Notification

File No.: GBU/ADM/243/2022-23/246 Date:21/08/2023

Gujarat Biotechnology University
M.Sc. Biotechnology Programme (2022-2024)
Semester-3 Elective Courses Credit Structure and Syllabus

The credit structure and Syllabus for elective courses in semester-3 of M.Sc. programme at GBU has been approved by the Chairman of academic council. In anticipation of approval of this credit structure and Syllabus for M.Sc. Semester-3 by the academic council, Credit structure and syllabus for the electives to be offered in semester-3 of M.Sc. Biotechnology Program, along with the students who have been assigned each elective, is notified as below :

1) **Course title:** Cell signalling in plant, animal & microbes
Course credit: 5
Course code: ECBT003
Maximum Marks :100
Passing Marks :50
Syllabus: Annexure-1

The details of the students allotted in this elective course are as follows:

Cell signalling in biotechnology		
Sr. No	**Student Name**	**Department**
1	Koustav Adhikary	Medical BT
2	Bloch Naheed Mahmadhanif	Medical BT
3	Raunak Singha	Animal BT
4	V M Aishwarya	Industrial BT
5	Chandni Tandel	Environmental BT
6	Laxmi Narayan Tiwari	Animal BT
7	Abhiraj Singh	Medical BT

2) **Course Name**: Public Health and Environment
Credit: 5
Course code: EPBH003
Maximum Marks:100

Passing Marks:50
Syllabus: Annexure-2

The details of the students allotted in this elective course are as follows:

Public health		
Sr. No	**Student Name**	**Department**
1	Ishani Kadu	Animal BT
2	Somesh Hariharno	Industrial BT
3	Debasish Paikray	Plant BT
4	Ashutosh Kumar	Environmental BT
5	Sravani Kavati	Animal BT
6	Parmar Khushi Arvindkumar	Medical BT
7	Lalchand Kumawat	Industrial BT
8	Bhawana Jain	Medical BT

3) Course Title: Smart proteins in plant, medical, animal, and industrial application
Course credit: 5
Course code: ESMP003
Maximum Marks :100
Passing Marks :50
Syllabus: Annexure-3

The details of the students allotted in this elective course are as follows:

Smart proteins in plant, medical, animal, and industrial application		
Sr. No	**Student Name**	**Department**
1	Pankhuri Gupta	Industrial BT
2	Sushantika Rajput	Animal BT
3	Neha Padhi	Animal BT
4	Prince Kumar	Medical BT
5	Simran Ketan Dani	Plant BT
6	Niraj Yadav	Plant BT

7	Patel Nidhi Bharatbhai	Animal BT
8	Adit Kotak	Medical BT
9	Krishna Tamboli	Animal BT
10	Teli Nisargkumar Vipulbhai	Medical BT
11	Preity Pragnya Sahoo	Animal BT

Registrar

Copy to: [For necessary action]

1. Dean (By E-mail)
2. Examination Committee (By E-mail)
3. Examination Department (By E-mail)
4. Academic Department (By E-mail)
5. IT Department (By E-mail)
6. All staff and students of GBU (By E-mail)
7. PA to Hon'ble Director General

Course title: Cell signalling in plant, animal & microbes

Course credit: 5
Course code: ECBT003

Syllabus of elective:

Cell signalling plays a vital role in many biotechnological applications, from genetic engineering to drug development. Signalling is a mode of communication within or between cells, and it is an important regulatory mechanism in all types of organisms, from bacterial, algal, plant, to animal, and human cells. Cell signalling plays an important role in different physiological functions by sensing of the cells' environment, as well as responding to internal and external stimuli. For instance, by intracellular signals, microbes and even mammalian cells can sense the presence of invading pathogens (eg. viruses) inside the cell. Multicellular organisms immune defence also requires cells to communicate with and instruct responses from other cells locally (or systemically) by activation of signalling pathways. Examples of this are also present in neuronal, endocrine, developmental and metabolic signalling. In this elective, we introduce signalling networks in living systems and will consider the principles of signalling at different levels of organization and evolution. Any change in the components of the cell signalling network may lead to pathological conditions and there will be opportunity to investigate how signalling pathways can go wrong or be subverted in diseases (infectious and genetic). A major focus will be the potential to interfere with signalling pathways for human benefit, plant survival in stressful conditions, or renewable energy production. This will include the principles of how researchers and industries go about discovering novel drugs (small molecule and biologic). There will be opportunity for students to develop their own ideas for a biotechnology application through the manipulation of signalling pathways. The present elective course will explore the intricate mechanisms of cell signalling pathways and their applications in biotechnology. Emphasizing an active learning curriculum, students will engage in case studies, and discussions to deepen their understanding of cell signalling and its applications in biotechnology. We hope that by the end of this elective course students will have the confidence to utilise their knowledge of signalling to design/develop/implement biotechnological solutions to problems of health, nutrition, food security and environmental control.

