

Choice Based Credit System (CBCS)

**NOWGONG COLLEGE
(AUTONOMOUS)**



SYLLABUS

DEPARTMENT OF BIOTECHNOLOGY

Learning Outcomes-based Curriculum Framework (LOCF)

of

Undergraduate Programme

BACHELOR OF SCIENCE IN BIOTECHNOLOGY

(B. Sc. Generic Elective Course)

(Effective from Academic Year 2020-21)

Approved in Academic Council Nowgong College (Autonomous)

1. Introduction to Programme

B.Sc. (Generic Elective) Biotechnology is a three-year undergraduate program. The programme fosters interdisciplinary approach to the study of biological sciences and engineering technologies. The curriculum is dispensed using a combination of classroom teaching, practicals, group discussions, home assignments and presentation.

7. Graduate Attributes

On completion of the programme students are expected to have acquired the skills of critical thinking, effective communication, social research methods and social outreach. The attributes expected from the graduates of B. Sc (Generic Elective) Biotechnology are:

- i. Develop an ability to solve, analyze and interpret data generated from experiments done in project work or practical courses.
- ii. Demonstrate knowledge for in-depth analytical and critical thinking to identify, formulate and solve the issues related to Biotechnology Industry, Pharma industry, Medical or hospital related organizations, Regulatory Agencies, & Academia.
- iii. Demonstrate skills to use modern analytical tools/ software/ equipment and analyze and solve problems in various courses of biotechnology.
- iv. Adopt code of ethics in professional and social context and demonstrate exemplary professional, ethical and legal behaviors in decision making.
- v. Apply written and oral communication skills to communicate effectively in healthcare, industry, academia and research
- vi. Apply responsibilities to promote societal health and safety, upholding the trust given to the profession by the society.
- vii. Develop skills, attitude and values required for self-directed, lifelong learning and professional development.

8. Programme Objectives: -

- i. To imbibe strong foundation of Biotechnology in students.
- ii. To make acquainted students with basic to high-level biotechnological concepts.
- iii. To expose students with the various present time biotechnological researches.
- iv. To update students with the scopes of biotechnology in various sectors like medical, industrial and entrepreneurship.
- v. To make students do projects, which prepares them for jobs or researches.

9. Programme Learning Outcomes:

This programme aims to help student acquire knowledge on the fundamentals of biotechnology for sound and solid base. It also helps acquire knowledge in domains of biotechnology enabling their applications in industry and research. This course aims to provide students with major biotechnology concepts and tools necessary to implement them. The programme also includes entrepreneurship education which promotes students to think unconventional talents and skills for development of viable commercial product. It aims at

teaching the skills of converting basic biology knowledge into sustainable business by providing innovative solutions to the existing challenges in the field of biotechnology. This course structure also motivates and assist students to pursue careers in related disciplines especially in research field, pharmaceuticals, food industries etc.

10. Teaching Learning Process:

The Department of Biotechnology at Nowgong College (Autonomous) is primarily responsible for organizing the Bachelor of Science course (Generic Elective) Biotechnology. Theoretical and practical instructions are given to the learners following the course of study provided in the syllabi. 90 classes are arranged for instructions and practical excluding examination in a semester.

11. Teaching Pedagogy:

Teaching Pedagogy involves classroom interaction, discussion, lectures, course based practical work, viva-voce, demonstration, presentation, classroom tests, and assignments. The achievement of course is described in each papers as learning outcomes in details.

12. Assessment Methods/ Evaluation Scheme

The students registered for academic programmes will study semester I to VI at the Nowgong College (Autonomous) and during these semesters Core, RDS and HGE courses are offered.

