and job orientation. The Under Graduate Geography course at NSOU is successfully running and learners are the pillar for such achievement. Based on their previous academic record, the learners get admitted in the geography discourse and thereafter a good student-teacher relationship grow up in each respective study centres as the strongest support to successful running of the Geography discourse in under graduate section. Thus, in Geography, the learners don't just learn in the classroom; they have the opportunities to learn relevant skills and apply their knowledge to real-world challenges. Thus, the expectation from the learners for the discourse are:

- a. They should be attentive in the PCP (Personal Contact Programme).
- b. They need to read the SLM (Self Learning Study Material) carefully.
- c. The item of the practical papers need to be practiced frequently.
- d. The instructions of the teacher must be followed minutely.
- e. They should be careful in learning the theoretical and practical parts and their should be understood with the help of the instructors.

Course Information

Geography a word derived from the Greek word *geographia* which means earth description has been long considered as one of the fundamental subjects in education system right from the beginning of the system. It is a unique subject which bridging the social and physical aspects of the globe. Geography is a field of science devoted to the study of the lands, the features, the inhabitants, and the phenomena of Earth. Geography's relevance to science and society arises from a distinctive and integrating set of perspectives through which geographers view the world around them. In general, as ODL is concerned, our main objective is to democratize education as a resource and provide every citizen, irrespective of gender, caste and creed, easy and affordable access to quality education and particularly, in the paradigm of social

sciences. The basic philosophy of our aim is to “Reach the Unreached”. Keeping this in mind Netaji Subhas Open University launched its Under Graduate Geography (BDP) from 2000-01 session. The growing number of enrolment in the under graduate course in Geography was the result of the demand of the discipline. The instruction is designed to engage students in learning experiences that not only enable them to learn content but also to develop greater passion for learning – enabling them to ‘learn to learn’ and to be lifelong learners. In the learner-centred paradigm of education, students are encouraged to take greater responsibility for their learning outcomes. We are also promoting the use of Indian language, Bengali for BDP SLM and total programme.

Programme Duration: *Course duration is 3 years. However, the students have the liberty to complete its course within 6 years.*

Eligibility: For the BDP geography, the students must have a Geography in Higher Secondary level from any recognized board. The admission will be done mostly through online form fill up.

Recommended Approach

As the state and national level, the higher educational institutions are expected to provide quality education, education for all, strategic plans for an institution that defines targets and measures of the programmes to be achieved by the institution. Apart from physical infrastructure, administrative policy and code of behaviour, school of sciences is actively engaged in its academic development of respective subjects. The School of Sciences has been designed its curriculum by the help of the board of studies, several learning resource materials, and feedback system through the BOS and an expert committee. Learning material through print-media named Self-Learning Material (SLM) is developed with the approach of self-explanatory, self-contained, self-motivating and self-evacuating followed by the UGC guideline.

- ✓ It tries to ensure quality service to the learners of the subject through development of good and appropriate standard Study Learning Material or SLM, integration of modern methods of teaching learning including usage of ICT and credibility of evaluation procedures.
- ✓ Organization of inter and intra Schools/ Institutional workshops, seminars on quality related themes and promotion of quality circles.

- ✓ Arrangement for feedback responses from students, parents and other stakeholders on quality related institutional processes.

Instructional Delivery Mechanism:

Type	Delivery Mechanisms	Provided (Yes/No)	Detailed Information (Please Mention the Activity Hour)
In-Person Delivery	PCP	Yes	Almost twelve PCP (2 hr for each PCP) for each 100 marks for the theory and eighty four PCP for each 100 marks for the practical papers in geography. The practical classes are arranged mostly during the September-December each year by clubbing the students of respective study centres, consequencing a examination at the 12 th day after a series of classes of 11 days. An inspected team of subject expert visit the Laboratory Cum Evaluation Session (LCES) centres during the 12 days.
	Student's participation in Seminar/workshop	Yes	Students actively participate in the seminar/workshops conducted by the University
Electronic Delivery	Online (Web driven/ Mobile App)	Yes	Using NSOU app, Google meet
	Offline DVD/SD Card/ USB Drive)	Yes	USB drive used

The curriculum design with the credit structure for Under Graduate (BDP) Geography is tabulated below:

Detailed Credit Structure:

Course Subjects	Number of Paper	Full Marks	Total Credit Value
Elective Geography Subjects	13	800	64
Subsidiary Subjects	3	300	24
Foundation course Subjects	2	200	16
Application Oriented Course	1	100	8
Language Course Subjects	2	100	8
Environmental Studies	1	50	4
Total		1550 Marks	124 Credit

➤ The curriculum design and detailed syllabus of Under Graduate Geography is given below:

Course	Course code	Block	Broad Heading	Credit	Marks	
Elective Subject:	EGR-1	1 & 2	Concepts of Physical Geography and Geotectonics	4	50	
	EGR-2	1 & 2	Landform Processes	4	50	
Honours Course (Geography) EGR	EGR-3	1 & 2	Climatology	4	50	
	EGR-4	1 & 2	Practical Geography-1	8	100	
	EGR-5	1 & 2	Soil Geography Biogeography	4	50	
	EGR-6	1 & 2	Geography of Resources	4	50	
	EGR-7	1 & 2	Geography of Economic Activities	4	50	
	EGR-8	1 & 2	Practical Geography – 2	8	100	
	EGR-9	1 & 2	Geography of Settlement	4	50	
	EGR-10	1 & 2	Geography of Population	4	50	
	EGR-11	1 & 2	Evolution of Geographical Thought	4	50	
	EGR-12	1 & 2	Practical Geography – 3	8	100	
	EGR-13 & 14	1 & 2	Environmental Geography, Agricultural Geography & Regional Planning	4	50	
	Total			Theory: 500 & Practical:300 Marks	64	800

Course	Broad Heading	Credit	Marks
Subsidiary Bengali or English	Subsidiary Bengali (SBG) / English (SEG), Paper-1	8	100
	Subsidiary Bengali (SBG) / English (SEG), Paper-2	8	100
	Subsidiary Bengali (SBG) / English (SEG), Paper-3	8	100
	Total	24	300
Compulsory Subject: Fundamental Course	Humanities and Social Science (FHS)	8	100
	Science and Technology (FST)	8	100
	Total	16	200
Application Oriented Course (Any One)	Household Chemistry (AOC-3)	8	100
	Total	8	100
Language Course Subjects	Bengali (FBG)	4	50
	English (FEG)	4	50
	Total	8	100
Environmental Studies	Environmental Studies (ENVS)	4	50
	Total	124	1550

Programme Objectives

Geography is a field of science devoted to the study of the lands, the features, the inhabitants, and the phenomena of Earth. Geography's relevance to science and society arises from a distinctive and integrating set of perspectives through which geographers view the world around them. Geography means earth description has been long considered as one of the fundamental subjects in education system right from the beginning of the system. In general, as ODL is concerned, our main objective is to democratize education as a resource and provide every citizen, irrespective of gender, caste and creed, easy and affordable access to quality education and particularly, in the paradigm of social sciences. Considering this, the University launched its Geography Programme at the Under-graduate level (BDP)

from the session 2000-2001. The main objectives for offering this programme are: –

- a. To prepare the students for the higher studies in this discipline by focussing the curriculum for understanding and resolving issues about the environment and sustainable development. It is an important link between the natural and social sciences.
- b. To help thye learners to develop a mental map of the community, province or territory, country and the world so that the learners can understand the “where” of places and events and relate them in the real world.
- c. The University is well prepared to offer such a programme. Cooperation from study centres/colleges under different University shall be sought to keep the parity between regular as well distance mode of UG Geography.
- d. To educate and train individuals to be effective managers and decision-makers by its field work exposer.
- e. To equip individuals with the necessary scientific skills and competencies to enable them to seek jobs and progress in their career by the hands-on computer based practical and the practical experience.
- f. To enhance the capabilities of the existing workforce in the country and abroad and thus contribute to economic development and business growth as they can cater the knowledge of such portions through its syllabus.
- g. To give chances to the willing students those who could not enter into the convention Universities due to their age, job and limitation of the seat in the respective subject and make them capable at per the students of other university.

Course/Paper Objectives

The syllabus structure includes all the important and relevant topics and therefore, the paper name is self-explanatory for its objectives. Thus a list of papers and their heading and marks are tabulated:

Course	Course code	Block	Broad Heading	Credit	Marks	
Elective Subject: Honours	EGR-1	1 & 2	Concepts of Physical Geography and Geotectonics	4	50	
	EGR-2	1 & 2	Landform Processes	4	50	
Course (Geography) EGR	EGR-3	1 & 2	Climatology	4	50	
	EGR-4	1 & 2	Practical Geography-1	8	100	
	EGR-5	1 & 2	Soil Geography Biogeography	4	50	
	EGR-6	1 & 2	Geography of Resources	4	50	
	EGR-7	1 & 2	Geography of Economic Activities	4	50	
	EGR-8	1 & 2	Practical Geography – 2	8	100	
	EGR-9	1 & 2	Geography of Settlement	4	50	
	EGR-10	1 & 2	Geography of Population	4	50	
	EGR-11	1 & 2	Evolution of Geographical Thought	4	50	
	EGR-12	1 & 2	Practical Geography - 3	8	100	
	EGR-13 & 14	1 & 2	Environmental Geography, Agricultural Geography & Regional Planning	4	50	
	Total			Theory: 500 & Practical: 300 Marks	64	800

Moreover, some of the course objectives can be pointed out as:

- i) The course objective is educate and train the learners to become effective managers, good educator, employer and as well as good researcher in near future. Counsellors with expertise in various fields of geography like geomorphology, hydrology, biogeography, climatology, meteorology etc. work together with graduate students to study fundamental and applied problems that are of compelling societal and scientific interest. Issues such as global climate change, water, energy and carbon cycling, vegetation and carbon dynamics associated with environmental change and management, landscape development, and human impacts on the environment are studied with particular emphasis
- ii) Our field courses are designed to give students an opportunity to do just that: learn valuable field skills, apply classroom knowledge, and connect to the

many organizations and issues that require geographic and environmental expertise.

- iii) The brief concept of Remote Sensing (RS) and Geographic Information Systems (GIS) in the practical papers enable students to learn the new applications of science within the physical, social and environmental spheres. The laboratory supports original applications of RS and GIS knowledge base to explore in higher studies, post graduate and further extended research works in environmental mapping, environmental change, and population health on continental, national and regional scales.

Learning Outcomes

In Geography, we don't just learn in the classroom; we provide students with opportunities to learn relevant skills and apply their knowledge to real-world challenges. Our field courses are designed to give students an opportunity to do just that: learn valuable field skills, apply classroom knowledge, and connect to the many organizations and issues that require geographic and environmental expertise. Thus students completing this programme will be able to:

- a. Appreciate Earth as the homeland of humankind and provide insight for wise management decisions about how the planet's resources should be used.
- b. Understand geography's way of looking at the world through the lenses of place, space, and scale. A central tenet of geography is that "location matters" for understanding a wide variety of processes and phenomena. Indeed, geography's focus on location provides a cross-cutting way of looking at processes and phenomena that other disciplines tend to treat in isolation. Geographers focus on "real world" relationships and dependencies among the phenomena and processes will give character to any location or place.
- c. Analyze environmental-societal dynamics relating human action to the physical environment, environmental dynamics linking physical systems, and human-societal dynamics linking economic, social, and political systems; and
- d. Conduct spatial representation using visual, verbal, mathematical, digital, and cognitive approaches. Places are natural laboratories for the study of complex relationships among processes and phenomena.

