Indian Institute of Science Education and Research Berhampur

Proposal of a New Course

Department of Biological Sciences

Course Title	**Biology I: Basic properties of living organisms**				
Course Level (tick (√) in relevant option)	100 ☑ 200 ☐ 300 ☐ 400 ☐ 500 ☐ 600 ☐ 700 ☐			Semester: Odd ☑ Even ☐ Either semester ☐	
Course applicable for	BSMS ☑ Int. PhD. ☐ Ph.D. ☐				
Tag of the course (tick (√) in the relevant option(s))	Institute Core ☑ Professional (Department) Core ☐ Department Elective ☐ Open Elective ☐ Minor ☐				
Type of the course	Theory ☑ Lab ☐ Project ☐ Non-Credit ☐				
Credit structure:	Lectures (L)	Tutorials (T)	Practicals (P)	Total Credits	
	3	0	0	3	
Course code:	BS101				
Name of faculties who can teach the course:	Any faculty member in the Department of Biological Sciences				
Will the course require participation of visiting faculties: ~~Yes~~ / No					
Prerequisites, if any Course code(s)	None				

Learning Objectives:

The course is aimed at teaching the students the basics properties of biological organisms. Such properties include the definition of life itself, the multi-level organization, relating structure and functioning of an organism, the way they reproduce, the way they communicate with the outside environment, and the way they maintain the internal condition within the body as a steady state. The course also introduces how Biologists study living entities.

Expected Learning Outcomes:

After completing the course, a student should be able to:

1. Define life as an interconnected physiological and biological interaction that is capable of showing self-replication, and evolution through natural selection.
2. Understand and appreciate different levels of biological organization.
3. Understand that all life forms are connected through evolutionary ancestry, and understand scientific theories on how life originated on earth.
4. Classify all life forms in a five-kingdom classification system.
5. Understand the chemical building blocks of living organisms.
6. Visualize cells as a building block of life, and the internal structure and function at a basic level.
7. How living organisms reproduce – a basic property of all living beings.
8. Understand the basics of an organism's interaction with the outside environment for survival and reproduction, the basic properties of population growth, population interactions within a community, and appreciate the true importance of biodiversity.
9. Understand the basic concept of homeostasis – a steady state that is essential to life, how organisms maintain this steady state under constantly varying environmental conditions such as temperature – and that this ability has a limit
10. Ask biologically relevant questions, pose scientific hypotheses, and design simple experiments to test such hypotheses

Course Content:

1. Excitement and relevance of Biology with a few examples
2. Definition and properties of life
3. Origin and evolution of living organisms
4. Concept of tree of life
5. Chemical basis of life: Biological macromolecules
6. Cell as the building blocks of life
7. Perpetuation of life
8. Organisms and their environment
9. Chemical and neuronal coordination:

10. How Biologists work: science of Biology, and a few key philosophical issues

Lecture Outline:

Module No.	Topic	No. of Hours
1	Excitement and relevance of Biology. A few examples.	1
2	Definition and properties: i. Life in its basic form. Basic life processes. ii. Different levels of organization: Cells, Tissues, Organs, and organisms	1
3	Origin and evolution of living organisms: Theories of origin of life. Evolution (descent with modification) and adaptation (evolution by natural selection).	1
4	Concept of tree of life. The broad classification of the living world	6 + 2* *(1 discussion session after every 3 lecture hrs = 2 discussion hours)
5	Chemical basis of life: Biological macromolecules: i. Protein ii. Lipid iii. Carbohydrate **iv.** Nucleic acids	6 + 2* *(1 discussion session after every 3 lecture hrs = 2 discussion hours)
6	Cells - the building blocks of life: i. Types and functions, Cell Theory ii. Structural components of cells and their function iii. Prokaryotic cell and Eukaryotic cell iv. Structure and functions of cell organelles **v.** Mitosis and the preservation of characters through generations. (Mention Meiosis as another type of cell division that will be discussed later)	6 + 2* *(1 discussion session after every 3 lecture hrs = 2 discussion hours)
7	Perpetuation of life: i. Reproduction in unicellular organisms. **ii.** Reproduction in multicellular organisms: Sexual and asexual modes of reproduction. Formation of gametes and Meiosis.	2 + 1* *(1 discussion hours)
8	Organisms and their environment: i. Determination of distribution of organisms: physical limits, habitat, niche ii. Population, community, and ecosystems iii. Basic principles of population growth iv. Community structure: population interactions, diversity v. Biodiversity and climate change	4 +1* *(1 discussion hours)
9	Coordination and homeostasis: i. Concept of homeostasis through thermoregulation in multicellular organisms **ii.** Chemical and neuronal coordination: Hormones and their roles in chemical coordination between a variety of processes. The idea of the nervous system and neurons.	3 +1* *(1 discussion hours)

	Perception, processing and action - three aspects of the nervous system.	
10	How Biologists work: i. Asking questions, formulating hypotheses, testing hypotheses, interpretation and arriving at a conclusion. Use of two examples of biological investigations to this effect. **ii.** Importance of evolutionary thinking. Emergent properties: A critical review of reductionism in the study of Biology through a few examples.	2 +1* *(1 discussion hours)

Brief Description of Tutorial Activities:

Module No.	Topic	No. of Hours

Brief Description of Laboratory Activities: Not applicable

Experiment No:	Topic	No. of Hours

Justification for a need of modification (If applicable): N/A

Suggested Reading:

Textbooks:

i. Sadava, D. E., Hillis, D. M., & Heller, H. C. (2011). *Life: The science of biology*. Macmillan. 9th Ed.

ii. Freeman, S., Quillin, K., Allison, L., Black, M., Taylor, E., Podgorski, G., & Carmichael, J. (2017). *Biological science*. Pearson Higher Ed. 6th Ed.

iii. Campbell, N. A., Reece, J. B., Ury, L. A., Cain, M. L., Wasserman, S. A., Minorsky, P. V., & Jackson, R. B. (2014) Biology: A Global Approach. 10th Ed.

Reference books:

i. Lehninger, A. L. (2017). *Lehninger Principles of Biochemistry: David L. Nelson, Michael M. Cox*. New York: Recording for the Blind & Dyslexic. 7th Ed.

ii. Freeman, S., & Herron, J. C. (2013). Evolutionary analysis. 5th Ed.

iii. Hill, R. W., Wyse, G. A., Anderson, M., & Anderson, M. (2016). *Animal physiology*. Sunderland, MA: Sinauer associates. 4th Ed.

iv. Pechenik, J. (2014). *Invertebrates*. McGraw Hill: Singapore. 7th Ed.

v. Kardong, K. V. (2018). *Vertebrates: comparative anatomy, function, evolution*. New York: McGraw-Hill. 8th Ed.

vi. Odum, E. P., & Barrett, G. W. (2017). Fundamentals of ecology. 5th Ed.

vii. Alberts, B., Heald, R., Johnson, A., Morgan, D., Raff, M., Roberts, K., & Walter, P. (2022). *Molecular biology of the cell.* WW Norton & Company. 7th Ed.

Modalities for Students Performance Assessment (with details of weightage for different components of performance assessment within the broad guidelines given in BS-MS/PhD manual):

a) Assessment will be based on written tests and assignments based on the course instructor(s)' preference.

b) Written tests:

i. Mid-semester examination on modules taught up to the time of the mid-semester.
ii. End-semester examination on all modules

iii. Quiz and class tests: One or more quizzes may be conducted by the instructor at any time of the semester. The course instructor may also conduct surprise quiz

c) Final grading will be as per the guidelines mentioned in the BS-MS manual.
d) The course instructor will declare the tentative weightage distribution in different components of assessments on the first class.

Additional Guidelines:

Depending on the class feedback, topics will be covered in doubt clearing and discussion sessions. Suggested frequency of such sessions – one after every 3 or 4 classes of a module such that in the entire semester there are around 32 lectures, and 10 doubt clearing sessions. Each session will be an interactive session where students can clear doubts, solve dummy problems, and discuss background information that might be important for those who did not have Biology as a subject during their higher secondary education.

Name and Signature of course proposers:

(Bodhisatta Nandy)

(Jose Sebastian)

Similarity with the existing courses, if any: Nil

(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.	Name of the Course	Course Code	Similarity Content	Approx. % of Content
1.				
2				

Justification of new course proposal if cumulative similarity content is >30%:

Recommendation of External experts/Senate members/Subject expert(s)

Description (Add separate sheet, if required)	Description (Add separate sheet, if required)

The above proposal followed by the recommendations of the External experts/Senate members/Subject expert(s) appointed by Director is found to be acceptable by the DUGC/DPGC in its meeting held on_____. The committee recommended the introduction of new course for consideration of CoAA/DoAA and Director/Chairperson Senate.