- i. English shall be the medium of instruction and examination for the Biotechnology subject.
- ii. Examinations shall be conducted at the end of each semester as per the academic calendar notified by the Nowgong College (Autonomous).
- iii. The assessment broadly comprises of internal assessment (Sessional Examination, attendance, Assignments and Seminar presentation) and End semester examination.
- iv. Theory papers with practical i.e Core Courses (RCC). Discipline Specific Electives (RDS), Generic Electives (HGE), consist of total 100 marks divided into 60 marks for theory, 20 marks for internal assessment and 20 marks for Practical.
- v. Internal assessment of 20 marks is comprises with 06 marks from assignment, 10 marks from sessional examination and 4 marks from attendance.
- vi. Each practical paper will carry 20 marks including 15 marks for continuous evaluation and 2 marks for practical note book and 3 marks for the oral test or *viva voce*.
Hardcopy of practical file has to be maintained by the students for each practical paper and has to be submitted in the concerned department at the time of examination.
- vii. The project paper in 6th semester (Paper Code: BIOT-HDS-6026) consists of 100 marks where 70 marks for the work and 30 marks for presentation.

BIOTECHNOLOGY (GENERIC COURSE)

Regular Core Course (RCC) or Honours Generic Elective Course (HGE)

Ability Enhancement Compulsory Course (AECC) papers

ENGL/ASSA/HIND/BENG-AEC-1014 (Theory)

ENST-AEC-2014 (Theory)

Course Papers

BIOT-RCC/HGE-1016 Biotechnology and Human Welfare (Theory+ Practical)

BIOT -RCC/HGE-2016 Developmental Biology (Theory+ Practical)

BIOT -RCC/HGE-3016 Biosafety and Bioethics (Theory+ Practical)

BIOT -RCC/HGE-4016 Entrepreneurship Development (Theory+ Practical)

Discipline Specific Elective Papers

BIOT -RDS-5016 Bioinformatics (Theory+ Practical)

BIOT -RDS-6016 Project (Work+ Presentation)

Skill Enhancement Courses

(4 papers to be selected as applicable from the pool table)

XXXX-SEC-3014 (Theory+ Practical/Presentation)

XXXX-SEC-4014 (Theory+ Practical/Presentation)

XXXX-SEC-5014 (Theory+ Practical/Presentation)

XXXX-SEC-6014 (Theory+ Practical/Presentation)

SEMESTER-I
BIOT-RCC/HGE-1016
(BIOTECHNOLOGY AND HUMAN WELFARE)
PAPER CREDIT: 06 (4T+2P)
Total No. of Lectures: 60+30 (L+P)
Total Marks: 100 (T60+IA20+P20)

Objectives-

- Introduction to protein structure, use of protein engineering in various industries.
- To understand various microbial activities that influences plant growth, stress response in plants, qualitative improvement of livestock.
- Introduction to environmental biotechnology.
- Introduction and application of biotechnology in forensic science.
- Introduction to the use of biotechnology in modern medicine.

Learning Outcome –

The students would be introduced to the world of biotechnology and its application in the medical field, protein engineering, forensic science, agriculture and environmental biotechnology.

CONTENTS –

1.1 THEORY

UNIT I (6 periods)

Structure of Protein; Protein engineering for industry: food, pharmaceutical, beverage, tanning and textile.

UNIT II (6 periods)

N₂ fixing and phosphate solubilizing microbes and plant growth promoting traits for sustainable agriculture. Plant-microbe interaction, stress response in plants, qualitative improvement of livestock.

UNIT III (10 periods)

Polyaromatic hydrocarbons, polycyclic biphenyls, non-chlorinated organic pollutants, biodegradation, bioremediation and phytoremediation, degradation of hydrocarbons and agricultural wastes, bioplastics, biopolymers and biosurfactants.

UNIT IV (8 periods)

Concept of Polymerase Chain Reaction (PCR), Gel electrophoresis; Biotechnology in forensic science, criminology, paternity determination using various methods of DNA finger printing.

UNIT V

(10 periods)

Biotechnology in modern medicine- overview, therapeutic agents, vaccines (recombinant vaccines), gene therapy, diagnostics, monoclonal antibodies, anti-venoms and chemotherapeutic agents.