- e. The learners can able to enhance their capabilities in the workforce by contributing a lot by their skills.
- f. Their learnings from the discource make them capable with the necessary scientific skills and competencies enriched and enabled them to become a good educator, teacher, employer and researcher.

Programme Outcomes

Course-wise Learning outcomes:

EGR 01

The learning outcome after completing this course will be to:

- Learn in details with examples Volcano and Vulcanicity
- Write down in details with application of Earth's Crust
- Specify in depth the concept of Rocks: Origin and Classification

EGR 02

The learning outcome after completing this course will be to:

- Deliberate in depth the concept of Geomorphic Processes and Resultant Landforms
- Understand in details with application of Topography of Ocean Floor
- Write down in details with examples Marine Deposition and Marine Resources

EGR 03

The learning outcome after completing this course will be to:

- Specify in details with examples Jet Stream and Air Mass
- Deliberate the classification and characteristics of Precipitation : Mechanism and Form
- Learn the characteristics of Monsoon, Thunderstorm

EGR 04

The learning outcome after completing this course will be to:

- Understand the characteristics of Prismatic Compass Survey

- Understand in details with examples Map Projection: Basic concepts and Subject
- Specify the classification and characteristics of Isopleth, Choropleth, Dot and Spher

EGR 05

The learning outcome after completing this course will be to:

- Write down in details with application of Soil Classification “ Dokuchaiev, Marbut, USDA, Indian
- Deliberate the details of Trophic Level”Food Chain, Energy Flow, Ecological Pyramid
- Understand in details with examples Factors of Plant Growth

EGR 06

The learning outcome after completing this course will be to:

- Write down the details of Nature and Resource
- Specify the characteristics of Nonconventional Resource
- Learn in details with application of Resource Utilisation

EGR 07

The learning outcome after completing this course will be to:

- Identify the details of Agriculture : Types, Characteristics
- Specify the classification and characteristics of Major Industry
- Learn the classification and characteristics of Industrial Regions

EGR 08

The learning outcome after completing this course will be to:

- Understand in details with application of Measures of Central Tendency
- Understand in details with examples Interpretation of topographical map
- Understand in details with examples Interpretation of Indian daily weather map

EGR 09

The learning outcome after completing this course will be to:

- Deliberate in depth the concept of Study of Settlement
- Write down in details with examples Rural Settlement
- Write down in details with application of Urban Settlements

EGR 10

The learning outcome after completing this course will be to:

- Write down the classification and characteristics of Population Growth
- Understand the classification and characteristics of Migration " internal and international
- Understand in depth the concept of Basic characteristics of population in India

EGR 11

The learning outcome after completing this course will be to:

- Write down in depth the concept of Development of Geographical Thoughts
- Identify the classification and characteristics of Approaches
- Understand in depth the concept of Changing Cultural Patterns of the World

EGR 12

The learning outcome after completing this course will be to:

- Learn the classification and characteristics of Field Report
- Specify the characteristics of Identification of Rocks and Minerals
- Deliberate in details with examples Basic Concept of Remote Sensing

EGR 13 & 14

The learning outcome after completing this course will be to:

- Identify in details with examples Components of Physical Environment
- Learn in details with examples Major Contemporary Environment Issues Global Scenario

- Identify in depth the concept of Environmental Approach to Management
- Learn the characteristics of Nature, scope and content of Agricultural Geography; Development of Agricultural Geography
- Write down the characteristics of a Concept of regions, types of planning b. Basic principles of regional planning c Locational theories of Weber, Losch and Christaller; Growth Pole theory of regional growth
- Understand in depth the concept of regional imbalances

Examination System:

Total Credit	64+24+16+8+8+4= 124 Credits	Total Marks: 1550
Evaluation System	Internal Assessment: 30%	Term End Examination: 70%
Examination System (Semester Wise)	Semester wise Paper	1550 Marks, 124 Credit
<i>1st Semester</i>	FBG, FEG, EGR-1, EGR-4	4+4+4+8 = 20 Credit
<i>2nd Semester</i>	FHS, EGR-2, EGR-3, EGR-5, ENVS	4+4+4+4+8 = 24 Credit
<i>3rd Semester</i>	FST, EGR-6, EGR-8	8+4+8 = 20 Credit
<i>4th Semester</i>	EGR-7, EGR-9, EGR-10, SBG/ SEG-1	4+4+4+8 = 20 Credit
<i>5th Semester</i>	EGR-11, EGR-12, SBG/SEG-2	4+8+8 = 20 Credit
<i>6th Semester</i>	EGR-13 & 14, SBG/SEG-3, AOC-3	4+8+8 = 20 Credit

Detailed Syllabus

http://www.wbnsou.ac.in/student_zone/courses/science/syllabus/BDP-Elective Subjects/EGR Syllabus.pdf

Bachelor Degree in Mathematics

B.Sc. in Mathematics (EMT)

Expectation form the Learners

Bachelor of Mathematics (EMT) is a under graduate programme in the field of Mathematics is a three years programme in Mathematics. The objective of the programme is to help the learners to acquire the fundamental concepts of higher Mathematics. This degree will take the learner's understanding of the concepts, theories and applications of mathematics to the graduate level, and give them the opportunity to study some statistics, theoretical physics or *mathematics education*. The syllabus is structured in such a way that a student can acquire the potential of analytical thinking towards solving a real world problem in a mathematical way. BSc in Mathematics graduates can get employed after completing their studies. Some of the most sought, working areas for the BSc Mathematics graduates in leading organizations include:

- Banking
- Finance
- Insurance
- Risk Management
- Universities
- Scientific Institutes

Besides the above-mentioned sectors, there are many other sectors that hunt for the eligible ones who have completed BSc Mathematics.

Some expectations from the learners of EMT are mentioned below:

- Getting the flavour of higher Mathematics and acquiring the knowledge of various tools and techniques of UG Mathematics;
- Students will have in depth idea of how Mathematics is applicable in day to day life;
- The theoretical part of Mathematics will develop a critical and logical mind;

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- Getting the idea of how real life problem can be interpreted in abstract way;
- Learners will get some feel knowledge of how research is performed in Mathematics;
- Enable students to enhance mathematical skills and understand the fundamental concepts of pure and applied mathematics;
- To provide qualitative education through effective teaching learning processes by introducing projects, participative learning and latest software tools.
- To inculcate the curiosity for mathematics in students and to prepare them for future research.
- To encourage collaborative learning and application of mathematics to real life situations.

Course Information

Bachelor of Mathematics (EMT) is a one of the popular undergraduate programmes of the university. The learners, after completion of Higher Secondary Examination or Equivalent (10+2) in Science with 50% marks in Mathematics are eligible to pursue B. Sc. Programme from Netaji Subhas Open University (NSOU). It aims to make the learners/students to grasp the preliminary abstract concept of Mathematics. It leads in creating the fundamental concept of various abstract nature of higher Mathematics as well as it creates logical mind.

It is a three years programme having sixteen Honours compulsory Papers or courses with 4 credit each. In this papers, student, finds identity various abstract nature of Mathematics rather than only calculation.

The courses are run through Personal Contact Programmes (PCPs) in the selected study centre and various regional centres of the university. Each Study Centre organises PCP Sessions on weekends/holidays and notifies the same to the students. Students are recommended to read their SLMs/SIMs thoroughly before participating in the PCP session to find it immensely useful. The E-SLM's have been uploaded in university website for convenience of the learners.

Recommended Approach:

Bachelor of Mathematics (EMT) Programme are conducted through Personal Contact Programme (PCP) at designated Study Centre/LSCs. Besides these PCP sessions the University also conducts special lectures at its Regional Centres from

time to time. The learners are expected to read the Self learning materials before coming to the PCP sessions and clarify their doubts. The E-SLMs have been uploaded in the university website for convenience. They are supposed to participate in the discussions during counselling sessions.

The computer practical class of EMT is organized in various regional centres as well as some selective study centres. All these labs are equipped with modern technologies. There is a strong relationship between the coordinators of the study centres and the concerned authorities of the university so that an effective mode of communication is established. Taking advantage of this liaison relevant information are timely disseminated amongst the learners about the various curriculum like submission of assignments and matters related to examinations. The university has its own e-repositories along with a ICT support which enable the learners to access the e-learning materials whenever they require. The learners are welcome to meet the concerned faculty at the Regional Centres whenever they feel. The learners and the concerned faculties are in regular contact through social networking sites. The University therefore adopts a very democratic and flexible approach where the learners are encouraged to learn from anywhere anytime.

Programme Objectives

- Understanding of the fundamental axioms in mathematics and capability of developing ideas based on them.
- Inculcate mathematical reasoning
- Prepare and motivate students for research studies in mathematics and related fields
- Provide knowledge of a wide range of mathematical techniques and application of mathematical methods/tools in other scientific and engineering domains.
- Provide advanced knowledge on topics in pure mathematics, empowering the students to pursue higher degrees at reputed academic institutions.
- Strong foundation on *algebraic topology* and *representation theory* which have strong links and application in theoretical physics, in particular string theory.
- Nurture problem solving skills, structured as well as inovative thinking, creativity through assignments, project work.

- Continue to acquire relevant knowledge and skills appropriate to professional activities and demonstrate highest standards of ethical issues in mathematical sciences
- Create awareness to become an enlightened citizen with commitment to deliver one's responsibilities within the scope of bestowed rights and privileges.

Course/Paper Objectives

Bachelor degree programme in Mathematics has sixteen papers having 50 marks each. The course wise objectives of different years are shown in the following table:

Code	Name of the course	Objectives
EMT-01	Differential Calculus and its Geometric Application	After completion of this course students will acquire various abstract aspects of differential calculus along with some application
EMT-02	Integral Calculus and Differential Equations	The main objective of this programme is to develop the concept of integral calculus and also it will helps the learners to grasp fundamental concept of differential equation
EMT-03	Classical Algebra & Abstract Algebra	Classical algebra is the classical part of algebra such as solving polynomialeqns, complex number etc. and abstract algebra is the abstract representation of various mathematical structure.
EMT-04	Vector Algebra & Vector Calculus	This paper deals with vector quantity and it also provides some real life example.
EMT-05	Linear Algebra & Transformation	It provides the various results of vector spaces and matrices.
EMT-06	Analytical Geometry	The main objectives of this paper is to make student familiar on how geometry can be represented through algebraic equations.

Code	Name of the course	Objectives
EMT-07	Mathematical Analysis - I	It provides deeper concept in mathematics such as limit, continuity, differentiability etc.
EMT-08	Mathematical Analysis – II	uses in more abstract mathematics. Application of analysis
EMT-09	Analytical Dynamics	The objective of these paper is to provide the student with various knowledge of dynamical system .
EMT-10	Analytical Statics	The objective of these paper is to provide the student with various knowledge of statics of a particle.
EMT-11	Numerical Analysis	It provides various tools for solving different kind of mathematical problems such as solving equation, integration, differentiation etc. in numerical manner.
EMT-12	Probability Theory	This course aims to develop various probabilistic concept both in theoretical and practical manner.
EMT-13	Statistics and its Application	The paper of statistics and application provides various tools for real life problem solving in industrial level.
EMT-14	Linear Programming and Game Theory	This paper develops, at an introductory level, the theoretical concepts and computational techniques of linear programming and game theory, and also discusses applications of these topics in the social, life, and managerial sciences.
EMT-15	Complex Analysis and Integral Transform	In the first half of the course, students learn basic facts on complex functions, their differential and integral calculus, in particular, get familiar with elementary complex functions. Students are able to

Code	Name of the course	Objectives
		differentiate and integrate such functions, as well as solve equations in complex domain involving such functions. Students learn to check whether a function is analytic. In the second half of the course they learn basic facts on Fourier series, Laplace transforms, and Fourier transforms, in particular, students learn to calculate Fourier series, apply central properties connected with the convergence of Fourier series.
EMT-16	Computer Programming (Practical)	The main objective of this paper is to provide student the practical knowledge of solving numerical problems.