Convener, DUGC	Convener, DPGC	HoD

For Use of Academic Section

Recommended/Not Recommended to Senate Chairperson	Coordinator/Dean, Academic Affairs
Recommended / Not Recommended for the approval/ratification by the Senate Director/Chairperson Senate	

Indian Institute of Science Education and Research Berhampur

Proposal of a New Course

Department of Biological Sciences

Course Title	**Biology II: Flow of Biological information**				
Course Level (tick (√) in relevant option)	100 ☑ 200 ☐ 300 ☐ 400 ☐ 500 ☐ 600 ☐ 700 ☐			Semester: Odd ☐ Even ☑ Either semester ☐	
Course applicable for	BSMS ☑ Int. PhD. ☐ Ph.D. ☐				
Tag of the course (tick (√) in the relevant option(s))	Institute Core ☑ Professional (Department) Core ☐ Department Elective ☐ Open Elective ☐ Minor ☐				
Type of the course	Theory ☑ Lab ☐ Project ☐ Non-Credit ☐				
Credit structure:	Lectures (L)	Tutorials (T)	Practicals (P)	Total Credits	
	42	0	0	3	
Course code:	BS102				
Name of faculties who can teach the course:	Any faculty member in the Department of Biological Sciences				

Will the course require participation of visiting faculties: ~~Yes~~ / No	
Prerequisites, if any Course code(s)	None

Learning Objectives:

The course is aimed at teaching the students the basics of biological information flow, central dogma of molecular biology, and fundamentals of developmental biology. Students will be able to appreciate how information flow works in biological systems and its guiding principles. It will enable the students to appreciate the organization of biological information and its faithful propagation across generations, at cellular and organismal levels, thus enabling the perpetuation of life. A deeper understanding of the central dogma of molecular biology will allow the students to appreciate the intricate mechanisms that are involved in deciphering the information stored in the DNA and its conversion into proteins to execute cellular activities/functions. Introduction to developmental biology topics allow the students to familiarize with the key concepts and mechanisms that guide organismal development from embryo to adulthood. Developmental gene expression driving cell fate determination and symmetry breaking will be discussed.

Expected Learning Outcomes:

After completing the course, a student should be able to:

1. Understand biological information flow, principles, and mechanisms.
2. Understand the basics of genetics, genes, chromosomes and genome organization.
3. Appreciate the intricate coordination involved in information flow from genes to proteins.
4. Understand fundamentals of DNA replication and gene expression regulation.
5. Understand processes such as horizontal gene transfer, evolution of new traits etc.
6. Appreciate the basics of developmental biology.
7. Understand embryonic development, formation of germ layers and body axis.
8. Appreciate the importance of gene expression regulation in development.

Understand the connection between development and evolution and the consequences of genetic mutations.

Course Content:

A. Basics of transmission genetics

1. Mendelian Genetics
2. Linkage and mapping
3. Epistasis, and other complexities in Genotype-phenotype
4. Chromosomal theory of inheritance
5. Genes: A concept and its physical form, chemical nature of genes
6. How genome is packaged: Nucleosome
7. Bacterial genome and its organization, horizontal gene transfer in multi-drug resistance evolution

B. Central dogma of Molecular Biology

8. Transmission of information
9. Expression of information
10. Brief overview of regulation of gene expression (genetic and epigenetic)

C. Embryonic development

11. Overview of the process fertilization and early development of a zygote
12. Formation of germ layers, and body axis
13. Organ formation (a very brief overview, referring to a classical case study)
14. Importance of gene expression in development

D. Connecting Development and Evolution: Mutations and their consequences

15. Introduction to modularity and parsimony at the DNA sequence and cellular level driving diversity in body forms.
16. Enhancers and their regulation in development
17. Developmental Constraints in body forms

Lecture Outline:

Module No.	Topic	No. of Hours
1	Mendelian Genetics: Particulate inheritance vs. blending and importance of Mendel's experiments, Mendel's laws of inheritance. Concepts of allele, locus, and allelic interactions	3 + 1* *(1 discussion hours)
2	Linkage and mapping: two loci model only, map distance, linkage groups	2 + 1* *(1 discussion hours)
3	Epistasis, and other complexities in Genotype-phenotype	1
4	Chromosomal theory of inheritance: Chromosomal behaviour during meiotic cell division and continuity of ploidy; connecting chromosomes to linkage group	1
5	Genes: A concept and its physical form, chemical nature of genes: DNA as genetic material (experimental proofs)	1
6	How genome is packaged: Nucleosome	1 + 1* *(1 discussion hours)
7	Bacterial genome and its organization, horizontal gene transfer in multi-drug resistance evolution	2 + 1* *(1 discussion hours)
8	Transmission of information: DNA replication in prokaryotes (as model) and a brief discussion of the differences seen in Eukaryotes	3 + 1* *(1 discussion hours)
9	Expression of information: Brief overview of transcription and translation in prokaryotes (as a model), a brief discussion of the differences seen in Eukaryotes	5 + 1 *(1 discussion hours)
10	Brief overview of regulation of gene expression (genetic and epigenetic)	2
11	Overview of the process fertilization and early development of a zygote	3 + 1* *(1 discussion hours)

12	Formation of germ layers, and body axis	2 + 1* *(1 discussion hours)
13	Organ formation (a very brief overview, referring to a classical case study)	1
14	Importance of gene expression in development	2 + 1* *(1 discussion hours)
15	Introduction to modularity and parsimony at the DNA sequence and cellular level driving diversity in body forms.	1
16	Enhancers and their regulation in development	1
17	Developmental Constraints in body forms	1 + 1* *(1 discussion hours)

Brief Description of Tutorial Activities:

Module No.	**Topic**	**No. of Hours**

Brief Description of Laboratory Activities: Not applicable

Experiment No:	Topic	No. of Hours

Justification for a need of modification (If applicable): N/A

Suggested Reading:

Textbooks:

i. Sadava, D. E., Hillis, D. M., & Heller, H. C. (2011). *Life: The science of biology*. Macmillan. 9th Ed.
ii. Freeman, S., Quillin, K., Allison, L., Black, M., Taylor, E., Podgorski, G., & Carmichael, J. (2017). *Biological science*. Pearson Higher Ed. 6th Ed.
iii. Lodish, Harvey F. (2008) *Molecular cell biology*. Macmillan, 8th Ed.

Reference books:

i. Watson, James D. (2017) *Molecular biology of the gene.* Pearson Education. 7th Ed.
ii. Gilbert, Scott F. and Barresi, Michael J. F. (2017) *Developmental Biology.* Oxford Univ. Press. 7th edition
iii. Pierce, B. A. (2012). *Genetics: A conceptual approach.* Macmillan. 7th Ed.
iv. Alberts, B., Heald, R., Johnson, A., Morgan, D., Raff, M., Roberts, K., & Walter, P. (2022). *Molecular biology of the cell*. WW Norton & Company. 7th Ed.

Modalities for Students Performance Assessment (with details of weightage for different components of performance assessment within the broad guidelines given in BS-MS/PhD manual):

a) Assessment will be based on written tests, and assignments based on the course instructor(s)' preference.

b) Written tests:

i. Mid-semester examination on modules taught up to the time of the mid-semester.
ii. End-semester examination on all modules
iii. Quiz and class tests: One or more quiz may be conducted by the instructor at any time of the semester. The course instructor may also conduct surprise quiz

c) Final grading will be as per the guidelines mentioned in the BS-MS manual.

d) The course instructor will declare the tentative weightage distribution in different components of assessments on the first class.

Additional Guidelines:

Each discussion class will be an interactive session where students can clear doubts, solve dummy problems, and discuss background information that might be important for those who did not have Biology as a subject during their higher secondary education.

Name and Signature of course proposers:

(Bodhisatta Nandy)

(Jose Sebastian)

Similarity with the existing courses, if any: Nil

(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.	Name of the Course	Course Code	Similarity Content	Approx. % of Content
1.				
2				

Justification of new course proposal if cumulative similarity content is >30%:

Recommendation of External experts/Senate members/Subject expert(s)

Description (Add separate sheet, if required)	Description (Add separate sheet, if required)

The above proposal followed by the recommendations of the External experts/Senate members/Subject expert(s) appointed by Director is found to be acceptable by the DUGC/DPGC in its meeting held on_____. The committee recommended the introduction of new course for consideration of CoAA/DoAA and Director/Chairperson Senate.