Course Outline:

Module 1: Fundamentals to Cell Signalling

- Overview of cell signalling and its importance in cell biology and biotechnology. How signalling propagate from cytosol to nucleus (transcription to translation)
- Different type of signalling in different cellular system
- Signal transduction: explanation on receptors, effectors, and second messengers
- General idea of various signalling molecules and their mode of action

Module 2: Importance of Cell Surface Receptors in Signalling Cascade

Discussion on various type of surface receptors such as;

- Receptor tyrosine kinases (RTKs)
- G protein-coupled receptors (GPCRs)
- Integrins and cell adhesion receptors
- Ion-channel receptors

Module 3: Discussion on Intracellular Signalling

- Protein kinases and phosphatases
- Protein-protein interactions in signal transduction
- Second messenger systems: cAMP, cGMP, IP3/DAG, Ca2+
- How scaffolding proteins help in signal transduction

Module 4: Signal Transduction Pathways

- Discussion on key signalling pathways: MTOR, MAPK, PI3K/AKT, JAK/STAT, Wnt, Notch, etc.
- Crosstalk among signalling pathways

Module 5: Signal Transduction in Biotechnology

- Signal transduction in drug discovery and development
- Targeting cell signalling for therapeutic interventions
- Cell signalling in synthetic biology. Engineering synthetic signalling pathways for biotechnology
- Signalling in tissue-engineering and stem cell driven research. Signal-responsive genetic switches

Module 6: Case Studies (research articles related to the subject given to students for self study)

- Analysis of case studies involving cell signalling in different field of biotechnology
- Signalling pathways can go wrong or be threatened in diseases (infectious and genetic).
- Group research projects on signalling-related biotechnological applications
- Ethical considerations in biotechnology research using cell signalling

Module 7: Breakout Sessions – 1: A 25–35-minute lecture aimed at students teaching based on topic selected by teams.

Module 8: Breakout Sessions – 2: Brain storming session to facilitate research project related to this elective.

Module 9: Final session: Project proposal and final presentation.

Mode/s of assessment:

- A 25–35-minute lecture aimed at students teaching their peers in their course about their research.

- A 400- (min) – 500-word (max) précis they would need to write on two of the other student teams' lectures presented by them (the teams can choose).
- The quality of questions the teams ask or their interventions during or after the other teams' lectures.

Annexure-2

Course Name: Public Health and Environment

Credit: 5
Course code: EPBH003

INTRODUCTION

Public health is an interdisciplinary approach that deals with the prevention of disease and the promotion of good health at the community level. Its core value is to provide essential services to populations where social, environmental, and biological determinants combine in complex ways to enable health and disease prevention. This course provides a comprehensive insight into the principles and practices in public health. Biotechnology has played a crucial role in advancing public health services. This elective will provide an opportunity for the students to gain knowledge about the principles related to biotechnology interventions concerning health for the community, public health surveillance, food security, disease prevention, and exploring how public health measures together with biotechnology innovation will be necessary to maintain population health status. There will be the opportunity for students to dig deeper through their own research applied to public health (e.g., malnutrition, infectious/life-threatening disease, mental health, personal hygiene, pollution, etc.) and comment on the success of the intervention and to suggest how this might be improved or followed up.

COURSE OUTLINE (syllabus)

Module 1: Biotechnology and its impact on public health
Public health and its importance, health determinants, and role of biotechnology in advancing essential public health services.
Module 2: Epidemiology
Epidemiology and its purpose, epidemiology surveillance, omics insight into epidemiological studies.
Module 3: Public health and nutrition
Nutritional problems and underlying causes, nutrition-related health issues and challenges, solutions to public health nutrition and food security
Module 4: Maternal and child health
Maternal and childcare, the effect of maternal health and cognitive development in children, universal immunization programme and vaccines for emerging infectious diseases.
Module 5: Environmental health
Environment Health and emerging issues, occupational health, advancements in technology for environmental health.
Module 6: Community health diagnosis and biotechnological approaches
Comprehensive and problem-oriented community health diagnosis (CHD), approaches to Community health diagnosis.
Module 7: Breakout Session 1

In this session, students in groups will propose one research study and a plan to execute the same.