Subsidiary Mathematics (SMT)

There are three subsidiary courses in Mathematics, each of them is of marks 100. These course is for B. Sc. Physics (EPH) and B. Sc. Chemistry (ECH) in 2nd and 3rd year. The course wise objectives of different years are shown in the following table :

Code	Name of the course	Objectives
SMT-01	Mathematics-I	This paper is divided into two blocks. In the first block, the reader will be familiar with complex number, theory of polynomials and matrices. Also in this paper, basic notion of abstract algebra is introduced. The second block deals with analytical geometry and vector algebra.
SMT-02	Mathematics-II	The main objective of this paper is to develop the concept of differential calculus and Integral calculus. Some basic concept of differential equation is also introduced here.
SMT-03	Mathematics-III	Block I of this paper deals with numerical analysis and analytical dynamics and the second block the concept of linear programming and game theory have been introduced.

Learning Outcomes

- Inculcate critical thinking to carry out scientific investigation objectively without being biased with preconceived notions.
- Equip the student with skills to analyze problems, formulate an hypothesis, evaluate and validate results, and draw reasonable conclusions thereof.
- Enabling students to develop a positive attitude towards mathematics as an interesting and valuable subject of study
- A student should get a relational understanding of mathematical concepts and concerned structures, and should be able to follow the patterns involved, use mathematical reasoning.
- Ability to analyze a problem, identify and define the computing requirements, which may be appropriate to its solution.
- Introduction to various courses like group theory, ring theory, field theory, metric spaces, number theory.
- Enhancing students' overall development and to equip them with mathematical modeling abilities, problem solving skills, creative talent and power of communication necessary for various kinds of employment.
- Ability to pursue advanced studies and research in pure and applied mathematical science.
- Acquire good knowledge and understanding in advanced areas of mathematics and statistics, chosen by the student from the given courses.
- Understand, formulate and use quantitative models arising in social science, Business and other contexts.

Programme Outcomes

Course outcomes

EMT 01

The learning outcomes of the course will be to:

- Learn in details with application of One variable function, limit continuity and their properties

- Identify in depth the concept of Derivatives of functions of one variable and higher order derivatives
- Identify in details with examples Tangent, normal and linear asymptote

EMT 02

The learning outcomes of the course will be to:

- Specify in details of definite integral with application of Double Integral, Triple Integral and Determination of Surface and Volume
- Deliberate the characteristics of Differential Equation their Genesis, Order and Degree
- Write down the classification and characteristics of Singular Solution

EMT 03

The learning outcomes of the course will be to:

- Learn in details with application of Complex Number, De-moivre Theorem polynomial divisibility etc.
- Write down in depth the concept of Sets
- Specify in details with examples Relations and Mapping

EMT 04

The learning outcomes of the course will be to:

- Learn in details with application of Vector Multiplication
- Write down in details with application of Derivatives of Vector
- Understand in details with application of Integration of Vectors

EMT 05

The learning outcomes of the course will be to:

- Deliberate in details with application of Vector Space or Linear Space
- Deliberate in details with examples Linear Transformation / Mapping
- Identify the details of Quadratic Form

EMT 06

The learning outcomes of the course will be to:

- Write down in depth the concept of Transformation of Coordinates and Invariant (in 2D & 3D)

- Identify in details with examples Polar Equation of Conics
- Identify the details of Straight Line (both in 2D, 3D)

EMT 07

The learning outcomes of the course will be to:

- Learn the classification and characteristics of Sets of Real Numbers and Properties
- Learn in details with application of Properties of Continuous Functions in a Closed Interval
- Identify in details with application of Implicit Function Theory for Function of Single Variable, Jacobians etc

EMT 08

The learning outcomes of the course will be to:

- Write down the classification and characteristics of Darboux Theorem on Integration
- Deliberate in depth the concept of Differentiation and Integration of Functions of Several Variables
- Write down in depth the concept of Convergence of Series by term Integration and Differentiation of Power Series

EMT 09

The learning outcomes of the course will be to:

- Deliberate the classification and characteristics of Central Forces and Stability of Orbits
- Identify the characteristics of Kinematics of a Rigid body.
- Learn the details of Equations of Motion and its Application in laws of Motions of Rigid Bodies

EMT 10

The learning outcomes of the course will be to:

- 1 Deliberate the characteristics of Forces, Their Resultant, Moment of Forces and Couple

- Write down the classification and characteristics of Centre of Gravity
- Write down the classification and characteristics of Thrust, Couple etc.

EMT 11

The learning outcomes of the course will be to:

- Deliberate in details with application of Different types of Differences and Divided Differences
- Specify in details with examples Numerical Differentiation and Numerical Integration
- Identify the details of numerically solving Eigenvalues and Eigenvectors of Matrices

EMT 12

The learning outcomes of the course will be to:

- Deliberate the classification and characteristics of Probability Distributions
- Identify in depth the concept of Conditional Distributions and two-dimensional transformation
- Identify the characteristics of Convergence in Probability

EMT 13

The learning outcomes of the course will be to:

- Write down the characteristics of Measures of Central Tendencies AM, GM, HM ; Mean, Median, Mode
- Specify in details with examples Normal Distribution : Sampling and Distributions Collected there from
- Understand in details with application of Different Characteristics of Point Estimation, Interval Estimation

EMT 14

The learning outcomes of the course will be to:

- Learn the details of Problems of Linear Programming
- Understand the details of Simplex Method of Solution of L. P. P.

- Deliberate in depth the concept of Functions of Complex Variable

EMT 15

The learning outcomes of the course will be to:

- Deliberate in depth the concept of Functions of Complex Variable
- Identify the characteristics of Properties of Laplace Transform
- Write down the details of Convolution Theorem

EMT 16

The learning outcomes of the course will be to:

- Specify in details with examples Representation of Data
- Write down in details with examples Elements of ANSI C
- Deliberate the classification and characteristics of Problems of Numerical Analysis

Examination System

There are sixteen core papers of 50 marks each having both theoretical and practical papers, four foundation courses, three subsidiary courses, one application oriented course and environmental study. All the enrolled learners can appear for the term end examination of each year. The total marks allotted for the course is 1550 which is equally divided into each year. The learner has to submit assignment for all the papers, followed by the term end examination each year. The total weightage of 30% for assignment while 70% is given for the term end examination.

Detailed Syllabus

Year	Course Code	Paper Name	Full Marks
1 st	EMT-01	Differential Calculus and its Geometric Application	50
	EMT-02	Integral Calculus and Differential Equations	50
	EMT-03	Classical Algebra & Abstract Algebra	50
	EMT-04	Vector Algebra & Vector Calculus	50
	EMT-05	Linear Algebra & Transformation	50

Year	Course Code	Paper Name	Full Marks
2nd	EMT-06	Analytical Geometry	50
	EMT-07	Mathematical Analysis - I	50
	EMT-08	Mathematical Analysis - II	50
	EMT-09	Analytical Dynamics	50
	EMT-10	Analytical Statics	50
	EMT-11	Numerical Analysis	50
3rd	EMT-12	Probability Theory	50
	EMT-13	Statistics and its Application	50
	EMT-14	Linear Programming and Game Theory	50
	EMT-15	Complex Analysis and Integral Transform	50
	EMT-16	Computer Programming	50

Practical

Netaji Subhas Open University (NSOU) has several Mathematics laboratories in its Regional Centres in West Bengal like at Durgapur and Kalyani. These laboratories consist of large number of client computers attached with a main server and also with a centralized power supply system. All these computers are equipped with modern technologies and soft wares.

Detailed Syllabus

http://www.wbnsou.ac.in/student_zone/courses/science/syllabus/BDP-Elective_Subjects/EMT_syllabus.pdf

Sources of E-resources

The university has its own e -repositories along with a strong ICT support which enables the learners to access the e-learning materials whenever they require. Various e-content, self-learning materials (e-SLM), audio-video lectures (A/V Lectures) and other relevant information pertaining to the course are available in the university website for the learners both in Bengali as well as in English version. Learners can download and read the study materials as per their convenience. Learner friendly Android based mobile application is also developed for the benefit of the learners.

The relevant link of e-SLM are given in the following table

Sl. No.	Name of the portal	URL Link
1.	E-SLM	http://www.wbnsou.ac.in/online_services/slm.shtml#active_slm
2.	NSOU audio video lecture	http://www.wbnsou.ac.in/online_services/econtent/List_AV_Lecture.shtml#active_econtent_avlecture
3.	NSOU web tv	http://www.wbnsou.ac.in/online_services/webtv.shtml#active_webtv
4.	NSOU Live Chat	http://www.wbnsou.ac.in/online_services/live_chat
5.	NSOU E-Store	schedule.shtml#active_livechatschedule http://www.wbnsou.ac.in/online_services/e_store.shtml#active_estore
6.	Math Arxiv	https://arxiv.org/archive/math
7.	American Mathematical Society	https://www.ams.org/home/page
8.	Swayam	https://swayam.gov.in/
9.	MIT Open courseware	https://ocw.mit.edu/courses/mathematics/
10.	Quanta Magazine	https://www.quantamagazine.org/mathematics/
11.	Calcutta mathematical society	https://www.calmathsociety.co.in/aspnet/html/cmsEvents
12.	The Indian Mathematical Society	http://www.indianmathsociety.org.in/

Bachelor Degree in Physics (EPH)

B.Sc. in Physics

Expectations from the Learners

Physics is a broad discipline in terms of its diverse aspects and as a practical based discourse, the learners have the opportunity to learn scientific approach and methods for understanding of natural phenomenon. They already have a basic practical knowledge and they can use it to extend their practical approach further thus they are the pillar and based on which this discourse successfully operated in the Physics discipline at NSOU. The Student-Teacher relationship is the strongest support to successful running of the Physics Bachelor Degree Programme. We welcome students into this programme based on their previous academic work, interests for further learning, letters of reference, and the ability of faculty to act as counsellors. We view the greatest strength of Physics, as a discipline, in NSOU is its ability to integrate and apply knowledge of basic science in theoretical approach as well as practical learning and it depends largely on the learners. The correlations among the various segments of the syllabus and the connections of theoretical and practical parts should be understood with the help of the instructors. In Physics, the learners don't just learn in the classroom; they have the opportunities to learn practical skills and use it for future study and research. Thus, the expectation from the learners for the discourse are:

- a. They should be attentive in the PCP (Personal Contact Programme).
- b. They need to read the SLM (Self Learning Study Material) carefully.
- c. The item of the practical papers need to be practice frequently.
- d. The instructions of the teacher must be followed minutely.
- e. They should be careful in learning the theoretical and practical parts.

Course Information:

Physics is one of main subject of basic science and considered as one of the fundamental subjects in education system right from the beginning of the system. A subject that is unique in explaining and understanding the nature. It is learned from very beginning of mankind in different way. And at present it is taught by thousands of University as one of the main subject in basic sciences. In general, as ODL is

concerned, our main objective is to democratize education as a resource and provide every citizen, irrespective of gender, caste and creed, easy and affordable access to quality education and particularly, in the paradigm of social sciences. The basic philosophy of our aim is to “Reach the Unreached”. Keeping this in mind Netaji Subhas Open University launched its Bachelor Degree Programme(BDP) from 2000-01 session. The opening of the BDP course in Physics was the result of the growing enrolment at higher secondary science level and the demand of the students as well as the study centres. The instruction is designed to engage students in learning experiences that not only enable them to learn content but also to develop greater passion for learning – enabling them to ‘learn to learn’ and to be lifelong learners. In the *learner-centred paradigm of education*, students are encouraged to take greater responsibility for their learning outcomes. The SLM of the course is in Bengali version.