Convener, DUGC Convener, DPGC	HoD

For Use of Academic Section

Recommended/Not Recommended to Senate Chairperson	Coordinator/Dean, Academic Affairs
Recommended / Not Recommended for the approval/ratification by the Senate Director/Chairperson Senate	

Indian Institute of Science Education and Research Berhampur

Proposal of a New Course

Department of Biological Sciences

Course Title	**BIO103 Introductory Biology laboratory**				
Course Level (tick (√) in relevant option)	100 ☑ 200 ☐ 300 ☐ 400 ☐ 500 ☐ 600 ☐ 700 ☐			Semester: Odd ☑ Even ☐ Either semester ☐	
Course applicable for	BSMS ☑ Int. PhD. ☐ Ph.D. ☐				
Tag of the course (tick (√) in the relevant option(s))	Institute Core ☑ Professional (Department) Core ☐ Department Elective ☐ Open Elective ☐ Minor ☐				
Type of the course	Theory ☑ Lab ☐ Project ☐ Non-Credit ☐				
Credit structure:	Lectures (L)	Tutorials (T)	Practicals (P)	Total Credits	
	0	0	3	1	
Course code:	BS103				
Name of faculties who can teach the course:	Any faculty member in the Department of Biological Sciences				
Will the course require participation of visiting faculties: ~~Yes~~ / No					
Prerequisites, if any Course code(s)	None				

Learning Objectives:

The laboratory based practical course is aimed at supplementing the theory courses – BIO101 and BIO102. The fourteen modules in this course covers essential concepts taught in the theory courses. While the first session familiarizes a student with a typical Biology lab, in each of the remaining modules, one key experimental method/approach is taught. The main broad objective of this course is to solidify the theoretical knowledge gained in the first-year theory courses by giving it a firm footing of practical understanding.

Expected Learning Outcomes:

After completing the course, a student should be able to:

1. Work in a typical Biology wet-lab
2. View cells and tissues of different kinds under a microscope
3. Confirm the presence of biological macromolecules such as, protein, carbohydrate, lipid in a sample
4. Quantify protein and nucleic acid content in a sample
5. Differentiate different animal and plant groups
6. Apply the concept of natural selection on biological and non-biological systems
7. Handle fruit flies for experiments, and identify genetic mutants
8. Perform monohybrid and dihybrid crosses to infer genetic nature of a mutant
9. Relate theoretical concept of cell division with the real cellular level events
10. Isolate crude (genomic) DNA from a tissue sample, and visualize methods such as PCR and Gel electrophoresis
11. Have a first-hand experience of what is referred to as gene regulation
12. Visualize early embryonic development in an animal model
13. Understand individual pattern formation

Course Content:

Part I:

1. Introduction to Biology lab: various instruments and how to use them
2. Microscopic observation: Cells (animal, plant), tissue section (animal and plant), gram staining of bacteria
3. Chemical test of protein, lipid, and carbohydrates (qualitative detection)
4. Quantitative test: protein and nucleic acid estimation using bradford method
5. Identification of different animal, and plant groups
6. Natural selection game

Part II:

1. Study of Drosophila, and mutants
2. Monohybrid and dihybrid cross and proof of Mendel's laws
3. Cell division and visualization of chromosome: Mitosis using Onion root tip, Meiosis using grasshopper or Drosophila testes, polytene chromosome in Drosophila salivary gland
4. Genomic DNA isolation and DNA quantification
5. Polymerase chain reaction and Gel electrophoresis
6. Demonstration of gene expression: lac Z staining in E. coli. Heat shock response in Drosophila
7. Study of developmental stages in a Chicken embryo: study of initial cleavages (developmental disc), primitive groove and primitive streak, late developmental stage
8. Human fingerprint analysis: patterns and forms

Lecture Outline: Not applicable

Module No.	Topic	No. of sessions

Brief Description of Tutorial Activities: Not applicable

Module No.	Topic	No. of Hours

Brief Description of Laboratory Activities: Not applicable

Experiment No:	Topic	No. of Hours
1	Introduction to Biology lab: various instruments and how to use them	3
2	Microscopic observation: Cells (animal, plant), tissue section (animal and plant), gram staining of bacteria	3
3	Chemical test of protein, lipid, and carbohydrates (qualitative detection)	3
4	Quantitative test: protein and nucleic acid estimation using Bradford method	3
5	Identification of different animal, and plant groups	3
6	Natural selection game	3
7	Study of Drosophila, and mutants	3
8	Monohybrid and dihybrid cross and proof of Mendel's laws	3
9	Cell division and visualization of chromosome: Mitosis using Onion root tip, Meiosis using grasshopper or Drosophila testes, polytene chromosome in Drosophila salivary gland	3
10	Genomic DNA isolation and DNA quantification	3
11	Polymerase chain reaction and Gel electrophoresis (demonstration only)	3
12	Demonstration of gene expression: lac Z staining in E. coli. Heat shock response in Drosophila	3
13	Study of developmental stages in a Chicken embryo: study of initial cleavages (developmental disc), primitive groove and primitive streak, late developmental stage	3
14	Human fingerprint analysis: patterns and forms	3

Justification for a need of modification (If applicable): N/A

Suggested Reading:

Manuals:

i. Course manual shared by the instructor

ii. Lakhotia SC and Ranganath HA (2024) Experiments with Drosophila for Biology Courses. Indian Academy of Sciences, Bengaluru). 2nd Ed.

iii. Sambrook, J., & Russell, D. W. (2001). Molecular Cloning: a Laboratory Manual. Cold Spring Harbor. 4th Ed.

Reference books:

i. Sadava, D. E., Hillis, D. M., & Heller, H. C. (2011). *Life: The science of biology*. Macmillan. 9th Ed.

ii. Freeman, S., Quillin, K., Allison, L., Black, M., Taylor, E., Podgorski, G., & Carmichael, J. (2017). *Biological science*. Pearson Higher Ed. 6th Ed.

iii. Campbell, N. A., Reece, J. B., Ury, L. A., Cain, M. L., Wasserman, S. A., Minorsky, P. V., & Jackson, R. B. Biology: A Global Approach. 10th Ed.

Modalities for Students Performance Assessment (with details of weightage for different components of performance assessment within the broad guidelines given in BS-MS/PhD manual):

a) Assessment will be based on:
i. Continuous assessment throughout the semester
ii. One or more quiz
iii. Viva-voce
iv. Submission of laboratory report and other report(s)
v. Attendance and regularity (optional)
d) The course instructor will declare the tentative weightage distribution in different components of assessments on the first class.

Additional Guidelines: None

Name and Signature of course proposers:

(Bodhisatta Nandy)

(Jose Sebastian)

Similarity with the existing courses, if any: Core course. Not applicable.

(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.	Name of the Course	Course Code	Similarity Content	Approx. % of Content
1.				
2				

Justification of new course proposal if cumulative similarity content is >30%:

Recommendation of External experts/Senate members/Subject expert(s)

Description (Add separate sheet, if required)	Description (Add separate sheet, if required)

The above proposal followed by the recommendations of the External experts/Senate members/Subject expert(s) appointed by Director is found to be acceptable by the DUGC/DPGC in its meeting held on_____. The committee recommended the introduction of new course for consideration of CoAA/DoAA and Director/Chairperson Senate.

Convener, DUGC	Convener, DPGC	HoD

For Use of Academic Section

Recommended/Not Recommended to Senate Chairperson	Coordinator/Dean, Academic Affairs
Recommended / Not Recommended for the approval/ratification by the Senate Director/Chairperson Senate	

Indian Institute of Science Education and Research Berhampur

Proposal of a New Course

Department of Biological Sciences

Course Title	**Biology III: Introduction to Evolution, Ecology and Ethology**				
Course Level (tick (√) in relevant option)	100 ☐ 200 ☑ 300 ☐ 400 ☐ 500 ☐ 600 ☐ 700 ☐			Semester: Odd ☑ Even ☐ Either semester ☐	
Course applicable for	BSMS ☑ Int. PhD. ☐ Ph.D. ☐				
Credit structure:	Lectures (L)	Tutorials (T)	Practicals (P)	Total Credits	
	42	0	0	3	
Course code:	BS201				
Name of faculties who can teach the course:	Bodhisatta Nandy				
Will the course require participation of visiting faculties: ~~Yes~~ / No					
Prerequisites, if any Course code(s)	None				

Learning Objectives:

The course is aimed at teaching the students the basics three fundamental subject areas of Biological Sciences – Evolutionary Biology, Ecology and Ethology. The course is thus divided into these three modules. Each of these modules are designed to cover the basics of these subjects – focusing on the key concepts. The module on evolution introduces the concept of organic evolution and discusses the evidences in support of the theories, direct case studies, and also busts a few common myths about the process of evolution. In addition, the course also introduces evolution as a population genetic phenomenon. After covering the basic mechanisms of evolution, it introduces the concept of speciation – the process through which new species are formed from pre-existing species. The module ends with the idea of a quantitative trait and its evolution, a subject widely applicable to almost all occurrences of evolution around us. The module on Ecology introduces Population, Community, and Ecosystem as three levels of Ecological processes – all key to understand abundance and distributions of organisms across the globe. It finally introduces Biodiversity, its importance, and the threats it is facing. The third module, on Ethology, introduces the science of Animal Behaviour. The module covers questions such as, how do animals communicate, find habitat to live, find suitable mate, and show parental care. The broader aim of this module is to teach the students the essence of how intricately evolution has shaped behavioural traits.