1.2 PRACTICALS

(Equivalent to 20 periods)

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

1. Ethanolic fermentation using yeast.
2. Isolation of *Rhizobium*/*Azotobacter*/*Azospirillum* etc. from soil/plant parts.
3. Microscopic observation of infected plant parts (sugarcane/rice/brinjal/legumes).
4. Estimation of residual halogens (chlorine/fluorine) in waste water/effluent.
5. DNA isolation from microbes/plants.
6. Visit to Advanced Laboratory/Universities.

SUGGESTED READING

1. Fundamentals of Molecular Biology (Theory and Practical). Arun Chandra Sahu (2021). Kalyani Publishers, India
2. Applied Plant Biotechnology. N Arumugam and V Kumaresan (2016). Saras Publication, Kanyakumari, India.
3. Biotechnology and Human Welfare. Biology Module IV for NEET (2018). McGraw Hill Education Publication, India
4. Experimental Microbiology. R. N. Bhattacharjee. Kalyani Publishers, New Delhi – 110002
5. Sateesh MK (2010) Bioethics and Biosafety, I. K. International Pvt Ltd.
6. Sree Krishna V (2007) Bioethics and Biosafety in Biotechnology, New age international publishers

SEMESTER-II
BIOT-RCC/HGE-2016
(DEVELOPMENTAL BIOLOGY)
PAPER CREDIT: 06 (4T+2P)
Total No. of Lectures: 60+30 (L+P)
Total Marks: 100 (T60+IA20+P20)

Objectives-

- To study the historical background of developmental biology, gametogenesis and fertilisation.
- To study the early embryonic development in vertebrates.
- To understand the developmental mechanics of cell commitment and differentiation at the level of genome.
- To study organogenesis in vertebrates.

Learning Outcome –

Students are exposed to concepts and processes in developmental biology, molecular mechanisms that underlie animal development, understand and appreciate the genetic mechanisms and the unfolding of the same during development.

CONTENTS –

2.1 THEORY

UNIT I: (10 periods)

Definition, scope & historical perspective of development Biology, Gametogenesis, Spermatogenesis, Oogenesis, Differentiation of eggs, spermatogenesis, Definition, mechanism, types of fertilization, Different types of eggs on the basis of yolk.

UNIT II: (12 periods)

Cleavage: Definition, types, patterns & mechanism Blastulation: Process, types & mechanism, Gastrulation: Morphogenetic movements– epiboly, emboly, extension, invagination, convergence, delamination. Formation & differentiation of primary germ layers, Fate Maps in early embryos.

UNIT III: (12 periods)

Differentiation: Cell commitment and determination- the epigenetic landscape: a model of determination and differentiation, control of differentiation at the level of genome, transcription and post-translation level. Concept of embryonic induction: Primary, secondary & tertiary embryonic induction, Neural induction and induction of vertebrate lens.

UNIT IV: (6 periods)

Neurulation, ontogenesis, development of vertebrate eye. Fate of different primary germ layers. Development of behaviour: constancy & plasticity, Extra embryonic membranes, placenta in Mammals. Concept of cloning.

2.2 PRACTICALS (Equivalent to 20 periods)

(Studies of the followings can be demonstrated through any other material or medium including Photographs/videos/virtual labs etc.)

1. Study of the process of gametogenesis in mammals.
2. Study of different morphogenic movements in early embryonic development.
3. Study the process of blastulation in human.
4. Study of cell commitment and determination.
5. Study the different stages of neurulation.
6. Study the structure and function of the placenta in mammals

SUGGESTED READING

1. Gilbert, S. F. (2006). Developmental Biology, VIII Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA.
2. Balinsky, B.I. (2008). An introduction to Embryology, International Thomson Computer Press.
3. Kalthoff, (2000). Analysis of Biological Development, II Edition, McGraw-Hill Professional.