Programme Duration: *Course duration is 3 years.* However, the students have the liberty to complete its course *within 5 years.*

Admission Procedure: Online Centralised admission process is conducted for B.Sc. Physics Programme. Students applied for this course through online. Students are admitted through online.

Eligibility: For BDP, the students must have a Higher Secondary from any board having Physics and Mathematics as a subject in higher Secondary.

Recommended Approach:

As the state and national level, the higher educational institutions are expected to provide quality education, education for all, strategic plans for an institution that defines targets and measures of the programmes to be achieved by the institution. Apart from physical infrastructure, administrative policy and code of behaviour, school of sciences is actively engaged in its academic development of respective subjects. The School of Sciences has been designed its curriculum by the help of the board of studies, several learning resource materials, and feedback system through the BOS and an expert committee. Learning material through print-media named Self-Learning Material (SLM) is developed with the approach of self-explanatory, self-contained, self-motivating and self-evacuating followed by the UGC guideline.

- ✓ It tries to ensure quality service to the learners of the subject through development of good and appropriate standard Study Learning Material or

SLM, integration of modern methods of teaching learning including usage of ICT and credibility of evaluation procedures.

- ✓ Organization of inter and intra Schools/ Institutional workshops, seminars on quality related themes and promotion of quality circles.
- ✓ Arrangement for feedback responses from students, parents and other stakeholders on quality related institutional processes.

Programme Objectives:

In recent years, there are ample scope of higher studies as well as research in Physics, thus the students opt this subject by choice. In Netaji Subhas Open University the target group of learners are mainly from the rural areas, particularly where the Universities are too far from their local residence, but the students from urban areas are also enrolling themselves. In West Bengal, a lot of students are passed higher secondary with science background, but due to limitation of seats in the conventional Universities/ PG colleges, all of them could not get enrolled themselves in the Physics subject of their choice. NSOU caters and tries to offer the best of the opportunity by offering this subject at the BDP level to the students. The main objectives for offering this programme are: –

- a. To focus within the curriculum for understanding the subject and gather practical knowledge. It is a important basic course for further study in higher education and could enhanced their knowledge by research.
- b. To develop a logical analysing power of natural events and experimental facts.
- c. The University is well prepared to offer Physics in BDP and the cooperation from study centres/colleges under different University shall be sought to keep the parity between regular as well distance mode of BDP in Physics. It is thus spreading the diverse real world knowledge base to the learners.
- d. To educate and train individuals to be effective for gathering further knowledge.
- e. To equip individuals with the necessary scientific skills and competencies to enable them to seek jobs and progress in their career by the hands-on computer based practical and the practical experience.
- f. To give chances to the willing students those who could not enter into the convention Universities due to their age, job and limitation of the seat in the

respective subject and make them capable at per the students of other university.

Course/Paper Objectives:

The BDP in Physics has various objectives which is multiple and diverse in nature. Some of the course objectives can be pointed out as:

- i) The course syllabus include all the recent development in science which enabled the learners to strengthen their knowledge base about the real world challenges and make them capable to understand the related issues and explore the inherent solutions.
- ii) The various practical experience make the learners more inclined for further study in Physics and research.
- iii) The course objective is educate and train the learners to become good educator, employer and as well as good researcher in near future. Counsellors with expertise in various fields of Physics work together with graduate students to study fundamental and applied problems that are of compelling societal and scientific interest. Basic physics content such as classical mechanics, electricity and magnetism, quantum mechanics, nuclear physics etc are studied with particular emphasis.
- iv) Our practical courses are designed to give students an opportunity to do just that: learn valuable skills, apply classroom knowledge.
- v) The syllabus structure includes all the important and relevant topics and therefore, the paper name is self-explanatory for its objectives.

Learning Outcomes:

After successful completion of the course, the learners are able to increase their knowledge base in the domain of Physics which enhances their employability in various fields. The greatest strength of Physics, as a discipline is its ability to integrate and apply knowledge across the Globe. The students completing this programme has following outcome:

- i) A large number of student avail this opportunity of this course and start fulfilling their dreams of higher education.
- ii) It increases understanding that scientific knowledge is the product of a process engaged in by a community of scientists.

- iii) It equips individuals with the necessary scientific skills and competencies to enable them to seek jobs and progress in their career.
- iv) It enhances the capabilities of the existing workforce in the country and thus contribute to economic as well as scientific development.
- v) It gives chances to the willing students those who could not entered into the conventional Universities due to their job and limitation of the seat in the respective subjects.
- vi) It helps to understand and apply theoretical and practical knowledge in the appropriate areas and enhance their living condition as well as to save the nature and its surroundings.
- vii) It helps student to work collaboratively with others (within different sections of the society) in cross-functional teams, and to motivate, lead, and mentor others.
- viii) The learners can able to enhance their capabilities in the workforce by contributing a lot by their skills.
- ix) Their learnings from the discourse make them capable with the necessary scientific skills and competencies enriched and enabled them to become a good educator, teacher, employer and researcher.

Programme Outcomes

Course-wise Learning Outcomes:

EPH 01

The learning outcome for the students completing this course will be to:

- Understand the characteristics of Vector algebra
- Deliberate in details with examples Probability
- Write down the details of Differential equations in physics

EPH 02

The learning outcome for the students completing this course will be to:

- Learn the details of Force and momentum
- Deliberate the details of Behaviour of systems of particles
- Identify in details with application of Hydrodynamics

EPH 03

The learning outcome for the students completing this course will be to:

- Specify the details of Simple Harmonic motion
- Deliberate in details with examples Wave motions
- Identify the classification and characteristics of Ultrasonics

EPH 04

The learning outcome for the students completing this course will be to:

- Learn in depth the concept to find Fourier coefficients of different periodic vibrations by graphical method
- Learn in details with examples to find out modulus of rigidity from torsional oscillation of a wire
- Write down in details with examples Use of thermocouple to draw cooling curve and to measure melting point

EPH 05

The learning outcome for the students completing this course will be to:

- Write down in details with application of Law of thermodynamics & applications
- Specify the details of Transport phenomena
- Learn in details with examples Particle Statistics

EPH 06

The learning outcome for the students completing this course will be to:

- Identify in details with application of Geometrical optics & Matrix method
- Understand the details of Polarisation of light
- Identify the characteristics of Optical fibers and electronics

EPH 07

The learning outcome for the students completing this course will be to:

- Deliberate the classification and characteristics of Charge, force and electric field
- Specify the characteristics of Gauss theorem
- Understand in depth the concept of Laplaces equations

EPH 08

The learning outcome for the students completing this course will be to:

- Deliberate in depth the concept of Calibration of a Thermister with the help of a thermocouple
- Understand the classification and characteristics of Zenor Diode characteristics in forward and reverse bias
- Identify in depth the concept of optical rotation of a sugar solution by a polarimeter

EPH 09

The learning outcome for the students completing this course will be to:

- Identify in details with examples Effect of current on magnetic field
- Understand the classification and characteristics of Electric induction and transient current
- Specify the classification and characteristics of Thermoelectricity

EPH 10

The learning outcome for the students completing this course will be to:

- Understand in depth the concept of Electronic control devices
- Understand the details of Amplifier circuits
- Deliberate in details with application of OPAMP & uses

EPH 11

The learning outcome for the students completing this course will be to:

- Specify in details with application of Lorentz transformations
- Understand the characteristics of Moment of inertia and Top motion
- Deliberate the classification and characteristics of Schrodinger equation

EPH 12

The learning outcome for the students completing this course will be to:

- Write down the classification and characteristics of to draw the hysteresis cycle of a ferro-magnetic material and calculate hysteresis loss
- Deliberate in details with examples to study series and parallel resonances and change of current with frequency in the circuit.
- Deliberate the characteristics of Use of an OPAMP as adder, subtractor, inverting and non-inverting amplifier

EPH 13 & 14

The learning outcome for the students completing this course will be to:

- Write down the characteristics of Electron, Cathode rays, Photoelectric effect, Thermal electrons
- Identify in depth the concept of Molecular spectra and Raman scattering
- Write down the characteristics of Magnetic properties of materials
- Identify the classification and characteristics of Radioactivity
- Identify the characteristics of Nuclear Reactions
- Write down the details of Particle accelerators

Examination System:

Total Credit	Credit of Theory Papers of 100 marks: 8 per paper and 50 marks: 4 per paper
	Total=64 credits
	Practical Papers has no internal assessment
Evaluation System	Internal Assessment: Theory: 30%
	Term End = 70%
Examination System	Total 3 Term End Examination

Structure of EPH

Elective Subjects : Honours Courses (EPH)

Course 01 : Mathematical Methods in Physics	4 Credits
Course 02 : Mechanics and General Properties of Matter	4 Credits
Course 03 : Harmonic Motion, Waves & Acoustics	4 Credits
Course 04 : Practical Physics - 1	8 Credits
Course 05 : Heat and Thermodynamics	4 Credits
Course 06 : Optics	4 Credits
Course 07 : Electrostatics	4 Credits
Course 08 : Practical Physics - 2	8 Credits
Course 09 : Electricity and Magnetism	4 Credits
Course 10 : Electronic Circuits and Devices	4 Credits
Course 11 : Relativity and Advanced Mechanics	4 Credits
Course 12 : Practical Physics - 3	8 Credits
Course 13 : Structure of atoms and molecular spectra	2 Credits
Course 14 : Nuclear Physics	2 Credits

Total = 64 Credits

Detailed Syllabus

http://www.wbnsou.ac.in/student_zone/courses/science/syllabus/BDP-Elective_Subjects/EPH_syllabus.pdf

Bachelor Degree in Zoology (EZO)

B.Sc. in Zoology

Expectation from the Learners

In West Bengal lots of students complete their high-school and intended to enter into the arena of higher education. Many of them are from weaker socio-economic section or have other engagement to take a regular curriculum or in parallel having earning responsibilities, therefore, need flexible education environment as provided by the ODL system in NSOU.

Through the undergraduate courses of Zoology, we expect that the learners will know about the different fields of this subject and can apply that in their life. Learners can look into the life process and surrounding with scientific introspection. It's our expectation that learners who are directly coming from either the conventional schooling system or from any other background and enrolling in the undergraduate BDP programme in Zoology, will successfully pursue the programmes and make them eligible for better employment opportunities with their acquired education. It is expected that learners would avail all resources including study materials, e-resources and online lectures, personal contact programmes, special sessions properly and ethically participate in the evaluation system to achieve their goals.

**E
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Course Information

The BDP programme is of 3 years duration which has two divisions, subsidiary zoology (SZO) with 3 papers as the supporting course for other honours programmes and elective zoology (EZO) with 14 different papers to achieve the honours degree in Zoology. The BDP is under the CBCS curriculum.

BDP courses are in Open and Distant Learning (ODL) mode where learners can enter through their marks in the preceding board or university examination after fulfilling the admission criteria.

The Study Centres under the university throughout the state will support the learners through personal contact programme (PCP), where University provides self-learning materials (SLM), e-resources in NSOU website, special online classes and PCP in NSOU Regional Campuses and conduct term-end examination (TEE) to

provide the degrees to the learners.