Expected Learning Outcomes:

After completing the course, a student should be able to:

1. Define evolution, and put natural selection in the context of the fundamental process that explains intricate fitness of an organism to its environment.
2. Defend evolution as a universal concept and definitive property of all biological entity – with citable examples in real life
3. Conceptualize a biological population as a gene pool – describing it with allele and genotype frequencies
4. Test if a population is in evolutionary stasis or is evolving
5. Solve one locus – two allele problems on selection, predict trajectory of an allele given a stable environment
6. Relate non-adaptive evolutionary processes with population size, and random events, solve problems on mutation rate, and gene flow
7. Define species and relate speciation with all evolutionary processes
8. Explain the existence of genetic variation, or directional or disruptive selection on human traits (or any other organism), predict the evolution of traits such as crop yield, activity, longevity etc.
9. Model population growth under density independent and dependent conditions
10. Model and describe growth of a population with age structure
11. Relate life history with population growth and other ecologically relevant events
12. Explain what limits distribution of an organism
13. Understand the intricacies of species interactions that stabilize an ecological community
14. Model ecosystem as a functional unit in an ecological system
15. Construct questions structured in a typical how and why dichotomy – frame corresponding hypotheses, and design simple experiment to test them
16. Differentiate between inherited and non-inherited behaviour
17. Relate animal communications, habitat selection, mate choice to its environment
18. Explain animal cooperation with evolutionary and ecological theories

Course Content:

A. Principles of Evolution

1. Evolution and Natural selection recalled
2. Evidences of evolution
3. Evolution in action - case studies
4. Common myths about evolution
5. Hardy-Weinberg equilibrium
6. Mechanism of Adaptive evolution
7. Other mechanism of evolutionary changes: Genetic drift, mutation, gene flow
8. Origin of species
9. Introduction to quantitative traits, heritability, different modes of selection on quantitative traits

B. Ecology

10. Population Ecology: population growth, competition, age structure, and life history
11. Community and Ecosystem ecology: Niche model, Species interactions
12. Wildlife and Conservation ecology: Biodiversity and its types, threats and benefits, Indian context

C. Behaviour

13. Introduction to Ethology
14. Instinctive and learnt behaviour, inheritance of behaviour
15. Communication
16. Optimality models in Animal Behaviour
17. Habitat selection and migration
18. Mating system and mate choice, parental care
19. Cooperation and conflict in animals, social animals
20. Ecology and Evolution in human welfare

Lecture Outline:

Module No.	Topic	No. of Hours
A. Primer to Evolution		--
1	Evolution and Natural selection recalled	1
2	Evidences of evolution	1
3	Evolution in action: Two case studies - Finches of Galapagos island, a pathogen evolving resistance to antibiotic / antiviral therapy	1
4	Common myths about evolution	1
5	Hardy-Weinberg equilibrium	1 + 1* *(1 discussion hours)
6	Mechanism of Adaptive evolution: Basic models of selection	4 + 1* *(1 discussion hours)
7	Other mechanism of evolutionary changes: Genetic drift, mutation, gene flow	2 + 1* *(1 discussion hours)
8	Origin of species: species concept and speciation	2
9	Introduction to quantitative traits, heritability, different modes of selection on quantitative traits	2
B. Primer to Ecology		--
1	Population Ecology: Exponential and logistic growth models, intraspecific competition, age-structured population and its growth, life history, human population growth.	4 +1* *(1 discussion hours)
2	Community and Ecosystem ecology: Species interactions - Niche model of interspecific competition, consumption (herbivory,	4 + 1* *(1 discussion hours)

	predation, parasitism), mutualism, examples of ecological community.	
3	Wildlife and Conservation ecology: Biodiversity and its types, threats and benefits, uniqueness of India in terms of global Biodiversity distribution, tiger and elephant conservation in India as case studies.	2
C. Primer to Ethology		--
1	What do ethologists study? Timbergen's experiments with parasitoid wasps	1
2	Instinctive and learnt behaviour, inheritance of behaviour	1
3	Communication	1
4	Optimality models in Animal Behaviour	1
5	Habitat selection and migration	1
6	Mating system and mate choice, parental care	2 + 1* *(1 discussion hours)
7	Cooperation and conflict in animals, social animals	2 +1* *(1 discussion hours)
D. Ecology and Evolution in human welfare		1

Brief Description of Tutorial Activities:

Module No.	Topic	No. of Hours

Brief Description of Laboratory Activities: Not applicable

Experiment No:	Topic	No. of Hours

Justification for a need of modification (If applicable): N/A

Suggested Reading:

Textbooks:

i. Sadava, D. E., Hillis, D. M., & Heller, H. C. (2011). *Life: The science of biology*. Macmillan. 9th Ed.

ii. Freeman, S., Quillin, K., Allison, L., Black, M., Taylor, E., Podgorski, G., & Carmichael, J. (2017). *Biological science*. Pearson Higher Ed. 6th Ed.

iii. Campbell, N. A., Reece, J. B., Ury, L. A., Cain, M. L., Wasserman, S. A., Minorsky, P. V., & Jackson, R. B. (2014) *Biology: A Global Approach*. 10th Ed.

Reference books:

i. Freeman, S., & Herron, J. C. (2013). *Evolutionary analysis*. 5th Ed.

ii. Odum, E. P., & Barrett, G. W. (2017). *Fundamentals of ecology*. 5th Ed.

iii. Alcock, J. (2009). *Animal behavior: An evolutionary approach*. Sinauer associates. 10th Ed.

Modalities for Students Performance Assessment (with details of weightage for different components of performance assessment within the broad guidelines given in BS-MS/PhD manual):

a) Assessment will be based on written tests, and assignments based on the course instructor(s)' preference.

b) Written tests:

i. Mid-semester examination on modules taught up to the time of the mid-semester.
ii. End-semester examination on all modules
iii. Quiz and class tests: One or more quiz may be conducted by the instructor at any time of the semester. The course instructor may also conduct surprise quiz

c) One or more assignments will be given on advanced level numerical problems and model building
d) Final grading will be as per the guidelines mentioned in the BS-MS manual.
e) The course instructor will declare the tentative weightage distribution in different components of assessments on the first class.

Additional Guidelines:

Each discussion class will be an interactive session where students can clear doubts, solve dummy problems, and discuss background information that might be important for those who did not have Biology as a subject during their higher secondary education.

Name and Signature of course proposers:

(Bodhisatta Nandy)

(Jose Sebastian)

Similarity with the existing courses, if any: Nil

(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.	Name of the Course	Course Code	Similarity Content	Approx. % of Content
1.				
2				

Justification of new course proposal if cumulative similarity content is >30%:

Recommendation of External experts/Senate members/Subject expert(s)

Description (Add separate sheet, if required)	Description (Add separate sheet, if required)

The above proposal followed by the recommendations of the External experts/Senate members/Subject expert(s) appointed by Director is found to be acceptable by the DUGC/DPGC in its meeting held on_____. The committee recommended the introduction of new course for consideration of CoAA/DoAA and Director/Chairperson Senate.

Convener, DUGC	Convener, DPGC	HoD

For Use of Academic Section

Recommended/Not Recommended to Senate Chairperson	Coordinator/Dean, Academic Affairs
Recommended / Not Recommended for the approval/ratification by the Senate Director/Chairperson Senate	

Indian Institute of Science Education and Research Berhampur

Proposal of a New Course

Department of Biological Sciences

Course Title	**Biology V: Microbiology & Immunology**				
Course Level (tick (√) in relevant option)	100 ☐ 200 ☑ 300 ☐ 400 ☐ 500 ☐ 600 ☐ 700 ☐			Semester: Odd ☐ Even ☑ Either semester ☐	
Course applicable for	BSMS ☑ Int. PhD. ☐ Ph.D. ☐				
Tag of the course (tick (√) in the relevant option(s))	Institute Core ☑ Professional (Department) Core ☐ Department Elective ☐ Open Elective ☐ Minor ☐				
Type of the course	Theory ☑ Lab ☐ Project ☐ Non-Credit ☐				
Credit structure:	Lectures (L)	Tutorials (T)	Practicals (P)	Total Credits	
	42	0	0	3	
Course code:	BS202				
Name of faculties who can teach the course:	Pravat Parida				
Will the course require participation of visiting faculties: ~~Yes~~ / No					
Prerequisites, if any Course code(s)	None				

Learning Objectives:

The course is aimed at introducing Microbiology and Immunology to students. In microbiology, students will be given a history of microbiology starting from the first observations of Antonie Van Leeuwenhoeck. The diversity of microbes along with characterization of viruses, bacteria, fungi will be introduced along with the mechanisms of their growth and propagation. Beneficial microbes and their interactions with other organisms will be covered along with the microbial nutritional requirements. Finally, host-pathogen interactions leading to certain diseases will be covered along with the control measures. In Immunology, a brief overview of the various cells and tissues in the vertebrate immune system will be given. Mechanisms leading to adaptive and innate immunity will be covered along with the pathogen or antigen sensing mechanisms. A brief introduction to immune receptor(s) structures will be done along with the interaction strategies with the diverse antigens. Finally, T-cell biology along with concepts of self-tolerance and graft rejection will be covered.