SEMESTER-III
BIOT-RCC/HGE-3016
(BIOSAFETY AND BIOETHICS)
PAPER CREDIT: 06 (4T+2P)
Total No. of Lectures: 60+30 (L+P)
Total Marks: 100 (T60+IA20+P20)

Objectives-

- Introduction to Intellectual Property Rights, Patenting methodologies in biotechnology and legal protection in the field of research.
- Introduction to the ethical issues related to molecular technologies used in biotechnology.
- Introduction to biosafety and health hazards concerning biotechnology.

Learning Outcome –

The students would be introduced to various rights associated in the field of biotechnology, ethical issues related with the field of research and various biosafety measures to be considered while working in this field.

CONTENTS

3.1 THEORY

UNIT- I (20 Periods)

Introduction to Indian Patent Law, World Trade Organization and its related intellectual property provisions. Intellectual/Industrial property and its legal protection in research, design and development. Patenting in Biotechnology, economic, ethical and depository considerations.

UNIT II (15 Periods)

Bioethics – Necessity of Bioethics, different paradigms of Bioethics – National & International. Ethical issues against the molecular technologies.

UNIT III (15 Periods)

Biosafety– Introduction to biosafety and health hazards concerning biotechnology. Introduction to the concept of containment level, Concept of BSL and Good Laboratory Practices (GLP) and Good Manufacturing Practices (GMP), concept of containment level and Good Laboratory Practices (GLP) and Good Manufacturing Practices (GMP).

3.2 PRACTICALS

1. Proxy filing of Indian Product patent.
2. Proxy filing of Indian Process patent.
3. Planning of establishing a hypothetical biotechnology industry in India.
4. Case study on COVID-19 Testing kit in India with emphasis on ethical issues.
5. Case study on women health ethics.
6. Study of equipment/instrument used in a biosafety laboratory.

SUGGESTED READING

1. Sateesh MK (2010) Bioethics and Biosafety, I. K. International Pvt Ltd.
2. Sree Krishna V (2007) Bioethics and Biosafety in Biotechnology, New age international publishers

SEMESTER-IV
BIOT-RCC/HGE-4016
(ENTREPRENEURSHIP DEVELOPMENT)
PAPER CREDIT: 06 (4T+2P)
Total No. of Lectures: 60+30 (L+P)
Total Marks: 100 (T60+IA20+P20)

Objectives-

- Introduction to the basics of entrepreneurship development.
- Introduction to the needs and process for establishment of an enterprise.
- To study about the financing of an enterprise.
- Introduction to marketing management.
- To study about entrepreneurship and international business.

Learning Outcome –

Students would be able to develop idea generation, creative and innovative skills and learn how to start an enterprise and design business plans that are suitable for funding by considering all dimensions of business.

CONTENTS

4.1 THEORY

UNIT I (10 Periods)

Introduction - Meaning, Needs and Importance of Entrepreneurship, Promotion of entrepreneurship, Factors influencing entrepreneurship, Features of a successful Entrepreneurship.

UNIT II (12 Periods)

Establishing an enterprise, Forms of Business Organization, Project Identification, Selection of the product, Project formulation, Assessment of project feasibility. Finance in projects.

UNIT III (15 Periods)

Financing the enterprise, Importance of finance / loans and repayments, Characteristics of finance, Fixed capital management: Sources of fixed capital, working capital its sources and how to move for loans, Inventory direct and indirect raw materials and its management.

UNIT IV (13 Periods)

Marketing management, Meaning and Importance, Marketing-mix, product management – Product line, Product mix, stages of product life cycle, marketing Research and Importance of survey, Physical Distribution and Stock Management.

UNIT V**(10 Periods)**

Entrepreneurship and international business, Meaning of International business, Selection of a product, Selection of a market for international business, Export financing, Institutional support for exports. Project Report on a selected product should be prepared and submitted.