Recommended Approach

The mission of the Higher Education Institutions is to bring more and more learners in the higher education and offer proper resources and environment to learn so that they can acquire quality education to contribute to the economic as well as scientific development of the nation. In contrast to the regular education system, ODL method offers the learners several means as recommended approaches for learning. Programmes in Zoology recommends the following means to the learners –

- Self-study materials (SLM) provided to the learners as text material. Additional reference materials can be consulted as recommended in the SLM.
- In the university learning management system (LMS) portal of NSOU the e-content and audio-video lectures covering some topics are available for the learners.
- Personal contact programme (PCP) in the study-centers or the NSOU regional centers are to be attended by the learners which provide them the option of direct interaction with faculties.
- Participation in the laboratory classes and evaluation session (LCES) or other practical sessions.
- Attending the online classes arranged by the School of Sciences of NSOU by the faculties of Zoology department for BDP courses (an initiative started from the lockdown period for COVID pandemic).

Along with, learners are to participate in the evaluation process through assignment and term-end examination (TEE) compulsorily to complete the course.

Programme Objective

General Programme Objectives: In science “the term theory is used to describe an organized body of principles and assumptions that account for a set of phenomena along with the rules for its application”. On the other hand, practical is a simplified, physical representation of a thing or process. The representation can take many forms, such as a diagram, a flow chart, a computer program, dissection, or a physical replica. NSOU provides all the pre-conditions of the science subjects while conducting both the Undergraduate and Post Graduate programme in Zoology. The main

objectives for offering these programs are: –

- To enlighten individuals about the animal world, their structural and functional diversity and importance in this living world.
- To equip individuals with the necessary scientific skills and competencies to enable them to seek jobs and progress in their career.
- To enhance the capabilities of the existing workforce in the country and thus contribute to economic as well as scientific development.
- To give chances to the willing students those who could not enter the conventional Universities due to their job and limitation of the seats in the respective subjects.
- Understand and apply theoretical knowledge in the areas of animal anatomy, physiology, biochemistry, behaviour etc. and its onward implication in a large in the society.
- Work collaboratively with others (within different sections of the society) in cross-functional teams, and to motivate, lead, and mentor others.
- To educate and train individuals to be effective managers and decision-makers.

Course/Paper Objective

The specific objective of EZO is to provide systematic knowledge in the subject which will serve as the basis of further higher education in this area. Fundamentally, with the provision of obtaining the degree to everyone interested to learn in this area, but unable to attain the conventional system of education; the course is structured so that it can generate interest among learners with basic understanding of the subject. This course with theoretical and practical topics and evaluation system is serving as a screening process for students to gain interest, sufficient understanding and skill on the subjects which will influence them to proceed further in this subject and gain an educated outlook to observe and assess this living world.

Course-wise Learning Outcomes

EZO 01

After completing this course the learning outcomes will be to:

- Specify the characteristics of Origin and diversity of Life
- Identify in details with examples Symmetry, Form and Life Style of Animals
- Deliberate in details with application of Annelida classificatio nupto subclass, functional anatomy of Nereis, earthworm and leech

EZO 02

After completing this course the learning outcomes will be to:

- Understanding the structure of chromosome
- Details of DNA and RNA properties
- Know about introduction of Genetic Engineering

EZO 03

After completing this course the learning outcomes will be to:

- Understand in details with examples Gametogenesis
- Write down in details with application of Fertilisation
- Specify the characteristics of Animal behaviour”

EZO 04

After completing this course the learning outcomes will be to:

- Specify in depth the concept of Major dissections on non-chordate :Periplanata, Achatina
- Deliberate the details of Major dissection on chordate : Oreochromis, lata, white rat
- Know about the concept of Identification of non-chordates

EZO 05

After completing this course the learning outcomes will be to:

- Learn in details with examples Protochordates
- Write down the characteristics of Vertebrates-fishes
- Write down the classification and characteristics of skeletal system

EZO 06

After completing this course the learning outcomes will be to:

- Identify in depth the concept of Taxonomy
- Learn the characteristics of Species concept
- Specify in details with examples on Evolution: modern concept

EZO 07

After completing this course the learning outcomes will be to:

- Learn the characteristics of Ecosystem ecology
- Identify in details with importance of Ecological factors
- Deliberate the characteristics of concept of environment

EZO 08

After completing this course the learning outcomes will be to:

- Specify the characteristics of determination of LG50 of any toxic substance on experimental model.
- Write down the characteristics of Whole mount of chick embryo (24h, 48h, 72h, 96h). Drawing and labeling of whole mount
- Identify the characteristics of Meiotic chromosome study of grasshopper from testes squash preparation

EZO 09

After completing this course the learning outcomes will be to:

- Identify in depth the concept of Thermodynamics
- Write down the details of Optical microscopy
- Identify the details of sample and population

EZO 10

After completing this course the learning outcomes will be to:

- Identify the classification and characteristics of histological techniques
- Specify in details with examples of staining,
- Specify the details of Endocrine glands

EZO 11

After completing this course the learning outcomes will be to:

- Learn in details with examples Animal associations
- Deliberate the characteristics of Life cycle, Pathogenicity of Plasmodium, Leishmania
- Understand in details with examples Structure and classification of immunoglobulins

EZO 12

After completing this course the learning outcomes will be to:

- Understand the details of preparation of skeleton of toad
- Understand in details with application of smear preparation of gut content of toad and cockroach
- Deliberate determination of blood group of man

EZO 13 & 14

After completing this course the learning outcomes will be to:

- Write down in depth the concept of Body fluids and their circulation
- Write down in details with examples on the physiology of respiration
- Write down the classification and characteristics of Chemical components of cell
- Deliberate the characteristics of Aquaculture resources
- Identify in details with examples Freshwater fish culture
- Write down the details of Apiculture

Specific Objectives of Subsidiary Zoology (SZO)

The subsidiary Zoology (SZO) course is the supportive course of other major subjects or elective subjects which is designed so that the learners can get the

elementary ideas about Zoology while acquiring deeper knowledge in some allied subjects. This will help to increase peripheral knowledge surrounding their major honours subject and help them to correlate the broader subject areas as interdisciplinary manner.

Learning Outcomes

Expected Programme Outcome in Zoology:

Students completing this programme will be able to have:

- “hand on” knowledge of the animals of the Earth and provide valuable insight for wise management of the planet’s resources and how they should be used;
- learners focus on “real world” relationships and dependencies among the phenomena and processes will give character to any location or place;
- summarizing a great deal of knowledge economically by incorporating it in a limited set of general principles;
- conduct spatial representation using visual, verbal, digital, and cognitive approaches; and
- leading to specific, testable predictions;
- development of inquisitiveness on the life processes and living world;
- ability to interpret the natural phenomena;
- explore and deduce the unknown territory of the subject area and life;
- develop curious and innovative mind to pursue quality research, and thereby, contributing in the frontier fields.

Our mission is to bring more and more learners in the higher education and thus contribute to economic as well as scientific development. In other way, involvement of more learners in higher education, development of their skills and innovativeness will help the nation to reach its goal.

Specific Outcome of the Bachelor Degree Programme in Elective Zoology (EZO)

This course is expected to make learners more enlightened regarding the life

process and living world and its importance in overall aspects.

Increase the ability and performances of workforces and widen the employability for fresher.

This course will screen out some quality learners with a keen interest on the subject who will pursue next level of learning in this subject and serve the higher education with their skill and ability.

Specific Outcome of the Bachelor Degree Programme in Subsidiary Zoology (SZO)

This area acting as supporting subject with the specific honours subject is helping to increase learners' peripheral knowledge and correlate their knowledge in broader aspect. This will help learners to think much holistically and apply their knowledge.

Examination Systems

Evaluation

The evaluation system of the programme is based on following components:

A. Continuous evaluation in the form of Assignments (30% weightage for UG)

This component carries a weightage of 30% for UG Zoology courses. There will be one graded assignment per course. The assignment is to be submitted to the Co-ordinator of the NSOU/Study Centre to which the student is assigned or attached with.

B. Term-end examination [TEE] (weightage: 70% for UG)

Term-end examinations is held once in every year in the months of June. The students are at liberty to appear in any of the examinations conducted by the University during the year. A student will be allowed to appear in the Term-End Examination, only after she/he has registered for that course and submitted the assignment.

C. Practical Examination (weightage: 100%):

For BDP, a length of 12 days practical (classes for 11 days and one day for

practical) are held during Puja vacation at different study centres. Attendance in this Lab Counselling and Evaluation Session (LCES) is mandatory, if a candidate fails to appear in the LCES for more than three days, he/she will not be eligible to participate in the rest of the session.

Detailed Syllabus

BDP Zoology (EZO)

http://www.wbnsou.ac.in/student_zone/courses/science/syllabus/BDP-Elective_Subjects/EZO_syllabus.pdf

BDP Zoology SZO syllabus

http://www.wbnsou.ac.in/student_zone/courses/science/syllabus/BDP-Subsidiary_Subjects/SZO_Syllabus_220114.pdf

Practical/Field Work/Dissertation Guideline

There is no field work or dissertation in the BDP programme as per present syllabus. But definite practical courses and papers are there. These papers have manuals in the self-study materials (SLM) which have been provided to the learners from the Study Centres as supplied by the University. The e-content of these SLMs are also available in the NSOU website for the learners (http://www.wbnsou.ac.in/online_services/slm.shtml#active_slm).

Sources of e-resources

The e-resource supports are available in the official portal of Netaji Subhas Open University.

All the Self learning materials are now available in e-SLM format on the website of the University under the 'Online Services' link (http://www.wbnsou.ac.in/online_services/slm.shtml#active_slm). Learners can easily get access to that using their electronic gadgets.

Learners can also get the benefit to learn from the uploaded Audio-Video lectures on different topics of Zoology in the specific link under NSOU website

(http://www.wbnsou.ac.in/student_zone/courses/science/AVL_Series.shtml#active_avl).

This is a developing service to support the learners for BDP programme which is believed to encompass most of the topics of the subject within next couple of years.

Presently, online classes on specific papers of BDP syllabuses in Zoology are being arranged regularly through the LMS support team of NSOU where NSOU faculties are taking online classes and interact with the learners at regular intervals apart from the PCP.

(http://www.wbnsou.ac.in/student_zone/interactions/online_class_schedule/bdp/bdp_online_class_schedule.shtml#bdp_online_class_schedule).

Post Graduate Degree in Geography

M.Sc. in Geography (PGGR)

Expectations from the Learners:

Geography is a broad discipline in terms of its diverse aspects and as a practical based discourse, the learners have the opportunity to explore many real world challenges and issues to understand and research, thus learners are the pillar, based on which this discourse successfully operated in the Post Graduate Geography discipline at NSOU. The Student-Teacher relationship is the strongest support to successful running of the Geography discourse in post graduate section. We welcome students into the post graduate programme based on their previous academic work, research interests, letters of reference, and the ability of faculty to act as counsellors. We view the greatest strength of geography, as a discipline, in NSOU is its ability to integrate and apply knowledge across the interface of the Earth's social and environmental systems and it depends largely on the learners. The correlations among the various segments of the syllabus and the connections of theoretical and practical parts should be understood with the help of the instructors. In Geography, the learners don't just learn in the classroom; they have the opportunities to learn relevant skills and apply their knowledge to real-world challenges. Thus, the expectation from the learners for the discourse are:

- a. They should be attentive in the PCP (Personal Contact Programme).
- b. They need to read the SLM (Self Learning Study Material) carefully.
- c. The item of the practical papers need to be practice frequently.
- d. The instructions of the teacher must be followed minutely.
- e. They should be carefull in learnng the theoretical and practical parts and their should be understood with the help of the instructors.