Expected Learning Outcomes:

After completing the course, a student should be able to:

1. Classify microbes into bacteria, viruses, fungi and protozoa
2. Infer simple interactions between microbes in microbial communities
3. Infer interaction microbes with animals and plants
4. Theoretically list out the diverse nutritional requirements for growing microbes, and apply the same to culturing microbes.
5. Comment on how pathogenic microbes cause certain diseases, and propose potential (simple) intervention strategies
6. Grasp the mechanism of emergence of antimicrobial resistance, and propose potential (simple) ways to control.
7. Comment on the diversity in immune cells in vertebrate immune system
8. Describe, broadly and briefly, how different immune cells operate in innate and adaptive immune systems in humans
9. Understand and apply the concept of immunological memory in the design of vaccines

10. Relate diverse immune receptor classes with their actions
11. Develop rudimentary ideas of applying T-cell biology in healthcare applications

Course Content:

A. Microbiology

1. Overview and History of Microbiology.
2. Microbial diversity
3. Microbial reproduction and growth.
4. Microbial nutrition
5. Microbial interactions
6. Microbial pathogens and control measures.
7. Importance and application of microbiology, Epidemic, Pandemic, and Multidrug resistant microbes.

B. Immunology

8. Introduction to vertebrate immune system
9. Foundations of Immunology - overview, cells, key players, and their generation
10. Natural and adaptive immune responses
11. Antibody Structure and B Cell Receptor
12. Antigen Recognition and Antibody Antigen Interaction
13. T Cell Biology and Immune Regulation

Lecture Outline:

Module No.	Topic	No. of Hours
1	**Overview and History of Microbiology**	1
2	**Microbial diversity:** General characteristics of different groups Acellular microorganisms (Viruses), Bacteria, Alage, Fungi, Protozoa	4 + 1* *(1 discussion hours)
3	**Microbial reproduction and growth:** Binary fission, Budding, Fragmentation, Sporulation Factors influencing the growth of microorganisms	3 + 1* *(1 discussion hours)
4	**Microbial nutrition:** Growth medium (selective, differential, enrichment, complete, synthetic and minimal medium)	2
5	**Microbial interactions:** Commensalism, Amensalism, Symbiosis, Parasitism & Predation	2
6	Microbial pathogens and control measures	2
7	Importance and application of microbiology, Epidemic, Pandemic, and Multidrug resistant microbes	3 + 1* *(1 discussion hours)
Introduction to vertebrate immune system		
8	**Foundations of Immunology** 1) Overview of the immune system: Organs, cells, and key molecular players 2) Hematopoiesis: Differentiation of stem cells into immune and blood cells	4
9	**Natural and adaptive immune responses** 1) Innate immune responses: Physical and chemical barriers to microbial entry 2) Pattern and Pattern recognition receptors and immediate defense 3) Adaptive immune responses: Specificity, memory, and clonal expansion	4 + 1* *(1 discussion hours)
10	**Antibody Structure and B Cell Receptor** 1) Structure and function of immunoglobulins and B Cell Receptors (BCR)	3 + 1* *(1 discussion hours)

	2) Antibody classes and their functional specialization	
11	**Antigen Recognition and Antibody Antigen Interaction** 1) Nature of antigens and epitopes 2) Antigen-antibody binding: Principles and diagnostics (e.g., agglutination, precipitation)	3 + 1* *(1 discussion hours)
12	**T Cell Biology and Immune Regulation** 1) MHC Class I and II: Structure, function, and polymorphism 2) T Cell Receptors (TCR), MHC restriction, and thymic selection 3) Concepts of self-tolerance and graft rejection	4 + 1* *(1 discussion hours)

Brief Description of Tutorial Activities:

Module No.	Topic	No. of Hours

Brief Description of Laboratory Activities: Not applicable

Experiment No:	Topic	No. of Hours

Justification for a need of modification (If applicable): N/A

Suggested Reading:

Textbooks:

i. Sadava, D. E., Hillis, D. M., & Heller, H. C. (2011). *Life: The science of biology*. Macmillan. 9th Ed.

ii. Freeman, S., Quillin, K., Allison, L., Black, M., Taylor, E., Podgorski, G., & Carmichael, J. (2017). *Biological science*. Pearson Higher Ed. 6th Ed.

iii. Campbell, N. A., Reece, J. B., Ury, L. A., Cain, M. L., Wasserman, S. A., Minorsky, P. V., & Jackson, R. B. (2014) Biology: A Global Approach. 10th Ed.

Reference books:

i. Punt, Jenni et al. (2019) *Kuby Immunology*. Eighth edition. New York: W.H. Freeman/Macmillan Learning.

ii. Willey, Joanne M., et al. (2014) *Prescott's Microbiology*. Ninth edition., McGraw-Hill,

Modalities for Students Performance Assessment (with details of weightage for different components of performance assessment within the broad guidelines given in BS-MS/PhD manual):

a) Assessment will be based on written tests, and assignments based on the course instructor(s)' preference.

b) Written tests:

i. Mid-semester examination on modules taught up to the time of the mid-semester.
ii. End-semester examination on all modules
iii. Quiz and class tests: One or more quiz may be conducted by the instructor at any time of the semester. The course instructor may also conduct surprise quiz

c) Final grading will be as per the guidelines mentioned in the BS-MS manual.
d) The course instructor will declare the tentative weightage distribution in different components of assessments on the first class.

Additional Guidelines:

Each discussion class will be an interactive session where students can clear doubts, solve dummy problems, and discuss background information that might be important for those who did not have Biology as a subject during their higher secondary education.

Name and Signature of course proposers:

(Bodhisatta Nandy)

(Vinay Bulusu)

Similarity with the existing courses, if any: Nil

(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.	Name of the Course	Course Code	Similarity Content	Approx. % of Content
1.				
2				

Justification of new course proposal if cumulative similarity content is >30%:

Recommendation of External experts/Senate members/Subject expert(s)

Description (Add separate sheet, if required)	Description (Add separate sheet, if required)

The above proposal followed by the recommendations of the External experts/Senate members/Subject expert(s) appointed by Director is found to be acceptable by the DUGC/DPGC in its meeting held on_____. The committee recommended the introduction of new course for consideration of CoAA/DoAA and Director/Chairperson Senate.

Convener, DUGC	Convener, DPGC	HoD

For Use of Academic Section

Recommended/Not Recommended to Senate Chairperson	Coordinator/Dean, Academic Affairs
Recommended / Not Recommended for the approval/ratification by the Senate Director/Chairperson Senate	

Indian Institute of Science Education and Research Berhampur

Proposal of a New Course

Department of Biological Sciences

<table>
<tr><td>Course Title</td><td colspan="5">Biology IV: Fundamentals of Cell and Molecular Biology</td></tr>
<tr><td>Course Level (tick (√) in relevant option)</td><td colspan="3">100 ☐ 200 ☑ 300 ☐ 400 ☐ 500 ☐ 600 ☐ 700 ☐</td><td colspan="2">Semester: Odd ☑ Even ☐
Either semester ☐</td></tr>
<tr><td>Course applicable for</td><td colspan="5">BSMS ☑ Int. PhD. ☐ Ph.D. ☐</td></tr>
<tr><td>Tag of the course (tick (√) in the relevant option(s))</td><td colspan="5">Institute Core ☑ Professional (Department) Core ☐ Department Elective ☐ Open Elective ☐ Minor ☐</td></tr>
<tr><td>Type of the course</td><td colspan="5">Theory ☑ Lab ☐ Project ☐ Non-Credit ☐</td></tr>
<tr><td rowspan="2">Credit structure:</td><td>Lectures (L)</td><td>Tutorials (T)</td><td>Practicals (P)</td><td>Total Credits</td><td></td></tr>
<tr><td>42</td><td>0</td><td>0</td><td>3</td><td></td></tr>
<tr><td>Course code:</td><td colspan="5">BS203</td></tr>
<tr><td>Name of faculties who can teach the course:</td><td colspan="5">R. Selvi Bharathvikru, Prosenjit Mondal, Pravat Parida, Jose Sebastian</td></tr>
<tr><td colspan="6">Will the course require participation of visiting faculties: ~~Yes~~ / No</td></tr>
<tr><td>Prerequisites, if any Course code(s)</td><td colspan="5">None</td></tr>
<tr><td colspan="6">Learning Objectives:
The course is aimed at teaching the students the basics of cell biology and fundamentals of molecular biology. Students will be able to appreciate how cells are organized and the importance of cellular activities. Learn about different cell organelles, their structure and functions etc. This course will enable the students to appreciate the basics of cell membrane organization and its importance along with processes such as membrane trafficking- how are they regulated etc. A deeper understanding molecular biology will allow the students to appreciate how organisms faithfully replicate genetic information and decipher information stored in the DNA. They will also learn the differences between replication, transcription and translation between prokaryotes and eukaryotes. A detailed understanding of various mechanisms involved in gene expression regulation will enable the students to appreciate how cell choregraph various cellular activities and functions. How they perceive and respond to external cues and signals.</td></tr>
<tr><td colspan="6">Expected Learning Outcomes:
After completing the course, a student should be able to:
1. Understand basics of cell biology
2. Understand cell organelles and their structure and functions.
3. Appreciate the detailed organization and function of cell membrane.
4. Understand fundamentals of membrane trafficking
5. Understand cell cycle
6. Learn the basics of DNA replication in prokaryotes and eukaryotes
7. Understand transcription and post-transcription mechanisms
8. Learn mechanisms of translation and post-translation
9. Appreciate the mechanisms of gene expression regulation
10. Understand RNA replication, types, mechanisms etc.</td></tr>
<tr><td colspan="6">Course Content:
1) A Tour of the Cell: The fundamental Units of Life, Cell organelles structures and their functions</td></tr>
</table>