PRACTICAL

1. Visit to enterprises (Vermicompost Unit/Intensive Pisciculture Unit/Food Processing Unit etc.
2. Report writing on visit emphasizing environment and biosafety issues.
3. Proposal writing for Innovative Start-up programme (Raw material, Machinery, Infrastructure, Marketing, Skilled/unskilled Manpower etc)

SUGGESTED READING

1. Entrepreneurship: New Venture Creation: David H. Holt
2. Patterns of Entrepreneurship: Jack M. Kaplan
3. Entrepreneurship and Small Business Management: C.B. Gupta, S.S. Khanka, Sultan Chand & Sons.

SEMESTER-V
BIOT-RDS-5016
(BIOINFORMATICS)
PAPER CREDIT: 06 (4T+2P)
Total No. of Lectures: 60+30 (L+P)
Total Marks: 100 (T60+IA20+P20)

Objectives-

- Introduction to the basics of computer application in biology.
- Introduction to various Protein information sources.
- Introduction and analysis of sequence and phylogeny.
- Introduction to databases searching.

Learning Outcome –

Students would be introduced to bioinformatic tools, databases, databanks, data format and data retrieval from the online sources, understand the essential features of the interdisciplinary field of science- for better understanding biological data and provide a strong foundation for performing further research in bioinformatics.

CONTENTS

4.1 THEORY

UNIT I (10 Periods)

Basic computer applications in biology, History of Bioinformatics. Sequence Information Sources, Different databases – NCBI, EMBL, Entrez, Unigene, Understanding the structure of each source and using it on the web.

UNIT II (20 Periods)

Protein Information Sources, PDB, SWISSPROT, TREMBL, Understanding the structure of each source and using it on the web. Introduction of Data Generating Techniques and Bioinformatics problem posed by them- Restriction Digestion, Chromatograms, Blots.

UNIT III (20 Periods)

Sequence and Phylogeny analysis, Detecting Open Reading Frames, Outline of sequence Assembly, Mutation/Substitution Matrices, Concept of Homology search, Pairwise Alignments, Introduction to BLAST, using it on the web, Interpreting results, Multiple Sequence Alignment, Phylogenetic Analysis.

UNIT IV

(10 Periods)

Searching Databases: SRS, Entrez, Sequence Similarity Searches-BLAST, FASTA, Data Submission. Genome Annotation: Pattern and repeat finding, Gene identification tools.

PRACTICALS

1. Understanding and use of various web resources: NCBI, EMBL, Entrez, Unigene, Green Gene, KEGG
2. Understanding and using Protein information resource (PIR) - PDB, Swissprot, TREMBL
3. Sequence analysis, Sequence alignment and information.
4. Using various BLAST and interpretation of results.
5. Retrieval of information from nucleotide databases.
6. Multiple sequence alignment using Clustal W.

SUGGESTED READING

1. Ghosh Z. and Bibekan and M. (2008) Bioinformatics: Principles and Applications. Oxford University Press.
2. Pevsner J. (2009) Bioinformatics and Functional Genomics. II Edition. Wiley-Blackwell.
3. Campbell A. M., Heyer L. J. (2006) Discovering Genomics, Proteomics and Bioinformatics. II Edition. Benjamin Cummings.
4. A Text Book of Bioinformatics. V Sharma, A. Shankar and A. Munjal (2015). Rastogi Publications, Meerut, India.

SEMESTER-VI
BIOT-RDS-6016
(PROJECT)

PAPER CREDIT: 06(4W+2P)

Total no. of period: 90

Total Marks: 100 (W80+ P20)

W: Work (Field/Laboratory/Library etc.)

P: Presentation

Objectives:

To stimulate the learning process.

To develop attitude and skill required for a specific study.

Outcomes:

Learners acquire knowledge on planning of an assigned work to achieve time bound specific goal.

Learners identify their roles, responsibilities and accountability of the task they are associated with.

The project contains – (may be modified as applicable for the study)

Broad Area of the Project, Title, Introduction, Review of Literature, Methodology, Results/Findings, Discussion, Summary, Acknowledgement, References.

Suggested Broad areas of Projects to be undertaken –

Antimicrobial activities, Biofertilizer, Food Processing, Food Preservation, Pisciculture, Bioinformatics.

...The End....