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Course Information:

Geography a word derived from the Greek word *geographia* which means earth description has been long considered as one of the fundamental subjects in education system right from the beginning of the system. A subject that is unique in bridging the social and physical aspects of the globe. Geography is a field of science devoted

to the study of the lands, the features, the inhabitants, and the phenomena of Earth. Geography's relevance to science and society arises from a distinctive and integrating set of perspectives through which geographers view the world around them. In general, as ODL is concerned, our main objective is to democratize education as a resource and provide every citizen, irrespective of gender, caste and creed, easy and affordable access to quality education and particularly, in the paradigm of social sciences. The basic philosophy of our aim is to "Reach the Unreached". Keeping this in mind Netaji Subhas Open University launched its Post Graduate Geography (PGGR) from 2006-07 session. The opening of the post-graduate course in Geography was the result of the growing enrolment at the under-graduate level and the demand of the students as well as the study centres. The instruction is designed to engage students in learning experiences that not only enable them to learn content but also to develop greater passion for learning – enabling them to 'learn to learn' and to be lifelong learners. In the *learner-centred paradigm of education*, students are encouraged to take greater responsibility for their learning outcomes. The SLM of the course is in English version, but we are also promoting the Bengali language for PG programme.

Programme Duration: *Course duration is 2 years.* However, the students have the liberty to complete its course *within 5 years.*

Admission Procedure: Centralised admission process is conducted for M.Sc. Geography Programme. Students applied for this course through online. Students are admitted through counselling (according to their marks) as per the availability of seats in five different study centres. Reservation of seats has been fixed as per the norm of the Government. Admission fees are collected through draft from the students.

Eligibility: For Post-graduate, the students must have a honours graduate in Geography from UGC recognised colleges. The admission will be done through counselling on merit basis.

Recommended Approach

As the state and national level, the higher educational institutions are expected to provide quality education, education for all, strategic plans for an institution that defines targets and measures of the programmes to be achieved by the institution. Apart from physical infrastructure, administrative policy and code of behaviour,

school of sciences is actively engaged in its academic development of respective subjects. The School of Sciences has been designed its curriculum by the help of the board of studies, several learning resource materials, and feedback system through the BOS and an expert committee. Learning material through print-media named Self-Learning Material (SLM) is developed with the approach of self-explanatory, self-contained, self-motivating and self-evacuating followed by the UGC guideline.

- ✓ It tries to ensure quality service to the learners of the subject through development of good and appropriate standard Study Learning Material or SLM, integration of modern methods of teaching learning including usage of ICT and credibility of evaluation procedures.
- ✓ Organization of inter and intra Schools/ Institutional workshops, seminars on quality related themes and promotion of quality circles.
- ✓ Arrangement for feedback responses from students, parents and other stakeholders on quality related institutional processes.

Type	Delivery Mechanisms	Provided (Yes/No)	Detailed Information (Please Mention the Activity Hour)
In-Person Delivery	PCP	Yes	Twelve PCP (1.5 hr for each PCP) for each 50 marks for the theory and twenty four PCP (1.5 hr for each PCP) for each 50 marks for the practical.
	Student's participation in Seminar/workshop	Yes	Students are actively participate in the seminar/workshops conducted by the University
Electronic Delivery	Online (Web driven/ Mobile App)	Yes	Using NSOU app, Google meet
	Offline DVD/SD Card/ USB Drive)	Yes	USB drive used
	Telecommunications	A-V lecture	One hour of lecture for many topic of the discourse
	Creation of Group	Yes	Study centre wise students groups created and various lecture documents, maps and informations were shared in these groups

The curriculum design with the brief syllabus for Post Graduate Geography is tabulated below:

Paper	Year	Paper Code	Paper Type	Weightage for Assignment	Weightage for Term End	Full Marks
Geotectonics& Geomorphology	First Year (Part-I)	PGGR-1 A	Theory	20%	80%	100
Hydrology, Oceanography		PGGR-1 B				
Climatology		PGGR-2A	Theory	20%	80%	100
Soil & Bio-geography		PGGR-2B	Theory			
Economic Geography		PGGR-3A	Theory	20%	80%	100
Social & Cultural Geography		PGGR-3B	Theory			
Population & Settlement Geography		PGGR-4A	Theory	20%	80%	50
Quantitative techniques		PGGR-4B	Practical			
Preparation of thematic Maps		PGGR-5A	Practical	0	100%	50
Map Interpretation & Field Techniques		PGGR-5B	Practical	0	100%	50
Geographical Thought	Second Year (Part-II)	PGGR-6A	Theory	20%	80%	100
Historical & Political Geography		PGGR-6B	Theory			
Environmental Issues in Geography		PGGR-7A	Theory	20%	80%	100
Regional Planning & Development		PGGR-7B	Theory			
Special Paper (Urban Geography & Geomorphology)		PGGR-8A	Theory	20%	80%	100
Special Paper (Urban Geography & Geomorphology)		PGGR-8B	Theory			
Regional Problems in India		PGGR-9A	Theory	20%	80%	50
Remote Sensing & GIS		PGGR-9B	Practical			
Special Paper Practical		PGGR-10A	Practical	0	100%	50
Field/ Field Oriented dissertation		PGGR-10B	Practical	0	100%	50
2 Years Course		Theory:700 & Practical: 300 Marks			Total: 1000 Marks	

Programme Objectives:

In recent years, there are ample scope of higher studies as well as research in Geography, thus the students opt this subject by choice. In Netaji Subhas Open University the target group of learners are mainly from the rural areas, particularly where the Universities are too far from their local residence; but the students from urban areas are also enrolling themselves. In West Bengal, a lot of students are graduated with science background, but due to limitation of seats in the conventional Universities/ PG colleges, all of them could not get enrolled themselves in the Geography subject of their choice. NSOU caters and tries to offer the best of the opportunity by offering this subject at the postgraduate level to the students who graduate themselves also do not find an opportunity to go for post graduate studies in other universities. The main objectives for offering this programme are: –

- i) To focus within the curriculum for understanding and resolving issues about the environment and sustainable development. It is an important link between the natural and social sciences which could further be explore by research.
- ii) To develop a mental map of the community, province or territory, country and the world so that the learners can understand the “where” of places and events and relate them in the real world.
- iii) The University is well prepared to offer geography in PG programme and the cooperation from study centres/colleges under different University shall be sought to keep the parity between regular as well distance mode of PG Geography. It is thus spreading the diverse real world knowledge base to the learners.
- iv) To educate and train individuals to be effective managers and decision-makers by its field work exposer.
- v) To equip individuals with the necessary scientific skills and competencies to enable them to seek jobs and progress in their career by the hands-on computer based practical and the practical experience.
- vi) To enhance the capabilities of the existing workforce in the country and abroad and thus contribute to economic development and business growth as they can cater the knowledge of such portions through its syllabus.

- vii) To give chances to the willing students those who could not enter into the convention Universities due to their age, job and limitation of the seat in the respective subject and make them capable at per the students of other university.

Course/Paper Objectives:

The geography discourse has various objectives which is multiple and diverse in nature. Some of the course objectives can be pointed out as:

- i) The course syllabus include all the recend development and challenges along with the base of the physical and human geography which enabled the learners to strengthen their knowledge base about the real world challenges and make them capable to undwerstand the related issues and explore the inherent solutions.
- ii) The various practical experience, like preparing charts, diagrams, maps, computer based maps, weather related charts, graphs, GIS mapping make the learners more inclined to find out the solutions of various challenges, connect them with the issues related and prepared a good outfit of the database by their field exposer which is teached in this discourse.
- iii) The course objective is educate and train the learners to become effective managers, good educator, employer and as well as good researcher in near future. Counsellors with expertise in various fields of geography like geomorphology, hydrology, biogeography, climatology, meteorology etc. work together with graduate students to study fundamental and applied problems that are of compelling societal and scientific interest. Issues such as global climate change, water, energy and carbon cycling, vegetation and carbon dynamics associated with environmental change and management, landscape development, and human impacts on the environment are studied with particular emphasis
- iv) Our field courses are designed to give students an opportunity to do just that: learn valuable field skills, apply classroom knowledge, and connect to the many organizations and issues that require geographic and environmental expertise.

- v) Geomatica, Map Info are the Geographic Information Systems (GIS) and Remote Sensing (RS) softwares teach here to understand the applications of science and geomatics within the physical, social and environmental aspects within geography discipline. The laboratory contains workstations with specialized software for GIS, remote sensing, spatial analysis and 3-D visualization (Geomatics). The laboratory supports by the original Map Info and Geomatica software for students and research examining the use of machine learning in automated environmental mapping, environmental change, and population health on continental, national and regional scales.

Paper	Group	Broad Heading	Marks
1	A	Geotectonics & Geomorphology	50
1	B	Hydrology & Oceanography	50
2	A	Climatology	50
2	B	Soil and Biogeography	50
3	A	Economic Geography	50
3	B	Social and Cultural Geography	50
4	A	Population and Settlement Geography	50
4	B	Quantitative techniques	50
5	A	Preparation of thematic maps	50
5	B	Map Interpretation and Field Techniques	50
Paper	Group	Broad Heading	Marks
6	A	Geographical Thought	50
6	B	Historical & Political Geography	50
7	A	Environmental Issues in Geography	50
7	B	Regional Planning & Development	50
8	A	Special Paper (Urban Geography / Geomorphology)	50
8	B	Special Paper (Urban Geography / Geomorphology)	50
9	A	Regional Problems in India	50
9	B	Remote Sensing & GIS	50
10	A	Special Paper Practical	50
10	B	Field/ Field Oriented dissertation	50

- vi) The syllabus structure includes all the important and relevant topics and therefore, the paper name is self-explanatory for its objectives. Thus a list of papers and their heading and marks are tabulated below:

Learning Outcomes:

After successful completion of the course, the learners are able to increase their knowledge base in the domain of geography which enhances their employability in various fields. The greatest strength of geography, as a discipline is its ability to integrate and apply knowledge across the interface of the Earth's social and environmental systems. The students completing this programme will be able to:

- I. Appreciate Earth as the homeland of humankind and provide insight for wise management decisions about how the planet's resources should be used.
- II. Understand geography's way of looking at the world through the lenses of place, space, and scale. A central tenet of geography is that "location matters" for understanding a wide variety of processes and phenomena. Indeed, geography's focus on location provides a cross-cutting way of looking at processes and phenomena that other disciplines tend to treat in isolation. Geographers focus on "real world" relationships and dependencies among the phenomena and processes will give character to any location or place.
- III. Analyze environmental-societal dynamics relating human action to the physical environment, environmental dynamics linking physical systems, and human-societal dynamics linking economic, social, and political systems; and
- IV. Conduct spatial representation using visual, verbal, mathematical, digital, and cognitive approaches. Places are natural laboratories for the study of complex relationships among processes and phenomena.
- V. The learners can able to enhance their capabilities in the workforce by contributing a lot by their skills.
- VI. Their learnings from the discourse make them capable with the necessary scientific skills and competencies enriched and enabled them to become a good educator, teacher, employer and researcher.