2) Membrane Structure and Function
3) Cell signalling and transport across cell membranes
4) Membrane trafficking
5) Cell cycle
6) DNA replication.
7) Transcription and processing of RNA.
8) Translation and post-translational modifications.
9) Protein targeting and sorting.
10) RNA replication, reverse transcription.

11) Regulation of gene expression.

Lecture Outline:

Module No.	Topic	No. of Hours
1	A Tour of the Cell: The fundamental Units of Life, Cell organelles structures and their functions	4 + 1* *(1 discussion hours)
2	Membrane Structure and Function	3
3	Cell signalling and transport across cell membranes	3 + 1* *(1 discussion hours)
4	Membrane trafficking	3
5	Cell cycle	3 + 1* *(1 discussion hours)
6	DNA replication.	4 + 1* *(1 discussion hours)
7	Transcription and processing of RNA.	3 + 1* *(1 discussion hours)
8	Translation and post-translational modifications.	4 + 1* *(1 discussion hours)
9	Protein targeting and sorting.	3
10	RNA replication, reverse transcription.	2
11	Regulation of gene expression.	3 + 1* *(1 discussion hours)

Brief Description of Tutorial Activities:

Module No.	Topic	No. of Hours

Brief Description of Laboratory Activities: Not applicable

Experiment No:	Topic	No. of Hours

Justification for a need of modification (If applicable): N/A

Suggested Reading:

Textbooks:

i. Sadava, D. E., Hillis, D. M., & Heller, H. C. (2011). *Life: The science of biology*. Macmillan. 9th Ed.
ii. Freeman, S., Quillin, K., Allison, L., Black, M., Taylor, E., Podgorski, G., & Carmichael, J. (2017). *Biological science*. Pearson Higher Ed. 6th Ed.
iii. Molecular Cell Biology, 8th Edition. by Harvey Lodish

Reference books:

i. Watson, James D. Molecular biology of the gene Edition: 7th
ii. *Bruce Alberts et al.,* Molecular Biology of the cell 6th Edition

Modalities for Students Performance Assessment (with details of weightage for different components of performance assessment within the broad guidelines given in BS-MS/PhD manual):

a) Assessment will be based on written tests, and assignments based on the course instructor(s)' preference.

b) Written tests:

i. Mid-semester examination on modules taught up to the time of the mid-semester.
ii. End-semester examination on all modules
iii. Quiz and class tests: One or more quiz may be conducted by the instructor at any time of the semester. The course instructor may also conduct surprise quiz

c) Final grading will be as per the guidelines mentioned in the BS-MS manual.
d) The course instructor will declare the tentative weightage distribution in different components of assessments on the first class.

Additional Guidelines:

Each discussion class will be an interactive session where students can clear doubts, solve dummy problems, and discuss background information that might be important for those who did not have Biology as a subject during their higher secondary education.

Name and Signature of course proposers:

(Bodhisatta Nandy)

(Jose Sebastian)

Similarity with the existing courses, if any: Nil

(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.	Name of the Course	Course Code	Similarity Content	Approx. % of Content
1.				

2				

Justification of new course proposal if cumulative similarity content is >30%:

Recommendation of External experts/Senate members/Subject expert(s)

Description (Add separate sheet, if required)	Description (Add separate sheet, if required)

The above proposal followed by the recommendations of the External experts/Senate members/Subject expert(s) appointed by Director is found to be acceptable by the DUGC/DPGC in its meeting held on_____. The committee recommended the introduction of new course for consideration of CoAA/DoAA and Director/Chairperson Senate.

Convener, DUGC	Convener, DPGC	HoD

For Use of Academic Section

Recommended/Not Recommended to Senate Chairperson	Coordinator/Dean, Academic Affairs
Recommended / Not Recommended for the approval/ratification by the Senate Director/Chairperson Senate	

Indian Institute of Science Education and Research Berhampur

Proposal of a New Course

Department of Biological Sciences

Course Title	**Biology VI: Basic Biochemistry**				
Course Level (tick (√) in relevant option)	100 ☐ 200 ☑ 300 ☐ 400 ☐ 500 ☐ 600 ☐ 700 ☐			Semester: Odd ☐ Even ☑ Either semester ☐	
Course applicable for	BSMS ☑ Int. PhD. ☐ Ph.D. ☐				
Tag of the course (tick (√) in the relevant option(s))	Institute Core ☑ Professional (Department) Core ☐ Department Elective ☐ Open Elective ☐ Minor ☐				
Type of the course	Theory ☑ Lab ☐ Project ☐ Non-Credit ☐				
Credit structure:	Lectures (L)	Tutorials (T)	Practicals (P)	Total Credits	
	42	0	0	3	
Course code:	BS204				
Name of faculties who can teach the course:	Vinay Bulusu, Vivek Tiwari, Shanti Swarup Srivastava, Pravat Parida, Arunkumar Krishnan				
Will the course require participation of visiting faculties: ~~Yes~~ / No					
Prerequisites, if any Course code(s)	None				

Learning Objectives:

The course is aimed at teaching the students the basic principles of thermodynamics and kinetics of chemical reactions and their applications in enzyme action and metabolic networks. Students will be able to appreciate how thermodynamically unfavorable reactions can be driven by coupling mechanisms to highly exergonic reactions like ATP hydrolysis and reactions with large negative free energy change. Regulation of enzyme activity by allosteric mechanisms will enable the students to appreciate how homeostasis can be maintained beyond genetic control. Metabolic pathways encompassing catabolism and anabolism will be discussed making students understand how biochemical reactions operate to generate energy or build macromolecules. Finally, with the availability of genome sequences across all kingdoms of life, students will be exposed to bioinformatic concepts to explore these sequences using various tools and concepts for comparative analysis.

Expected Learning Outcomes:

After completing the course, a student should be able to:

1. Describe thermodynamic principles of reactions, and apply to metabolism in biological systems
2. Relate mechanism of enzyme action with reaction rates and design simple strategies to speed up a reaction.
3. Understand allostery and its invaluable contribution to reducing the costs associated with transcription and translation.
4. Navigate metabolic networks with a logical perspective.
5. Understand different databases of sequences.
6. Use various bioinformatic concepts to understand gene duplication events and speciation.
7. Carry out gene prediction and annotation (simple)

Course Content:

A. Fundamentals of Biochemistry:

1. Thermodynamics and Bioenergetics

2. Enzyme kinetics
3. Enzyme Catalytic mechanisms
4. Metabolic Regulation and Allostery

B. Physiological Biochemistry:

5. Basic concepts of metabolism
6. Catabolism and anabolism, energy generation and storage
7. Glycolysis, citric acid cycle, oxidative phosphorylation
8. Pentose phosphate pathway
9. Gluconeogenesis, glycogen metabolism
10. Fatty acid metabolism
11. Amino acid metabolism

C. Introduction to Computational Biology

12. The central dogma in the era of big data
13. Genome and genome structure
14. Introduction to genome sequencing and annotation
15. Introduction to comparative genomics
16. Gene prediction and functional annotation

Lecture Outline:

Module No.	Topic	No. of Hours
1	Thermodynamics and Bioenergetics: Laws of thermodynamics, principle of equilibrium, Le Chateliers principle, Transition state theory, phosphoryl transfer reactions and ATP.	4 + 1* *(1 discussion hours)
2	Enzyme kinetics: Michaelis-Menten Kinetics, Regression analysis of kinetic data, Kinetic Models, Steady state and Rapid equilibrium.	2 + 1* *(1 discussion hours)
3	Enzyme Catalytic mechanisms: Acid-Base catalysis, Covalent catalysis and metal ion catalysis.	2 + 1* *(1 discussion hours)
4	Metabolic Regulation and Allostery: Design principles of metabolism,pathway regulation, Hill Equation, models of allostery including sequential model, concerted model and ensemble model.	5 + 2* *(1 discussion session after every 3 lecture hrs = 2 discussion hours)
5	Basic concepts of metabolism	2
6	Catabolism and anabolism, energy generation and storage	3 + 1* *(1 discussion hours)
7	Glycolysis, citric acid cycle, oxidative phosphorylation	3 + 1* *(1 discussion hours)
8	Pentose phosphate pathway	2
9	Gluconeogenesis, glycogen metabolism	2
10	Fatty acid metabolism	2
11	Amino acid metabolism	2
12	The central dogma in the era of big data: DNA, RNA, protein sequences,different data formats and diverse biological databases (NCBI, UniProt,PDB, Ensembl)	1