Module 8 Breakout Session 2

This will be an interactive session where students can share the progress of their study and any problems they have come across while its execution.

Module 9 Final session

Final Presentation

MODE/S OF ASSESSMENT

- A 25–35-minute lecture aimed at students teaching their peers in their course about their research.
- A 400- (min) – 500-word (max) précis they would need to write on two of the other student teams' lectures presented by them (the teams can choose).
- The quality of questions the teams ask or their interventions during or after the other teams' lectures.

Annexure-3

Course Title: Smart proteins in plant, medical, animal, and industrial application

Course credit: 5
Course code: ESMP003

Syllabus of each elective:

Smart Proteins (also known as 'alternative proteins') are being developed globally as an alternative to animal-derived meat, eggs, and dairy, with vast implications for food security, public health, and planetary health. The smart protein sector will be important in India too as over 70% of the 1.3 billion population identify as non-vegetarian, but cited income rather than religion as the reason for not eating meat. There are many reasons why India can and should take the lead in this sector.

The sector covers a range of different methodologies to produce smart proteins but can broadly be defined as **plant-based products**, **cultured meat products and fermented biomass**. This elective will look at the ways in which crops such as soy, wheat, pulses and legumes (peas, mung beans), and millets can be made into meat alternatives that are acceptable and attractive to 'veg' and to 'non-veg' consumers alike. The sessions will cover areas of interest for students of *plant, environmental and industrial biotech* as this sector has enormous potential for the agricultural and food technology industries. We will go on to discuss the methods involved in culturing animal cells in vitro as a means to generate alternative meat products that do not involve harvesting living animals with the attendant costs to the climate. So, students will gain insights in protein structure, animal cell biology, stem cell biology and tissue engineering (relevant *to medical and animal biotech*). Finally, fermentation-derived alternative proteins can be derived from the cultivation of microbial cell factories to make either a primary source of food protein (whole-cell biomass) but also as to derive specialized food ingredients (e.g. flavouring).

Smart protein-derived foods seem likely to use less land, water, and energy and emit vastly fewer emissions. However, it will be important in all of these sectors to discuss the economic, environmental, health, and ethical issues. What is the market size, can products be produced cheaply and sold at price levels that allow populations to change eating habits, can the food industry pivot in this direction? What are the environmental impacts, considering the whole-life process of production, is it sustainable? How do these products which are ultimately processed foods impact on human health (salt, sugar, additives etc)? In a country like India which has a culturally plant-based agricultural economy are smart proteins needed? We would like to air some of these debates in this elective.

Course outline:

Module 1: Sustainable food sources and their nutritional importance

Overview of different nutritionally important food sources, the importance of proteins in nutrition, different sources of proteins and their applications in the food industry,

Module 2: Introduction to smart proteins (1 hr)
What are smart proteins, the basis for selection as smart proteins, classification of smart proteins, the role of smart proteins in the food industry, challenges for smart proteins as a food source

Module 3: Biotechnological approaches to develop smart proteins (Interactive lecture, case studies, group discussion and self-study

(A) Plant-derived proteins as smart proteins (1 hr)

Designing and formulation of plant-based meat, market potential and challenges of plant-derived meat, understanding plant-derived eggs, dairy, and seafood and their potential applications

(B) Science of the cultivated meet (1 hr)

What is cultivated meat, how it's made, benefits of cultivated meat, market potential, and challenges of cultivated meat

(C) Fermentation-derived proteins (1 hr)

Industrial importance of fermentation-derived proteins, whole cell biomass as protein alternative, application of fungi in alternative protein sector, microbial derived food ingredients (natural pigment, flavoring agents, etc.)

Module 5: Investments in the smart protein sector (1 hr)
Strategies to establish smart proteins setup (CAPEX, OPEX, etc.), an overview of Startups on plant-based meat/cultivated meat, funding opportunities and future prospectives of a smart protein segment

Module 6: Breakout session 1
A 25–35-minute lecture aimed at students teaching based on topic selected by teams.

Module 7: Breakout Session II
Brain storming session to facilitate research project related to this elective.

Module 8: Final session
Project proposal and final presentation.

Mode of assessment

- A 25–35-minute lecture aimed at students teaching their peers in their course about their research.
- A 400- (min) – 500-word (max) précis they would need to write on two of the other student teams' lectures presented by them (the teams can choose).
- The quality of questions the teams ask or their interventions during or after the other teams' lectures.