Examination System:

Total Marks	Part-I (500) + Part-II (500)	500+500 = 1000 Marks
Total Credit	Credit of Theory Papers of 100 marks: 8 per paper and 50 marks: 4 per paper	Credit of Practical Papers of 50 marks: 4 per paper
	Part-I (Theory 350 Marks: 28 credit) (Practical 150 Marks: 12 credit)	Part-II (Theory 350 Marks: 28 credit) (Practical 150 Marks: 12 credit)
	Part-I (40) + Part-II (40)	40+40 = 80 Credit
Evaluation System	Internal Assessment: Theory: 20%	Term End Examination: (Theory):80%
	NA	Practical: 100%
Pass marks	No assignment for practical Papers. Pass marks of any theory and practical paper is 40%.	
Examination System	Total 2 Term End Examination	1000 Marks

Detailed Syllabus:

http://www.wbnsou.ac.in/student_zone/courses/science/syllabus/PGP/PGGR_Syllabus.pdf

Post Graduate Degree in Mathematics (PGMT)

M.Sc. in Mathematics

Expectation form the Learners

Master of Mathematics (PGMT) is a two-year Post Graduate Degree Programme in the field of Mathematics having a range of specializations and career options emerging in recent years. This programme is divided in two parts- pure mathematics and applied mathematics. Pure Mathematics focuses mainly the theoretical part of mathematics and it is suitable of those students who want core knowledge in Mathematics. Applied Mathematics is the applicable part of Mathematics. This programme is suitable for students, who want to pursue higher studies or research work in the area of pure and applied Mathematics as well as theoretical computer sciences and statistics. Learners can work as a faculty in different colleges & universities after clearing the requisite exams such as UGC NET/JRF, SET etc. After successful completion, the students may increase their knowledge with the new tools and techniques of Mathematics. A student after completing this course may go either for various government jobs such as school service, college service or research programme in various institutes and universities in India or abroad.

Some expectations from the learners of PGMT are mentioned below:

- Getting the flavour of higher Mathematics and acquiring the knowledge of various tools and techniques of Mathematics.
- Students will have in depth idea of how Mathematics is applicable in day to day life
- The theoretical part of Mathematics will develop a critical and logical mind
- Getting the idea of how real life problem can be interpreted in abstract way
- Learners will get some knowledge of how research is performed in Mathematics
- Enable students to enhance mathematical skills and understand the fundamental concepts of pure and applied mathematics.
- To provide qualitative education through effective teaching learning processes by introducing projects, participative learning and latest software tools.

- To inculcate the curiosity for mathematics in students and to prepare them for future research.
- To encourage collaborative learning and application of mathematics to real life situations.

Course Information

Master of Mathematics (PGMT) of Netaji Subhas Open University is one of the demanding master degree programme in this country. It helps to provide students with a knowledge, abilities and insight in Mathematics and computational techniques so that they are able to work as mathematical professional. Its mission is to offer globally-relevant, industry-linked, research-focused, technology-enabled seamless education at the graduate, postgraduate and research levels in various areas of Mathematical sciences keeping in mind that the manpower so spawned is excellent in quality, is relevant to the global scientific and technological needs, is motivated to give its best and is committed to the growth of the Nation.

Students having completed three years graduate degree programme with Mathematics as honours are eligible to join this programme. The objective of the programme is to help the learners to achieve the deep concept of higher Mathematics. The M.Sc. degree of Mathematics in NSOU will not only help the student to concrete the abstract concept of Mathematics but also make them more aware of the current research of Mathematics. There are two specialization of M.Sc. Mathematics programme: Pure Mathematics and Applied Mathematics. Pure Mathematics is the theoretical part of Mathematics and Applied Mathematics is the application part of Mathematics. Both these specializations will enrich a student with deep mathematical flavour.

It is a two years programme. In the first year student have to take ten papers with a numerical computer programming practical course. In the second year they have to choose either pure Mathematics or applied Mathematics with ten papers in each streams.

The courses are run through Personal Contact Programmes (PCPs) in the selected study centre and various regional centres of the university. The PCP sessions are mostly conducted on Sundays. 18 hours of general Personal Contact Programme (PCPs) are offered to the learners for each paper of 50 Marks are taken by the internal faculties and experienced academic counsellors who are from various eminent Colleges or Universities.

Recommended Approach

Master of Mathematics (PGMT) Programme are conducted through Personal Contact Programme (PCP) at designated Study Centre/LSCs. Besides these PCP sessions the University also conducts special lectures at its Regional Centres from time to time. The learners are expected to read the Self learning materials before coming to the PCP sessions and clarify their doubts. The E-SLMs have been uploaded in the university website for convenience. They are supposed to participate in the discussions during counselling sessions.

The computer practical class of PGMT is organized in various regional centres as well as some selective study centres. All these labs are equipped with modern technologies. There is a strong relationship between the coordinators of the study centres and the concerned authorities of the university so that an effective mode of communication is established and relevant information are timely disseminated amongst the learners about the various curriculum like submission of assignments and matters related to examinations. The university has its own e-repositories along with a ICT support which enable the learners to access the e-learning materials whenever they require. The learners are welcome to meet the concerned faculty at the Regional Centre whenever they feel. The learners and the concerned faculties are in regular contact through social networking sites. The University therefore adopts a very democratic and flexible approach where the learners are encouraged to learn from anywhere anytime.

Programme Objectives

The objectives of PGMT programmes are the followings:

- Understanding of the fundamental axioms in mathematics and capability of developing ideas based on them.
- Inculcate mathematical reasoning
- Prepare and motivate students for research studies in mathematics and related fields
- Provide knowledge of a wide range of mathematical techniques and application of mathematical methods/tools in other scientific and engineering domains.
- Provide advanced knowledge on topics in pure mathematics, empowering the students to pursue higher degrees at reputed academic institutions.

- Strong foundation on *algebraic* topology and *representation* theory which have strong links and application in theoretical physics, in particular string theory.
- Nurture problem solving skills, thinking, creativity through assignments, project work.
- Assist students in preparing (personal guidance, books) for competitive exams e.g. NET, GATE, etc.
- Continue to acquire relevant knowledge and skills appropriate to professional activities and demonstrate highest standards of ethical issues in mathematical sciences
- Create awareness to become an enlightened citizen with commitment to deliver one's responsibilities within the scope of bestowed rights and privileges.

Course/Paper Objectives

Master degree programme in Mathematics has twelve papers having 100 marks each including 2 special papers. The course wise objectives of different years are shown in the following table:

Name of the course	Objectives
IA: Abstract Algebra IB: Linear Algebra	Abstract algebra provides more abstract concepts of various mathematical structure such as group, ring, field. Linear algebra provides various studies of vector spaces and their transformation maps.
IIA: Real analysis & Metric spaces IIB: Complex analysis	The main objectives of the first paper is to give generalization of various mathematical concepts such as limit, continuity in more abstract space rather than the real line. Complex analysis helps students learn basic facts on complex functions, their differential and integral calculus, in particular, get familiar with elementary complex functions, are able to differentiate and integrate such functions, as well as solve equations in complex domain involving such functions, students learn to check whether a function is analytic.

<p>IIIA: Ordinary differential equation (ODE) IIIB: Partial differential equation & special functions</p>	<p>ODE is the study of theoretical and practical procedure to study ordinary differential equations. Partial differential equation is the study of such kind of differential equation having more than one independent variables.</p>
<p>IVA: Numerical analysis IVB: Computer programming numerical analysis unit application to problems of</p>	<p>Numerical analysis provides more advanced study of numerical analysis such as approximation, numerical integration etc. Computer programming is the study of solving numerical problem through computer programming language like C.</p>
<p>VA: Principles of Mechanics VB: Elements of Continuum Mechanics & Special Theory of Relativity</p>	<p>Principles of mechanics allows one to describe and predict the conditions of rest or movement of particles and bodies subjected to the action of forces. Continuum mechanics is a branch of mechanics that deals with the mechanical behavior of materials modeled as a continuous mass rather than as discrete particles.</p>
<p>VIA: General topology VIB: Functional analysis</p>	<p>General topology is the generalization of metric spaces and real analysis. The main objectives of this paper is to give various ideals such as continuity, convergence in set-theory manner. Functional analysis provides the various tools to study continuous functions over norm linear spaces and it also study eign values & natures of these functions.</p>
<p>VIIA: Differential equations and integral transformations VIIB: Integral equations & generalised functionary</p>	<p>These provide the study of various equations involving integration.</p>
<p>VIIIA: Differential geometry VIIB: Graph Theory</p>	<p>The main objectives of differential geometry is to provide generalized concept of analysis to study various geometric and topological structure of a space. Graph theory is the study of in graph theory, combinatorial stadies of graph (a certain dincreate strnetune) is done.</p>

Pure Mathematics	
IXA(i): Advanced Complex analysis IXB(i): Advanced Topology	The main objective of advanced complex analysis is the study of various advanced topic of complex analysis such as conformal mapping, entire function, many valued functions and some concept of Riemannian surface. Advanced topology focuses on more advanced concept like compactification, metrization, uniform space etc.
XA(i): Advanced Differential geometry XB(i): Advanced Functional Analysis	Advanced Differential geometry emphasises on the study of various deep concepts of geometry such as Riemannian curvature, Ricci curvature, Weyl curvature and their inter relationship. Advanced Functional Analysis focuses on the study of topological vector space, bounded linear functional and eigen value-eigen vectors of oprators.
Applied Mathematics	
IXA(ii): Operations Research IXB(ii): Mathematical models in ecology	The main aim of operation research is to study the advanced tools that deals with the application of advanced analytical methods to help make better decisions. It Introduces students to the world of mathematical modelling – the art, the mechanics, the possibilities, and the limitations. It works through examples of how to use models to solve real world problems something alont IX B (ii)
XA(ii): Fluid Mechanics XB(ii): Mechanics of Solids	It develops an appreciation for the properties of Newtonian fluids. Its main focus is to study analytical solutions to variety of simplified problems and understanding the dynamics of fluid flows and the governing non-dimensional parameters. Mechanics of Solids is to understand the theory of elasticity including strain/ displacement and Hooke’s law relationship and analyze solid mechanics problems using classical methods and energy methods

Learning Outcomes

- Create a hypothesis and appreciate how it relates to broader theories.
- Evaluate hypotheses, theories, methods and evidence within their proper contexts.
- Solve complex problems by critical understanding, analysis and synthesis.
- Demonstrate engagement with current research and developments in the subject.
- Critically interpret data, write reports and apply the basics of rules of evidence.
- Select, interpret and critically evaluate information from a range of sources that include books, scientific reports, journals, case studies and the internet.
- Develop proficiency in the analysis of complex physical problems and the use of mathematical or other appropriate techniques to solve them.
- Provide a systematic understanding of the concepts and theories of mathematics and their application in the real world – to an advanced level, and enhance career prospects in a huge array of fields.
- Criticize mathematical arguments developed by themselves and others.
- Communicate effectively by oral, written, computing and graphical means.
- Recognize the need to engage in lifelong learning through continuing education and research
- Assist students in preparing (personal guidance, books) for competitive exams e.g. NET, GATE, etc.

Examination System

There are twenty-four core theoretical papers of 50 marks and one practical paper. All the enrolled learners can appear for the term end examination of each year. The total marks allotted for the course is 1000 which is equally divided into each year. At the end of 1st year, learners have to select pure or applied stream. The learner has to submit assignment for all the papers, followed by the term end examination each year. The total weightage of 20% for assignment while 80% is given for the term end examination.