13	Genome and genome structure: What is a genome? Basic genome structure in prokaryotes vs. eukaryotes	1
14	Introduction to genome sequencing & annotation, Orthologs, paralogs,gene families	1
15	Introduction to comparative genomics: Why comparative genomics: synteny, conservation, divergence	1
16	Gene prediction & functional annotation (Why it is important and how it is done)	1

Brief Description of Tutorial Activities:

Module No.	**Topic**	**No. of Hours**

Brief Description of Laboratory Activities: Not applicable

Experiment No:	Topic	No. of Hours

Justification for a need of modification (If applicable): N/A

Suggested Reading:

Textbooks:

i. Sadava, D. E., Hillis, D. M., & Heller, H. C. (2011). *Life: The science of biology*. Macmillan. 9th Ed.
ii. Freeman, S., Quillin, K., Allison, L., Black, M., Taylor, E., Podgorski, G., & Carmichael, J. (2017). *Biological science*. Pearson Higher Ed. 6th Ed.
iii. Campbell, N. A., Reece, J. B., Ury, L. A., Cain, M. L., Wasserman, S. A., Minorsky, P. V., & Jackson, R. B. (2014) Biology: A Global Approach. 10th Ed.

Reference books:

i. Lehninger, A. L. (2017). *Lehninger Principles of Biochemistry: David L. Nelson, Michael M. Cox*. New York.
ii. Irwin H Segel (2010) *Biochemical Calculations How to Solve Mathematical Problems in General Biochemistry.* 2nd Ed.
iii. Stryer L (2002) *Biochemistry.* W.H.Freeman & Co Ltd. 5th Ed.
iv. Koonin EV, Galperin MY. (2003) Sequence - Evolution - Function: Computational Approaches in Comparative Genomics. Boston: Kluwer Academic.
v. Saitou, N (2018) *Introduction to Evolutionary Genomics*. Springer. 2nd Ed.
vi. Ohno, S. (2013). *Evolution by gene duplication.* Springer Science & Business Media.

Modalities for Students Performance Assessment (with details of weightage for different components of performance assessment within the broad guidelines given in BS-MS/PhD manual):

a) Assessment will be based on written tests, and assignments based on the course instructor(s)' preference.

b) Written tests:

i. Mid-semester examination on modules taught up to the time of the mid-semester.
ii. End-semester examination on all modules

iii. Quiz and class tests: One or more quiz may be conducted by the instructor at any time of the semester. The course instructor may also conduct surprise quiz

c) Final grading will be as per the guidelines mentioned in the BS-MS manual.
d) The course instructor will declare the tentative weightage distribution in different components of assessments on the first class.

Additional Guidelines:

Each discussion class will be an interactive session where students can clear doubts, solve dummy problems, and discuss background information that might be important for those who did not have Biology as a subject during their higher secondary education.

Name and Signature of course proposers:

(Bodhisatta Nandy)

(Vinay Bulusu)

Similarity with the existing courses, if any: Nil.

(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.	Name of the Course	Course Code	Similarity Content	Approx. % of Content
1.				
2				

Justification of new course proposal if cumulative similarity content is >30%:

Recommendation of External experts/Senate members/Subject expert(s)

Description (Add separate sheet, if required)	Description (Add separate sheet, if required)

The above proposal followed by the recommendations of the External experts/Senate members/Subject expert(s) appointed by Director is found to be acceptable by the DUGC/DPGC in its meeting held on_____. The committee recommended the introduction of new course for consideration of

CoAA/DoAA and Director/Chairperson Senate.

Convener, DUGC	Convener, DPGC	HoD

For Use of Academic Section

Recommended/Not Recommended to Senate Chairperson	Coordinator/Dean, Academic Affairs
Recommended / Not Recommended for the approval/ratification by the Senate Director/Chairperson Senate	

Indian Institute of Science Education and Research Berhampur

Proposal of a New Course

Department of Biological Sciences

Course Title	**Biology pre-major lab I**				
Course Level (tick (√) in relevant option)	100 ☐ 200 ☑ 300 ☐ 400 ☐ 500 ☐ 600 ☐ 700 ☐			Semester: Odd ☑ Even ☐ Either semester ☐	
Course applicable for	BSMS ☑ Int. PhD. ☐ Ph.D. ☐				
Tag of the course (tick (√) in the relevant option(s))	Institute Core ☑ Professional (Department) Core ☐ Department Elective ☐ Open Elective ☐ Minor ☐				
Course Level (tick (√) in relevant option)	100 ☐ 200 ☑ 300 ☐ 400 ☐ 500 ☐ 600 ☐ 700 ☐				
Type of the course	Theory ☐ Lab ☑ Project ☐ Non-Credit ☐				
Credit structure:	Lectures (L)	Tutorials (T)	Practicals (P)	Total Credits	
	0	0	3	1	
Name of faculties who can teach the course:	R. Selvi Bharathvikru, Prosenjit Mondal, Pravat Parida, Jose Sebastian, Bodhisatta Nandy				
Will the course require participation of visiting faculties: ~~Yes~~ / No					
Prerequisites, if any Course code(s)	None				

Learning Objectives:

The practical course is aimed to provide hands-on experience and training for the students in various aspects of ecology, evolution, cell biology and molecular biology. The course will start with a training on basic microscopy. Cell biology lab sessions will allow the students to be familiar with fundamentals of cell biology and Immuno-histochemistry techniques. In the molecular biology part, students will prepare competent cells, estimate their efficiency and use these cells for learning bacterial transformation procedures. This will be followed by plasmid DNA isolation, DNA visualization via Agarose gel electrophoresis, quantity and quality estimation. Students will also learn genomic DNA isolation procedures from bacteria and quality and quantity estimations. Thus, the course will enable the students to gather valuable experience and practical training in most of the routine aspects of molecular biology and cell biology, helping them to better appreciate the subject and be more curious. On the other hand, the Evolution-Ecology-Ethology part of the course will complement the theory course taught in the same semester – connecting theoretical understanding with direct practical observation. The objective is to give a solid foundation in these key aspects of Biological science, which is important for Biology students as well as students specializing in other science disciplines.

Expected Learning Outcomes:

After completing the course, a student should be able to:

1. Handle microscopes for visualizing cells and other biological samples with more independence
2. Carry out experiments using basic cell biology lab techniques including immune- histochemistry
3. Prepare competent cells under supervision
4. Carry out plasmid isolation under supervision
5. Carry out genomic DNA isolation & characterization, agarose gel electrophoresis, and visualize DNA under supervision
6. Identify the outcome of selection and genetic drift in a population
7. Identify, and quantify a quantitative trait, and design an experiment to measure its heritability
8. Conduct an experiment to demonstrate mate choice and sexual selection in an animal
9. Carry out simple ethological experiment such as, habitat preference etc. to test basic principles of ethology

10. Generate and analyze life table data (cohort life table)
11. Carry out basic documentation of biodiversity

Course Content:

1) Microscopes and their use
2) Evolution, Ecology, Ethology lab
   a) Demonstration of selection and drift using Drosophila
   b) Quantitative trait and heritability using sternopleural bristles and sex comb in Drosophila
   c) Sexual selection and mate choice using a model system
   d) Habitat selection and optimization of resource use using an insect model
   e) Campus biodiversity study
   f) Preparation of Drosophila life table
3) Cell Biology lab:
   a) Microscopic observation of different types of cells
   b) Visualization of cell organelles
   c) Immuno-histochemistry of tissues
4) Molecular Biology lab:
   a) Competent cell preparation,
   b) Transformation
   c) Plasmid DNA isolation
   d) Agarose gel electrophoresis
   e) DNA isolation & characterization

Lecture Outline:

Module No.	Topic	No. of Hours

Brief Description of Tutorial Activities: NA

Module No.	Topic	No. of Hours

Brief Description of Laboratory Activities:

Experiment No.	Topic	No. of Hours
1	Demonstration of selection and drift using Drosophila	Multi-class (3)
2	Quantitative trait and heritability using sternopleural bristles and sex comb in Drosophila	Multi-class (3)
3	Sexual selection and mate choice using a model system	3
4	Habitat selection and optimization of resource use using an insect model	3
5	Campus biodiversity study	Multi-class (3)
6	Preparation of Drosophila life table	Multi-class (3)
7	Microscopes and their use	3
8	Microscopic observation of different types of cells	3
9	Visualization of cell organelles	3

10	Immuno-histochemistry of tissues	3
11	Competent cell preparation	3
12	Transformation	
13	Plasmid DNA isolation	3
14	Agarose gel electrophoresis	3
15	DNA isolation & characterization	3

Justification for a need of modification (If applicable): N/A

Suggested Reading:

Manual:

i. Course manual shared by the instructor

ii. Lakhotia SC and Ranganath HA (2024) Experiments with Drosophila for Biology Courses. Indian Academy of Sciences, Bengaluru). 2nd Ed.

iii. Sambrook, J., & Russell, D. W. (2001). Molecular Cloning: a Laboratory Manual. Cold Spring Harbor. 4th Ed.

