ENVI: Industrial Bioprocessing

Module Title:	Industrial Bioprocessing

Credits:	5

NFQ Level:	8

Module Delivered In	1 programme(s)

Teaching & Learning Strategies:	The module will build on knowledge gained in the Microbial Cell Factory in year 3 module. Learners will be introduced to the role and utility of microorganisms in industrial applications. The teaching and learning strategy will encompass formal lectures on EBL, active learning and group discussions. The learning environment will be student centered with the aim of enthusing the students with an appreciation of Industrial Bioprocessing. Students will be given continual formative feedback both in lectures and through written drafts of continuous assessment. The teaching and learning environment will employ a balance between traditional and active learning approaches. Current concepts will be delivered using key selected research papers and review articles and students will be facilitated and supported to become independent learners capable of interpreting complex principles relating to Industrial Bioprocessing.

Module Aim:	The aim of this module is to introduce students to the principles of industrial microbiology, bioprocessing and biochemistry as applied in an industrial context and also to provide the microbiology and cell biology knowledge base for students to successfully enter the biotechnological, pharmaceutical and biopharmaceutical industries.

Learning Outcomes	
On successful completion of this module the learner should be able to:	
LO1	Critically discuss the structure and function of a stirred tank bioreactor and its integration into an overall bioprocess
LO2	Critically discuss the importance of upstream processes in industrial bioprocessing.
LO3	Explain the interrelationship between biological processes, engineering and process technology.
LO4	Discuss the bioprocessing technologies and bioreactors employed in the biotechnology and biopharmaceutical industries.
LO5	Explain in detail the importance of asepsis, sterilisation and process control in bioprocessing

Pre-requisite learning
Module Recommendations *This is prior learning (or a practical skill) that is recommended before enrolment in this module.*
No recommendations listed
Incompatible Modules *These are modules which have learning outcomes that are too similar to the learning outcomes of this module.*
No incompatible modules listed
Co-requisite Modules
No Co-requisite modules listed
Requirements *This is prior learning (or a practical skill) that is mandatory before enrolment in this module is allowed.*
No requirements listed

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Module Content & Assessment

Indicative Content
Choice of host cell organisms Mammalian versus microbe biologics production an historical perspective. Post-translational modifications including protein folding in biologics and consequences for efficacy. Culture collections and maintenance of cultures.
Mammalian cell culture Origins, storage and applications of continuous cell lines. Aseptic cell culture technique, media and growth requirements for commonly used cell lines including the Chinese Hamster Ovary cell line. Maintenance of a cell bank. Industrial scale chemical based media formulation. Disposal bioreactors, scale up and their operation.
Industrial bioprocessing and bioreactor design Essential features of a fermenter, different kinds of fermenters, Stirred-Tank Reactors, Bubble Columns Reactors, Airlift Reactors with internal/external draft tubes, Fluidized-Bed reactors. Immobilised cell bioreactors.
Downstream processing: Harvest. Separation technologies, centrifugation and filtration, cell disintegration, solvent extraction and other purification techniques.
Bioprocess optimisation, asepsis and control Batch, Fed batch, Perfusion and Continuous Culture. Metabolic control and the overproduction of desirable metabolites to include primary and secondary metabolites. Issues with scale-up. Fermentation systems, services and ancillary equipment. Fermenter control and instrumentation. Cleaning in place. Sterilization and the maintenance of sterility.
Mass transfer and aeration Principles of mass transfer, definition of kLA and its calculation. Respiration of carbohydrates and hydrocarbons. Movement and transfer of oxygen through gas and liquid interface. Critical oxygen level, importance of aeration, agitation and implications of rheology and shear force and shear stress on biocatalysts.
Fermentation economics and mathematical modelling Productivity and Yield Coefficients. Trade off between sterility, power input, aeration and agitation. Addressing the financial viability of an industrial bioprocess, examples from the past present and future perspectives.

Assessment Breakdown	%
Continuous Assessment	30.00%
End of Module Formal Examination	70.00%

Special Regulation
Learners must achieve a minimum grade (35%) in the Final Examination

SETU Carlow Campus reserves the right to alter the nature and timings of assessment

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Module Workload

Workload: Full Time		
Workload Type	*Frequency*	*Average Weekly Learner Workload*
Lecture	12 Weeks per Stage	3.00
Practicals	12 Weeks per Stage	1.00
Independent Learning	15 Weeks per Stage	6.00
	Total Hours	138.00

Module Delivered In

Programme Code	Programme	Semester	Delivery
CW_SABTP_B	Bachelor of Science (Honours) in Biosciences with Biopharmaceuticals	7	Mandatory