Detailed Syllabus

Course Code	Name of the course	Full Marks
IA	Abstract Algebra	50
IB	Linear Algebra	50
IIA	Real analysis & Metric spaces	50
IIB	Complex analysis	50
IIIA	Ordinary differential equation (ODE)	50
IIIB	Partial differential equations to copy from syllabus special functions	50
IVA	Numerical analysis	50
IVB	Computer programming numerical analysis	50
VA	Principles of Mechanics	50
VB	Elements of Continuum Mechanics & Special Theory of Relativity	50
VIA	General topology	50
VIB	Functional analysis	50
VIIA	Differential equations, integral transformation	50
VIIB	Integral Equations	50
VIIIA	Differential geometry	50
VIIIB	Graph Theory	50
Pure Mathematics		
IXA(i)	Advanced Complex analysis	50
IXB(i)	Advanced Topology	50
XA(i)	Advanced Differential geometry	50
XB(i)	Advanced Functional Analysis	50
Applied Mathematics		
IXA(ii)	Operations Research	50
IXB(ii)	Mathematical Models in Ecology	50
XA(ii)	Fluid Mechanics	50
XB(ii)	Mechanics of Solids	50

Practical

Netaji Subhas Open University (NSOU) has several Mathematics laboratories in its Regional Centres in West Bengal at Durgapur and Kalyani. These laboratories consist of large number of client computers attached with a main server and also with a centralized power supply system. All these computers are equipped with modern technologies and software. The students have to successfully participate in a Computer Training Programme which is mandatory in the Computer Laboratory at the Regional Centres or any designated study centre.

http://www.wbnsou.ac.in/student_zone/courses/science/syllabus/PGP/PGMT_Syllabus.pdf

Sources of E-resources

The university has its own e-repositories along with a strong ICT support which enables the learners to access the e-learning materials whenever they require. Various e-content, self-learning materials (e-SLM), audio-video lectures (A/V Lectures) and other relevant information pertaining to the course are available in the university website for the learners both in Bengali as well as in English version. Learners can download and read the study materials as per their convenience. Learner friendly Android based mobile application is also developed for the benefit of the learners. The relevant link of e-SLM are given in the following table

Sl. No.	Name of the portal	URL Link
1.	E-SLM	http://www.wbnsou.ac.in/online_services/slm.shtml#active_slm
2.	NSOU audio video lecture	http://www.wbnsou.ac.in/online_services/econtent_List_AV_Lecture.shtml#active_econtent_avlecture
3.	NSOU web tv	http://www.wbnsou.ac.in/online_services/webtv.shtml#active_webtv
4.	NSOU Live Chat	http://www.wbnsou.ac.in/online_services/live_chat_schedule.shtml#active_livechatschedule
5.	NSOU E-Store	http://www.wbnsou.ac.in/online_services/e_store.shtml#active_estore
6.	Math Arxiv	https://arxiv.org/archive/math
7.	American Mathematical Society	https://www.ams.org/home/page
8.	Swayam	https://swayam.gov.in/
9.	MIT Open courseware	https://ocw.mit.edu/courses/mathematics/
10.	Quanta Magazine	https://www.quantamagazine.org/mathematics/
11.	Calcutta mathematical society	https://www.calmathsociety.co.in/aspnet/html/cmsEvents
12.	The Indian Mathematical Society	http://www.indianmathsociety.org.in/

Post Graduate Degree in Zoology

M.Sc. in Zoology (PGZO)

Expectation from the Learners

In West Bengal lots of students complete their high-school and intended to enter into the arena of higher education. Many of them are from weaker socio-economic section or have other engagement to take a regular curriculum or in parallel having earning responsibilities, therefore, need flexible education environment as provided by the ODL system in NSOU.

Through the undergraduate and post-graduate courses of Zoology, we expect that the learners will know about the different fields of this subject and can apply that in their life. Learners can look into the life process and surrounding with scientific introspection. It's our expectation that learners who are directly coming from either the conventional schooling system or from any other background and enrolling in the undergraduate BDP programme and post-graduate PGZO programme in Zoology, will successfully pursue the programmes and make them eligible for better employment opportunities with their acquired education. It is expected that learners would avail all resources including study materials, e-resources and online lectures, personal contact programmes, special sessions properly and ethically participate in the evaluation system to achieve their goals. The newly introduced Ph.D programme, being a regular programme, is expected to be pursued by candidates who can meet the required criteria of the programme. Eventually, Zoology programmes in NSOU expect highest integrity and effort from their learners to avail the facilities and resources provided by the university for making them eligible and capable to stride forward into the next phase of their life and achieve success and contribute the nation in her socio-economic advancement.

Course Information

Netaji Subhas Open University presently possess the Post Graduate programme in Zoology (PGZO). The postgraduate programme in Zoology is for 2 years with 10 papers to study.

PGZO courses are in Open and Distant Learning (ODL) mode where learners can

enter through their marks in the preceding university examination after fulfilling the admission criteria.

The Study Centres under the university throughout the state will support the learners through personal contact programme (PCP), where University provides self-learning materials (SLM), e-resources in NSOU website, special online classes and PCP in NSOU Regional Campuses and conduct term-end examination (TEE) to provide the degrees to the learners.

Recommended Approach

The mission of the Higher Education Institutions is to bring more and more learners in the higher education and offer proper resources and environment to learn so that they can acquire quality education to contribute to the economic as well as scientific development of the nation. In contrast to the regular education system, ODL method offers the learners several means as recommended approaches for learning. Programmes in Zoology recommends the following means to the learners –

- Self-study materials (SLM) provided to the learners as text material. Additional reference materials can be consulted as recommended in the SLM.
- In the university learning management system (LMS) portal of NSOU the e-content and audio-video lectures covering some topics are available for the learners.
- Personal contact programme (PCP) in the study-centers or the NSOU regional centers are to be attended by the learners which provide them the option of direct interaction with faculties.
- Participation in the laboratory classes and evaluation session (LCES) or other practical sessions.
- Attending the online classes arranged by the School of Sciences of NSOU by the faculties of Zoology department for both BDP and PG courses (an initiative started from the lockdown period for COVID pandemic).

Along with, learners are to participate in the evaluation process through assignment and Term-End Examination (TEE) compulsorily to complete the course.

Programme Objective

General Programme Objectives: In science “the term theory is used to describe an organized body of principles and assumptions that account for a set of phenomena along with the rules for its application”. On the other hand, practical is a simplified, physical representation of a thing or process. The representation can take many forms, such as a diagram, a flow chart, a computer program, dissection, or a physical replica. NSOU provides all the pre-conditions of the science subjects while conducting both the Undergraduate and Post Graduate programme in Zoology. The main objectives for offering these programs are: –

- To enlighten individuals about the animal world, their structural and functional diversity and importance in this living world.
- To equip individuals with the necessary scientific skills and competencies to enable them to seek jobs and progress in their career.
- To enhance the capabilities of the existing workforce in the country and thus contribute to economic as well as scientific development.
- To give chances to the willing students those who could not enter the conventional Universities due to their job and limitation of the seats in the respective subjects.
- Understand and apply theoretical knowledge in the areas of animal anatomy, physiology, biochemistry, behaviour etc. and its onward implication in a large in the society.
- Work collaboratively with others (within different sections of the society) in cross-functional teams, and to motivate, lead, and mentor others.
- To educate and train individuals to be effective managers and decision-makers.

Course/Paper Objective

Post-Graduation Programme in Zoology (PGZO) has one course structure with 10 papers. The specific objective of PGZO is to provide knowledge in the subjects to the learners at its basic and advanced levels and help to create insights about the facts and processes of the subject. The course will provide information about the frontier areas of development in the subject both at global and regional scale to

generate keenness to learn more and motivate learners to proceed towards more difficult areas of the subject to understand and work on it. It is aimed that the theoretical and practical parts of the course will help them to enhance the skills and command on the subject, which in turn also develop their research aptitude and contributively participate in the development of the subject.

Learning Outcomes

Students completing this programme will be able to have:

- “hand on” knowledge of the animals of the Earth and provide valuable insight for wise management of the planet’s resources and how they should be used;
- learners focus on “real world” relationships and dependencies among the phenomena and processes will give character to any location or place;
- summarizing a great deal of knowledge economically by incorporating it in a limited set of general principles;
- conduct spatial representation using visual, verbal, digital, and cognitive approaches; and
- leading to specific, testable predictions;
- development of inquisitiveness on the life processes and living world;
- ability to interpret the natural phenomena;
- explore and deduce the unknown territory of the subject area and life;
- develop curious and innovative mind to pursue quality research, and thereby, contributing in the frontier fields.

Our mission is to bring more and more learners in the higher education and thus contribute to economic as well as scientific development. In other way, involvement of more learners in higher education, development of their skills and innovativeness will help the nation to reach its goal.

Specific Outcome

By obtaining the M.Sc degree in Zoology this course enable students to obtain knowledge and skills to obtain wider chances of employability with quality.

This course will enable students for teaching and research including M.Phil and Ph.D courses by qualify NET or GATE or other similar examinations.

Provide the opportunity and capability to get jobs through School or College or Public Service Commissions.

It may also help workforce learners to continue and progress in their educational and/or professional fields.

Overall, this will produce students who will serve the subjects with their thinking and understanding and contribute in the progress of the subject through the process of science and for the society.

Examination Systems

Evaluation

The evaluation system of the programme is based on the following components:

A.Continuous evaluation in the form of assignments in Theory Papers (20% weightage for PG programme)

This component carries a weightage of 20% for PG zoology programme. There will be one graded assignment per course. The assignment is to be submitted to the Co-ordinator of the NSOU/Study Centre to which the student is assigned or attached with.

B.Term-end examination in Theory Papers (weightage: 80% for PG programme)

Term-end examinations are held once in every year in the months of June. The students are at liberty to appear in any of the examinations conducted by the University during the year. A student will be allowed to appear in the Term-End Examination (TEE), only after she/he has registered for that course and submitted the assignments. This TEE is carrying 80% weightage for the theory part.

C.Practical Examination (weightage: 100%):

For Post graduate course, the practical classes are held in specific phases in the study-centres or NSOU regional centres preferably during summer recess periods or other suitable time and final Term-end Examination (TEE) in practical papers are held once in a year. This TEE possesses 100% weightage of marks for practical in

the assessment process. TEE practical Examinations are held in the study centres and learners have to appear in examinations in their respective study centres.

Detailed Syllabus

Post Graduate Zoology (PGZO) syllabus

The detailed syllabus of presently continuing syllabus of post graduate zoology programme (PGZO) is available in the NSOU portal in the following link: http://www.wbnsou.ac.in/student_zone/courses/science/syllabus/PGP/PGZO_Syllabus.pdf

Practical/Field Work/Dissertation Guideline

The detailed guideline of the Field Work Report or Dissertation or Review Report which is a mandatory paper as per the syllabus of PGZO is available in the NSOU portal in the following link: http://www.wbnsou.ac.in/student_zone/courses/science/field_manual/PGZO/20200121_Manual_Dissertation_PGZO_IXA.pdf

Sources of e-resources

The e-resource supports are available in the official portal of Netaji Subhas Open University.

All the Self learning materials are now available in e-SLM format on the website of the University under the 'Online Services' link (http://www.wbnsou.ac.in/online_services/slm.shtml#active_slm). Learners can easily get access to that using their electronic gadgets.

Learners can also get the benefit to learn from the uploaded Audio-Video lectures on different topics of Zoology in the specific link under NSOU website (http://www.wbnsou.ac.in/student_zone/courses/science/AVLSeries.shtml#active_avl). This is a developing service to support the learners for BDP and PG programme which is believed to encompass most of the topics of the subject within a couple of years.

Presently, online classes in specific papers of PG syllabuses in Zoology are being arranged regularly through the LMS support team of NSOU where NSOU faculties are taking online classes and interact with the learners at regular intervals apart from the PCP.

(http://www.wbnsou.ac.in/student_zone/interactions/online_class_schedule/bdp/bdp_online_class_schedule.shtml#bdp_online_class_schedule).