Reference books:

i. Sadava, D. E., Hillis, D. M., & Heller, H. C. (2011). *Life: The science of biology*. Macmillan. 9th Ed.

ii. Freeman, S., Quillin, K., Allison, L., Black, M., Taylor, E., Podgorski, G., & Carmichael, J. (2017). *Biological science*. Pearson Higher Ed. 6th Ed.

iii. Campbell, N. A., Reece, J. B., Ury, L. A., Cain, M. L., Wasserman, S. A., Minorsky, P. V., & Jackson, R. B. Biology: A Global Approach. 10th Ed.

Modalities for Students Performance Assessment (with details of weightage for different components of performance assessment within the broad guidelines given in BS-MS/PhD manual):

a) Assessment will be based on:
i. Continuous assessment throughout the semester
ii. One or more quiz
iii. Viva-voce
iv. Submission of laboratory report and other report(s)
v. Attendance and regularity (optional)

d) The course instructor will declare the tentative weightage distribution in different components of assessments on the first class.

Additional Guidelines: None

Name and Signature of course proposers:

(Bodhisatta Nandy)

(Jose Sebastian)

Similarity with the existing courses, if any: Nil

(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.	Name of the Course	Course Code	Similarity Content	Approx. % of Content
1.				
2				

Justification of new course proposal if cumulative similarity content is >30%:

Recommendation of External experts/Senate members/Subject expert(s)

Description (Add separate sheet, if required)	Description (Add separate sheet, if required)

The above proposal followed by the recommendations of the External experts/Senate members/Subject expert(s) appointed by Director is found to be acceptable by the DUGC/DPGC in its meeting held on_____. The committee recommended the introduction of new course for consideration of CoAA/DoAA and Director/Chairperson Senate.

Convener, DUGC	Convener, DPGC	HoD

For Use of Academic Section

Recommended/Not Recommended to Senate Chairperson	Coordinator/Dean, Academic Affairs
Recommended / Not Recommended for the approval/ratification by the Senate Director/Chairperson Senate	

Indian Institute of Science Education and Research Berhampur

Proposal of a New Course

Department of Biological Sciences

Course Title	**Biology pre-major lab II**				
Course Level (tick (√) in relevant option)	100 ☐ 200 ☑ 300 ☐ 400 ☐ 500 ☐ 600 ☐ 700 ☐			Semester: Odd ☐ Even ☑ Either semester ☐	
Course applicable for	BSMS ☑ Int. PhD. ☐ Ph.D. ☐				
Tag of the course (tick (√) in the relevant option(s))	Institute Core ☑ Professional (Department) Core ☐ Department Elective ☐ Open Elective ☐ Minor ☐				
Type of the course	Theory ☐ Lab ☑ Project ☐ Non-Credit ☐				
Credit structure:	Lectures (L)	Tutorials (T)	Practicals (P)	Total Credits	
	0	0	3	1	
Course code:	BS206				
Name of faculties who can teach the course:	Vinay Bulusu, Vivek Tiwari, Shanti Swarup Srivastava, Pravat Parida				
Will the course require participation of visiting faculties: ~~Yes~~ / No					
Prerequisites, if any Course code(s)	None				

Learning Objectives:

The practical course is aimed at giving students hands on experience with practical experiments associated with biochemistry, microbiology and immunology. Students are expected to design enzyme assays using UV/Vis spectroscopy and estimate concentrations of biomolecules using Beer-Lambert's law. Methods involving precipitation of proteins will be shown and students are expected to understand the principles associated with these techniques. Different methods of culturing and characterizing bacteria will be taught and tests for checking antibiotic resistance following transformation of suitable plasmids will be shown. Immunological techniques of radial immunodiffusion for characterizing antigen-antibody interaction will be shown. ABO blood typing will be shown. Students should be able to understand the principles of blood typing.

Expected Learning Outcomes:

After completing the course, a student should be able to:

1. Carry out measurements using Ultraviolet Visible spectroscopy (UV/Vis) spectrophotometer
2. Design enzyme assays, and estimate kinetic parameters from enzyme assays
3. Plot graphs of the data and interpolate kinetic parameters
4. Demonstrate how addition of salt might precipitate proteins as predicted by the theory
5. Culture bacteria based on nutritional requirements
6. Design and carry out (under supervision) assays to test antibiotic resistance
7. Identify diverse immune cells by staining with Leishman's stain.
8. Carry out agglutination reaction that underlies the blood grouping
9. Demonstrate antigen antibody interaction by immune diffusion methods

Course Content:

Biochemistry lab

a) Principle of Absorbance spectroscopy, Beer-Lambert's law for concentration estimation.
b) Enzyme assays and kinetics: Assay Design, Specific activity calculation, estimation of

c) kinetic parameters.
d) Amino acid analysis by paper chromatography and Thin layer chromatography.
e) Principle of Salting out of proteins by ammonium sulfate precipitation.
f) Floating leaf disc assay to demonstrate Photosynthesis.

Microbiology & Immunology lab

g) Identification of microorganisms, staining techniques (Gram's, acid fast)
h) Bacterial plating
i) Tests for antibiotic resistance,
j) Plaque assay, preparation of bacterial competent cells, transformation,
k) Total Leukocyte Count using Leishman's Stain
l) ABO Blood Grouping and Rh Testing
m) Serum Separation from Whole Blood
n) Single Radial Immunodiffusion
o) Double Radial Immunodiffusion

Brief Description of Laboratory Activities:

Experiment No:	Topic	No. of Hours
1	Principle of Absorbance spectroscopy, Beer-Lambert's law for concentration estimation.	3
2	Enzyme assays and kinetics: Assay Design, Specific activity calculation, estimation of kinetic parameters.	6
3	Amino acid analysis by paper chromatography and Thin layer chromatography.	3
4	Principle of Salting out of proteins by ammonium sulfate precipitation.	3
5	Principle of Salting out of proteins by ammonium sulfate precipitation.	3
6	Floating leaf disc assay to demonstrate Photosynthesis.	3
7	Identification of microorganisms, staining techniques (Gram's, acid fast)	3
8	Bacterial plating	3
9	Tests for antibiotic resistance	3
10	Plaque assay, preparation of bacterial competent cells, transformation	3
11	Total Leukocyte Count using Leishman's Stain	3
12	ABO Blood Grouping and Rh Testing	3
13	Serum Separation from Whole Blood	3
14	Single Radial Immunodiffusion	3
15	Double Radial Immunodiffusion	3

Justification for a need of modification (If applicable): N/A

Suggested Reading:

Textbooks:

1. Laboratory Manual to be made by the instructor(s).

Reference books:

1. Wilson, Keith, and John M. Walker. (2006) *Principles and Techniques of Practical Biochemistry*. 8th ed., Cambridge University Press.

Modalities for Students Performance Assessment (with details of weightage for different components of performance assessment within the broad guidelines given in BS-MS/PhD manual):

a) Assessment will be based on:

i. Continuous assessment throughout the semester
ii. One or more quiz
iii. Viva-voce
iv. Submission of laboratory report and other report(s)
v. Attendance and regularity (optional)

d) The course instructor will declare the tentative weightage distribution in different components of assessments on the first class.

Additional Guidelines: None

Name and Signature of course proposers:

(Bodhisatta Nandy)

(Vinay Bulusu)

Similarity with the existing courses, if any: Core course. Not applicable.

(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.	Name of the Course	Course Code	Similarity Content	Approx. % of Content
1.				
2				

Justification of new course proposal if cumulative similarity content is >30%:

Recommendation of External experts/Senate members/Subject expert(s)

Description (Add separate sheet, if required)	Description (Add separate sheet, if required)

The above proposal followed by the recommendations of the External experts/Senate members/Subject expert(s) appointed by Director is found to be acceptable by the DUGC/DPGC in its meeting held on_____. The committee recommended the introduction of new course for consideration of CoAA/DoAA and Director/Chairperson Senate.

Convener, DUGC	Convener, DPGC	HoD

For Use of Academic Section

Recommended/Not Recommended to Senate Chairperson	Coordinator/Dean, Academic Affairs
Recommended / Not Recommended for the approval/ratification by the Senate Director/Chairperson Senate	